

# BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, Orissa

## Textile Engineering

3 <sup>RD</sup> Semester				4 <sup>th</sup> Semester			
Theory		Credit Hrs	Credit	Theory		Credit Hrs	Credit
BSCM1205	Mathematics- III	3-1-0	4	BSCM1210	Mathematics - IV	3-1-0	4
BSCC1208	Chemistry-II	2-0-0	3	HSSM3205	Organisational Behavior OR	3-0-0	3
BECS2212	C++ and Objected Oriented Programming.	3-0-0	3	HSSM3204	Engg. Economics & Costing	3-0-0	
HSSM3204	Engg. Economics & Costing OR	3-0-0	3	BECS2208	Database Management System	3-0-0	3
HSSM3205	Organisational Behaviour			PCTX4203	Fibre Science & Technology-II	2-0-0	2
PCTX4201	Fibre Science & Technology-I	2-0-0	2	PCTX4204	Yarn Manufacture-II	3-0-0	3
PCTX4202	Yarn Manufacture-I	3-0-0	3	PCTX4205	Fabric Manufacture-I	3-0-0	3
	<b>Total</b>		<b>18</b>		<b>Total</b>		<b>18</b>
<b>Practicals / Sessionals</b>				<b>Practicals / Sessionals</b>			
HSSM7203	Communication & Interpersonal skills for Corporate Readiness Lab	0-0-3	2	PCTX7203	Fibre Science & Technology-II Lab.	0-0-3	2
BECS7212	C++ and Objected Oriented Programming Lab	0-0-3	2	PCTX7204	Yarn Manufacture-II Lab	0-0-3	2
PCTX7201	Fibre Science & Technology-I Lab.	0-0-3	2	PCTX7205	Fabric Manufacture-I Lab	0-0-3	2
PCTX7202	Yarn Manufacture-I Lab.	0-0-3	2	BECS7208	Database Management System Lab	0-0-3	2
	<b>Total</b>		<b>8</b>		<b>Total</b>		<b>8</b>
			<b>26</b>				<b>26</b>

## BSCM1205 **Mathematics - III**

### **Module-I**

**(18 hours)**

Partial differential equation of first order, Linear partial differential equation, Non-linear partial differential equation, Homogenous and non-homogeneous partial differential equation with constant co-efficient, Cauchy type, Monge's method, Second order partial differential equation  
The vibrating string, the wave equation and its solution, the heat equation and its solution, Two dimensional wave equation and its solution, Laplace equation in polar, cylindrical and spherical coordinates, potential.

### **Module-II**

**(12 hours)**

Complex Analysis:

Analytic function, Cauchy-Riemann equations, Laplace equation, Conformal mapping,

Complex integration: Line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula, Derivatives of analytic functions

### **Module –III**

**(10 hours)**

Power Series, Taylor's series, Laurent's series, Singularities and zeros, Residue integration method, evaluation of real integrals.

### **Text books:**

1. E. Kreyszig, "Advanced Engineering Mathematics", Eighth Edition, Wiley India  
Reading Chapters: 11,12(except 12.10),13,14,15
2. B.V. Ramana, "Higher Engineering Mathematics", McGraw Hill Education, 2008  
Reading chapter: 18

### **Reference books:**

1. E.B. Saff, A.D. Snider, "Fundamental of Complex Analysis", Third Edition, Pearson Education, New Delhi
2. P. V. O'Neil, "Advanced Engineering Mathematics", CENGAGE Learning, New Delhi

# BSCC1208 Chemistry - II

## Module I

**1. Water Technology:** Hardness of Water : Types of hardness, Units of hardness and their interrelation, Determination of hardness(EDTA method only). Disadvantage of hard water . Water softening technology (internal and external (limesoda,zeolite,and ion exchange methods ) Desalination(electrodialysis, reverse osmosis, Sterilization of water by bleaching power, chlorine, ozone, chloramine. Determination of B.O.D and C.O.D of water sample.

**2. Corrosion:** Theories of corrosion , Types of corrosion , Factors affecting corrosion, Corrosion Control: (Proper design and fabrication procedure, Cathodic protection, Passivation).

## MODULE-II

**1. Fuels:** Classification of fuels, calorific value, (Determination by Dulong's formula),G.C.V&N.C.V

Liquid fuel: Classification of petroleum, Refining of petroleum , Cracking, Knocking and anti knocking,cetane and octane numbers . Unleaded petrol, synthetic petrol, power alcohol

Gaseous Fuel : Producer gas, Water gas, LPG , CNG, Kerosene gas

Combustion Calculation.

## **2. Battery technology**

Introduction, Batteries and cells, Basic components of battery, its Classification characteristics,Chemical batteries(dry, Lead acid & gel batteries) Alkaline batteries(zinc-air,aluminium-air,Nickel metal hydride battery) Reserve batteries(magnesium-copper,Gordan-magnesium battery) Nickel cadmium battery

## Module III

**1. POLYMER .** Polymer: Types, polymerization process and mechanisms

Conducting polymers(poly aniline, poly acetylene),polymer composite(carbon fiber)

Preparation. Properties and uses of following polymer(polyethylene,PMMA,PTFE

Bakelite,polyurethanes,polycarbonate)

## **2 Nano materials**

Nano material; Carbon nano tube,(synthesis, properties and application.) Application of nano material in medicine, fuel cell, catalysis (only general idea)

### **Text Books:**

1. Engineering chemistry by Putti R.vIjayasrarhy ,PHI Ltd
2. Engineering chemistry by P.C jain and M. jain

### **Reference Books:**

1. Engineering chemistry by N Krishnamurthy ,p vallinaygam, Dmadhavan, PHI Ltd
2. Engineering chemistry by mary,jane.shultz ,Cengage learning publication
3. Engineering chemistry by R.Gopalan,D.venkaapaya,and SNagarajan, Vikas publishing house.

# BECS2212 C++ & Object Oriented Programming

## Module I

(08 hrs)

Introduction to object oriented programming, user defined types, structures, unions, polymorphism, encapsulation. Getting started with C++ syntax, data-type, variables, strings, functions, default values in functions, recursion, namespaces, operators, flow control, arrays and pointers.

## Module II

(16 hrs)

Abstraction mechanism: Classes, private, public, constructors, destructors, member data, member functions, inline function, friend functions, static members, and references.

Inheritance: Class hierarchy, derived classes, single inheritance, multiple, multilevel, hybrid inheritance, role of virtual base class, constructor and destructor execution, base initialization using derived class constructors.

Polymorphism: Binding, Static binding, Dynamic binding, Static polymorphism: Function Overloading, Ambiguity in function overloading, Dynamic polymorphism: Base class pointer, object slicing, late binding, method overriding with virtual functions, pure virtual functions, abstract classes.

Operator Overloading: This pointer, applications of this pointer, Operator function, member and non member operator function, operator overloading, I/O operators.

Exception handling: Try, throw, and catch, exceptions and derived classes, function exception declaration.

## Module III

(08 hrs)

Dynamic memory management, new and delete operators, object copying, copy constructor, assignment operator, virtual destructor.

Template: template classes, template functions.

Namespaces: user defined namespaces, namespaces provided by library.

## Text Books:

1. Object Oriented Programming with C++ - E. Balagurusamy, McGraw-Hill Education (India)
2. ANSI and Turbo C++ - Ashoke N. Kamthane, Pearson Education

## Reference Books:

1. Big C++ - Wiley India
2. C++: The Complete Reference- Schildt, McGraw-Hill Education (India)
3. "C++ and Object Oriented Programming" – Jana, PHI Learning.
4. "Object Oriented Programming with C++" - Rajiv Sahay, Oxford
5. Mastering C++ - Venugopal, McGraw-Hill Education (India)
6. "Object Oriented Programming with C++", David Parsons, Cengage Learning.

# HSSM3204 **Engineering Economics & Costing**

## **Module-I: (12 hours)**

Engineering Economics – Nature and scope, General concepts on micro & macro economics. The Theory of demand, Demand function, Law of demand and its exceptions, Elasticity of demand, Law of supply and elasticity of supply. Determination of equilibrium price under perfect competition (Simple numerical problems to be solved). Theory of production, Law of variable proportion, Law of returns to scale.

## **Module-II: (12 hours)**

Time value of money – Simple and compound interest, Cash flow diagram, Principle of economic equivalence. Evaluation of engineering projects – Present worth method, Future worth method, Annual worth method, internal rate of return method, Cost-benefit analysis in public projects. Depreciation policy, Depreciation of capital assets, Causes of depreciation, Straight line method and declining balance method.

## **Module-III: (12 hours)**

Cost concepts, Elements of costs, Preparation of cost sheet, Segregation of costs into fixed and variable costs. Break-even analysis-Linear approach. (Simple numerical problems to be solved)

Banking: Meaning and functions of commercial banks; functions of Reserve Bank of India. Overview of Indian Financial system.

### **Text Books:**

1. Riggs, Bedworth and Randhwa, “Engineering Economics”, McGraw Hill Education India.
2. M.D. Mithani, Principles of Economics.

### **Reference Books :**

1. Sasmita Mishra, “Engineering Economics & Costing“, PHI
2. Sullivan and Wicks, “ Engineering Economy”, Pearson
3. R.Paneer Seelvan, “ Engineering Economics”, PHI
4. Gupta, “ Managerial Economics”, TMH
5. Lal and Srivastav, “ Cost Accounting”, TMH

# HSSM 3205 **Organizational Behaviour**

## **Module I :**

The study of Organizational Behaviour : Definition and Meaning, Why Study OB

Learning – Nature of Learning, How Learning occurs, Learning and OB.

Foundations of Individual Behaviour : Personality – Meaning and Definition, Determinants of Personality, Personality Traits, Personality and OB.

Perception – Meaning and Definition, Perceptual Process, Importance of Perception in OB. Motivation – Nature and Importance, Herzberg's Two Factor Theory, Maslow's Need Hierarchy Theory, Alderfer's ERG Theory, Evaluations.

## **Module II :**

Organizational Behaviour Process : Communication – Importance, Types, Gateways and Barriers to Communication, Communication as a tool for improving Interpersonal Effectiveness, Groups in Organizations – Nature, Types, Why do people join groups, Group Cohesiveness and Group Decision-making Managerial Implications, Effective Team Building. Leadership-Leadership & Management, Theories of Leadership-Trait theory, Leader Behaviour theory, Contingency Theory, Leadership and Follower ship, How to be an effective Leader, Conflict-Nature of Conflict and Conflict Resolution. An Introduction to Transactional Analysis (TA).

## **Module-III :**

Organization : Organizational Culture – Meaning and Definition, Culture and Organizational Effectiveness. Introduction to Human Resource Management-Selection, Orientation, Training and Development, Performance Appraisal, Incentives Organizational Change – Importance of Change, Planned Change and OB techniques. International Organisational Behaviour – Trends in International Business, Cultural Differences and Similarities, Individual and Interpersonal Behaviour in Global Perspective.

## **Text Books :**

1. Keith Davis, Organisational Behaviour, McGraw-Hill.
2. K.Aswathappa, Organisational Behaviour, Himalaya Publishing House.

## **Reference Books :**

1. Stephen P. Robbins, Organisational Behaviour, Prentice Hall of India
2. Pradip N. Khandelwal, Organizational Behaviour, McGraw-Hill, New Delhi.
3. Uma Sekaran, "Organizational Behaviour", TATA McGraw-Hill, New Delhi.
4. Steven L McShane, Mary Ann Von Glinow, Radha R Sharma" Organizational Behaviour" , TATA McGraw- Hill.
5. D.K. Bhattachayya, "Organizational Behaviour", Oxford University Press
6. K.B.L.Srivastava & A.K.Samantaray, "Organizational Behaviour" India Tech
7. Kavita Singh, "Organizational Behaviour", Pearson

# PCTX4201 Fibre Science & Technology - I

## Module-I

( 10 Hrs)

### Introduction:

- a) Classification of textile fibres according to their nature and origin,
- b) essential and desirable properties of textile fibres,
- c) staple fibre and continuous filaments,

### Natural fibres:

- a) cotton: concept of varieties; ginning, baling ,
- b) jute, Flax:- varieties, retting process ( extraction of fibre from bast),
- c) protein fibres:- wool:- classification, grading, scouring, silk:- classification, concept of sericulture, degumming, throwing, reeling.

## Module-II

( 10 Hrs )

### Man-made fibres:

- a) Principles of melt spinning, dry spinning and wet spinning,
- b) Manufacturing process of regenerated fibres - viscose & diverse forms of viscose, cuprammonium and acetate rayon
- c) Manufacturing of synthetic fibres - principles of polycondensation with reference to polyesters, polyamides, principles of poly addition with reference to acrylics
- d) concept of quenching operation and finish application,

## Module-III

( 10 Hrs)

### Properties of Fibres

**Physical properties: Fibre length** - Technical significance of fibre length, introduction to length distributions, Measurement of fibre length of cotton fibre - Baer sorter diagram, 2.5% and 50 % span length, Uniformity ratio, **Fibre fineness** : Fibre linear density, Technical significance of fibre fineness; methods of measuring fineness of cotton fibres, jute, flax, wool, silk and man-made fibres, Maturity of cotton fibre and its influence on fineness. Determination of maturity of cotton fibre by different methods. Maturity Co-efficient. concept of micro denier fibre **Moisture Content and Regain:** Moisture content and regain, relative and absolute humidity, effect of moisture on fibres, **Fibre density, Crimp** - Significance, measurement. **Tensile Strength** - Tensile strength of single fibre, bundle strength of cotton,

**Chemical Properties of Fibres** : Chemical properties of different cellulosic, protein and synthetic fibres such as cotton, jute, flax, pineapple, wool, silk, polyester, polyamide, polyacrylonitriles etc.

### Text Books:

1. Manmade Fibres - R.W. Moncrieff,
2. Textile Fibre - V.A. Shenai
3. Dyeing and Chemical Technology of Textile Fibres by E.R. Trotman,

### Reference Books :

4. Man-made Fibres Science and Technology, Vol. 1,2,3 - H.F. Mark, S.M. Atlas and E. Cernia,
5. Polyester Fibres Chemistry and Technology - H. Ludwig,
6. Textbook of Polymer Science by F.W. Billmeyer.
7. Production of Man-made Fibres – A.Vaidya
8. Principle of Testing – J.E.Booth

# PCTX4202 Yarn Manufacture – I

## Module – I ( 20 hrs )

**1. Short Staple fibre Spinning** (brief idea): Introduction, raw materials, opening and cleaning - the need for opening and cleaning, mixing/blending, drafting, Principle of yarn formation systems.

### 2. Blow Room:

Basic operations in the blow room - opening, cleaning, feeding, dust removal, Blow room line - sequence of machines- need for various types of machines , study of various openers and cleaners used in a modern Blow room line -their classification - principle of operation-position etc, study of components such as feed apparatus- feed with two clamping cylinders, feed with a roller and pedals; grid- grid as an opening device, elements of grid, waste collection under the grid, grid adjustment; different type of mixer/blender. General factors influencing opening and cleaning; Idea of accessories and associated equipment (dust removing and disposing devices; material transport devices, material flow control devices, metal extractors, fire eliminator, chute feed system). Production calculations; Performance assessment of blow room line -: cleaning efficiency, degree of opening, waste, nep generation, lap weight variation and rejection, lap build, norms for blow room operations- Miantanace schedule..

## Module – II ( 10 hours)

### 3. Carding:

Objects of Carding. Principle of carding, stripping and brushing actions. Study of different parts, functions and constructional features of a Carding Machine. Study of card clothing - geometry and specification of licker-in, cylinder, flat and doffer metallic wire, Analysis of carding force. Theoretical treatment of fibre configuration in card sliver, Mechanics of fibre entanglement and fibre transfer during carding, Mechanics of neps and hook formation and its effect on yarn quality, Features of a high production card. Modern developments in Carding. Draft, production and calculation in card. Gauging and setting at different zone in a card. Method of stripping and its effect on yarn quality, Defects in card web:- Causes and remedies. Maintenance schedules. Auto leveller in card.

## Module –III ( 15 hours)

### 4. Draw Frame:

Objects of Draw frame, Operation principle, Principle of roller drafting , Drafting wave, Drafting Force, behaviour of the fibres in the drafting zone, friction fields, distribution of draft, additional effects of draft; perfect and real drafting; nature of drafting irregularities; Equalizing: unevenness of fibre strands, basic possibilities of equalizing, doubling, levelling; Study of various drafting system, Drafting Rollers arrangement, Doubling, blending and hook removal at draw frame, , coiling- delivery, condensing, sliver coiling, can changing. Gearing and production calculation, Design and principle of Auto leveler- open loop and close loop . Maintenance schedule. Recent development in Draw frame.

**5. Combing:** Introduction, Objects of combing process, types of comber, sequence of operation in a comber ( combing cycle) ; Methods of lap preparation for combing: process - outline, operating principles of sliver lap machine, ribbon lap machine and sliver doubling machine; comparative assessment of web doubling and sliver doubling processes; combing: parameters influencing combing operation- raw material, material preparation, factors associated with machine setting, ambient conditions, influence of feed stock on combing, parallelisation of fibres in the sheet, sheet thickness (wt.), evenness of the lap sheet, disposition of hooks, number of draw frame passages, degree of combing, noil theory, noil elimination with forward feed and backward feed, influence of machine components and settings on combing, feed distance moved per cycle, type of feed, detachment setting, points on the combs, depth of penetration of the top comb, piecing;

### Text Books:

1. A Practical Guide to Opening and Cleaning - W.Klien
2. A Practical guide to Carding – W.Klien
3. A Practical Guide to Combing & Drawing - W. Klein

### Reference Books:

- 4.. Spun Yarn Technology - Oxtoby
5. Spun Yarn Technology, Vol. I & II - V. ubramani
6. Manual Cotton Spinning- F. Charnley
7. The Principle of Roller Drafting & The Irregularity of Drafted Materials by G. A. R. Foster,



# HSSM7203 **Communication & Interpersonal skills for Corporate Readiness Lab.**

**Lab**

**30 hours**

This course will focus on communication in professional (work-related) situations of the kind that BPUT graduates may expect to encounter on entering the professional domain. Some typical forms of work-related communication, oral or written, are listed below. Practice activities for all four skills can be designed around these or similar situations.

1. Gaining entry into an organization
  - i. Preparing job-applications and CVs
  - ii. Facing an interview
  - iii. Participating in group discussion (as part of the recruitment process)
  
- 2 In-house communication
  - a. Superior/ Senior → subordinate / junior (individual → individual / group)
    - i. Welcoming new entrants to the organization, introducing the workplace culture etc.
    - ii. Briefing subordinates / juniors : explaining duties and responsibilities etc.
    - ii. Motivating subordinates / juniors ('pep talk')
    - iii. Instructing/ directing subordinates/ juniors
    - iv. Expressing / recording appreciation, praising / rewarding a subordinate or junior
    - v Reprimanding / correcting / disciplining a subordinate/junior (for a lapse) ; asking for an explanation etc.
  
  - b. Subordinate / Junior → Superior / Senior
    - i. Responding to the above
    - ii. Reporting problems / difficulties / deficiencies
    - iii. Offering suggestions

# BECS7212 **C++ & Object Oriented Programming Lab**

1. Programs on concept of classes and objects.(1 class)
2. Programs using inheritance.(1 class)
3. Programs using static polymorphism.(1 class)
4. Programs on dynamic polymorphism.(1 class)
5. Programs on operator overloading.(1 class)
6. Programs on dynamic memory management using new, delete operators.(1 class)
7. Programs on copy constructor and usage of assignment operator.(1 class)
8. Programs on exception handling .(1 class)
9. Programs on generic programming using template function & template class.(1 class)
10. Programs on file handling.(1 class)

## PCTX7201 **Fibre Science & Technology – I Lab.**

- 1.To calculate the moisture regain and moisture content of a given Cotton sample by hot air oven method.
- 2.To trace the Fibre length-cumulative frequency percentage by means of sorter diagram.
3. To measure the Maturity co-efficient of Cotton fibre by caustire method.
4. To measure the fineness of a given sample by Air flow method.
5. To determine the bundle strength of cotton fibre using Stelometer.
6. To calculate Trash Content % of a given Cotton sample by the TRASH ANALYSER.
7. To measure the diameter of Wool fibre.
8. To determine the denier of silk fibre.
9. To find the crimp % of fibre.
10. To measure the tensile strength of single fibre.

## PCTX7202 **Yarn Manufacture – I Lab.**

1. To study the flow of materials through various organs of a Blow room line.
2. To study and sketch the working mechanism of various openers, cleaners, blenders and lap formation unit in a Blow-Room line.
3. To study and sketch the working mechanism of various operations of a card with respect to flow of material
4. To study different settings of the card
5. To study the gearing plan and calculation of draft constant, draft and production constant of a Card.
- 6, To study and sketch the working mechanism of draw frame with respect to flow of material
7. To study and sketch the working mechanism of drafting zone of draw frame.
8. To study the ratch setting of draw frame drafting system
9. Calculation of draft constant and draft of a drawframe.
10. General study of different parts of comber and their operations.

## BSCM1210 Mathematics – IV

### Module-I

(20 hours)

#### Numerical methods:

Approximation and round of errors, Truncation error and Taylor's series

Roots of equation: The bisection method, the false-position method, fixed point iteration, the Newton-Raphson method, Muller's method

Linear algebraic equation: LU decomposition, the matrix inverse, Gauss-Seidel method

Interpolation: Newton divided difference interpolation, Lagrange Interpolation, Newton's forward and backward interpolation.

Numerical integration: The trapezoidal rule, The Simpson's rules, Gauss quadrature

Ordinary differential equation: Euler's method, Improvement of Euler's method, Runge-Kutta methods

### Module-II

(10 Hours)

#### Probability:

Probability, Random variables, Probability distributions, Mean and variance of distribution, Binomial, Poisson and Hypergeometric distributions, Normal distribution, Distribution of several random variables.

### Module-III

(10 Hours)

#### Mathematical Statistics:

Random sampling, Estimation of Parameters, Confidence Intervals, Testing of hypothesis, Acceptance sampling, Chi square test for goodness of fit, Regression Analysis, Fitting Straight Lines, Correlation analysis.

#### Text books:

1. S. C. Chapra and R. P. Canale, "*Numerical methods for Engineers*", Fifth Edition, McGraw Hill Education  
Reading Chapters : 2, 3(3.1, 3.2), 4(4.2, 4.3), 5(5.1, 5.2, 5.3), 6(6.4), 9(9.1, 9.2), 10(10.2), 13(13.1,13.2,13.5), 16(16.1, 16.2), 17(17.3), 20(20.1, 20.2, 20.3)
2. E. Kreyszig," *Advanced Engineering Mathematics*:", Eighth Edition, Wiley India  
Reading Chapters: 22, 23( except 23.5 and 23.8)

#### Reference books:

1. Jay L. Devore, "Probability and Statistics for Engineering and Sciences", Seventh Edition, Thomson/CENGAGE Learning India Pvt. Ltd
2. P. V.O'Neil, "*Advanced Engineering Mathematics*", CENGAGE Learning, New Delhi

# BECS2208 Database Management System

## **Module I :** (10 hours)

Database System Architecture - Data Abstraction, Data Independence, Data Definitions and Data Manipulation Languages. Data models - Entity Relationship(ER), Mapping ER Model to Relational Model, Network .Relational and Object Oriented Data Models, Integrity Constraints and Data Manipulation Operations.

## **Module II :** (12 hours)

Relation Query Languages, Relational Algebra and Relational Calculus, SQL.  
Relational Database Design: Domain and Data dependency, Armstrong's Axioms, Normal Forms, Dependency Preservation, Lossless design.

Query Processing Strategy.

## **Module III:** (10 hours)

Transaction processing: Recovery and Concurrency Control. Locking and Timestamp based Schedulers.

Database Recovery System: Types of Data Base failure & Types of Database Recovery, Recovery techniques

### Text Books:

1. Database System Concepts by Sudarshan, Korth (McGraw-Hill Education )
2. Fundamentals of Database System By Elmasari & Navathe- Pearson Education

### References Books:

- (1) An introduction to Database System – Bipin Desai, Galgotia Publications
- (2) Database System: concept, Design & Application by S.K.Singh (Pearson Education)
- (3) Database management system by leon &leon (Vikas publishing House).
- (4) Fundamentals of Database Management System – Gillenson, Wiley India
- (5) Database Modeling and Design: Logical Design by Toby J. Teorey, Sam S. Lightstone, and Tom Nadeau, “”, 4<sup>th</sup> Edition, 2005, Elsevier India Publications, New Delhi

# PCTX4203 Fibre Science and Technology – II

## Module-I

( 10 hours)

1. **Mechanical properties of Textile fibres** :Basic definition- true stress, specific stress, tenacity and breaking length, recapitulation of elastic and plastic deformation, Hook's law and Poisson's ratio; stress-strain curves; comparative stress-strain diagrams of different fibres.
2. **Elastic recovery, strain recovery, work recovery**; Shear, bending, torsion and compression;
3. **Other properties**  
a) Optical Properties, b) Thermal properties, c) Fibre friction and d) Dielectric properties.

## Module-II

( 10 hours)

### 4. Structure of Fibres :

- a. **Morphological structure** : Longitudinal and cross-sectional view of natural and man-made fibres.
- b. **Chemical structure** :: chemical structure of synthetic fibres, chemical structure of natural fibres-vegetable or cellulosic, animal or polypeptide fibres, recapitulation of bonding in polymer fibres – primary bonding, secondary bonding, methods of investigating structure-idea of infrared spectroscopy, x-ray, microscopy, NMR etc;
- c. **Microstructure and macrostructure of fibres**; Recapitulation of crystalline and non-crystalline materials –structure of crystals, polymer crystals, X-ray diffraction and crystallinity, thermal analysis of polymers by DTA, TGA and DSC.

## Module-III

( 10 hours)

5. **Texturing**: Introduction, purpose, bulked and textured yarns, methods of texturing thermoplastic and non-thermoplastic yarns- basic principles, feed material characteristics-study of twist-set-detwist, false twist, edge crimp, stuffer box crimp; knit de-knit techniques of texturing and the techniques of modified stretch yarn;,, properties and uses of textured.
6. High performance fibres.: Introduction to Polyurethane, Kevlar , Nomex, Glass fibre, Carbon fibre, PVA fibre, PVC fibre etc.

### Text Books

1. Physical Properties of Textile Fibres by W.E. Morton and J.W.S. Hearle
2. Manmade Fibres - R.W. Moncrieff,
3. Textile Fibre, V.A. Shenai
4. Dyeing and chemical Technology of Textile Fibres " , Trotman, E.R., Charles Griffin and Co Ltd., London. 1990.

### Referene Books :

1. Fiber Science by Steven B. Warner,
2. Mechanical Properties of Solid Polymers by I. M. Ward,
3. Textile- Motivate Series by A. Wynne, Macmillan.
4. Textile Chemistry , American Elsevier Publishing Co. Inc., New York , 1986.
- 5.. Peters, R.H., " Textile Chemistry Vol.I, II and III " , Elsevier Publishing Co.Inc., New York, 1985.
- 6 . Menachem Lewin and Stephen B.Sello, " Handbook of fibre science and Technology; Vol.I, Fundamentals and preparation-Part A " , Marcel Dekker Inc., New York, 1983.

# PCTX4204 Yarn Manufacture –II

## Module-I

( 10 hours)

### 1. SPEED FRAME:

Principles and objects of Speed Frame.  
Study of flow of material and different parts  
Study of various parts of drafting system, roller weighting and setting, distribution of  
Principle of twisting, parts and function of flyer, development of a flyer.  
Principle of Winding, Flyer leading and bobbin leading systems  
Principles of differential mechanism in a Simplex.  
Function and description of building mechanism, cone drum arrangements.  
Features of a modern Simplex Frame, recent developments.  
Defects and remedies in Simplex process.  
Lubrication and maintenance schedule for Speed Frame.  
Calculations pertaining to speed, production, draft and twist, coils/inch, etc.

## Module-II

( 20 hours)

### 2. RING FRAME:

Objects and principles of Ring Spinning Machines.  
Constructional features and identification of different parts.  
Study of creel, Principles of drafting systems on Ring Frames, High drafting and Super High Drafting System, Weighting System on Ring Frame. Twisting and winding operation.  
Study of Rings, Travellers, Spindles for their designs and efficient working.  
Study of building mechanism. Factors affecting yarn tension and its control in spinning. Methods of driving ring frame, variable and dual motor drive.  
Study of special attachment such as Automatic doffing and pneumatic waster extraction.  
Study of common defects in ring spun yarn and their methods of analysing yarn defects due to roller vibrations, roller slip and roller eccentricity.  
Modifications to be effected while spinning polyester, viscose and blends on Ring Frame.  
Calculation regarding speed, production and efficiency in Ring Frame, Study of twist factor for single yarn and twist, strength and count relationship.  
General idea about Lubrication and maintenance of High Speed Ring Frame.

## Module – III

( 15 hours)

### 3. DOUBLING:

Principles and objects of doubling, wet and dry doubling, different methods of threading, detailed study of creels, building motions, rings, travellers and spindles on doublers. Concept of balanced twist in doubled yarn, direction of twist in doubled yarn and its relation to single yarn. TFO- Principle, technique, Fancy doublers, different systems of fancy yarn production.

### 4. REELING:

Brief study of machines used for reeling, straight and cross reeling, advantages and disadvantages, doffing systems, Calculation.

### 5. NEW SPINNING SYSTEM:

- Open end spinning systems: principle of rotors spinning system, constructional features and different parts rotor spinning m/c. Economics and quality of rotor spun yarn.
- Principle of Friction Spinning, Features of DREF – I, DREF-II and DREF-III spinning system.
- Airjet Spinning: Principle,
- Comparison of the properties among Rotor, DREF, Air jet and Ring spun yarn.

## Text Books:

1. A Practical Guide to Ring Spinning, W.Klien
2. A Practical guide to Combing and Drawing. W.Klien

## Reference Books:

1. Manual of Cotton Spinning (Vol-IV) Part-I & II, The Textile Institute, Manchester
2. Manual of Cotton Spinning (Vol-V), The Textile Institute, Manchester
3. Open End Spinning, O. Neil
4. New Spinning System, W.Klein
5. Spun Yarn Technology, Oxtoby
6. TFO- Technology & Techniques, HVS Murty

# PCTX4205 Fabric Manufacture – I

## Module – I

( 15 hours)

1. **Introduction:** a) The fabric, b) methods of fabric formation, c) phases in the formation of fabric by weaving, d) a technical introduction to weaving mechanism.
2. **Preparatory processes:** Introduction, sequence of processes. Objects of different processes.
3. **Winding and Warping:**  
Single –end Warp Winding-a) Winding machines-basic function - study of different parts of warp winding m/c- classification of winding machines, spindle and drum driven machines- driving the package e.g., constant surface speed, constant angular speed, varying angular speed. - Types of yarn clearers and their merits and demerits, yarn tensioner, anti patterning device etc.b) Different types of packages and package build-parallel, near parallel wind & cross wound packages, standard package formats (cop, cone, cheese, pineapple etc.) c) winding techniques-random, precision and combined, d) winding parameters: winding rate, wind and traverse ratio, gain, winding angle, e) winding faults; pattern formation, principles of pattern breaking.  
**Single –end Weft winding-** a) Introduction b) need, c) shape and build of the pirn, c) basic requirements, d) elements of the pirn winding machines, e) concept of basic terms-pirn density, cohesion, consistency of pirn diameter, bunch building, chase, winding and binding coils, yarn tails and back wind, spindle speed, direction of rotation, f) degree of automation, g) description of features of a pirn winding machine with respect to a latest commercially available machine.

## Module-II

( 20 hours)

**Warping:** a) Introduction, b) principal methods of warping, c) warping process, d) warping creels- continuous chain creel, truck creel, magazine creel, automatic creel, unrolling creel e) yarn tension in warping, f) stop motions and measuring motions, g) leasing and beaming, h) beam warping or direct warping- process, machines, i) section warping- process, machines, section building and relating drum storage capacity to beam flange diameter.

**4. Sizing:** a) Introduction, b) sizing process, c) size ingredients, d) factors which affect the properties of sized yarns, f) preparation of the size paste- formulation and equipments, g) techniques of sizing, h) types of sizing, i) concept of factors governing the pick up of size, j) principal machine elements- creel, size box, drying arrangements, head stock, tension control mechanisms, measuring and marking mechanisms etc., k) modern trends in sizing.

**Reaching in and Drawing in :** a) Introduction, b) need, c) process, d) modernization, e) related calculations.

## Module –III

( 10 hours)

**5. Basic mechanism of Loom (weaving) -** a) Classification of looms, history of loom development b) Study of different parts of a Handloom and Powerloom c) Study of basic operations i.e Shedding – types of shedding - study of tappet shedding, Picking and checking mechanism, Beating up etc, Eccentricity of the sley, Timing and seating.

**Text Books and Reference Books:**

1. Winding – Silver Jubilee Monograph by BTRA,
2. Sizing – Materials, Methods, Machinery Ajoankar, Talukdar & Wadekar,
3. Weaving Conversion of Yarn to Fabric Lord & Mohammed,
4. Textile Maths Volume III J.E.Booth,
5. Cotton Weaving Gordeev, Volkov, Blinov & Svyantenko,
6. Weaving Mechanism – Pat-I & II N.N.Banerjee
7. Handbook of Weaving Preparation D.S. Verma,
- 8.
9. Plain Weaving Motion K.T Aswani

## PCTX7203 **Fibre Science and Technology – II Lab.**

1. To study the stress-strain behavior of different fibres.
2. To study the longitudinal and cross-sectional views of different fibres.
3. To learn the identification of different cellulosic, protein and synthetic the fibres by burning test, touching, observing the cross- section .
4. To learn the identification of different cellulosic, protein and synthetic fibres by chemical testing
5. To determine % of blend composition of different variety of blended yarn ( minimum 5 Varieties)

## PCTX7204 **Yarn Manufacture –II Lab.**

1. Study of different parts and flow of material in a Simplex Machine.
2. Study of building mechanism in Simplex.
3. Study of the Gearing Diagram of Simplex and calculation of Draft Constant and Twist constant.
4. Study of drafting rollers setting in Speed frame.
5. Study of different parts and flow of material in a Ring Frame .
6. Study of the Gearing Diagram of a Ring Frame and calculation of Draft Constant and Twist constant.
7. To learn the roller setting, spindle gauging and lappet centering of a Ring Frame
8. Study of Building mechanism in a Ring Frame
9. Study of different parts of Rotor Spinning Frame.
10. Study of different parts of a Ring Doubler
11. Study of different parts of Reeling, Bundling, Baling M/c.
12. To Produce a yarn from a given roving/sliver in Ring Frame/ Rotor Frame



## PCTX7205 **Fabric Manufacture - I Lab**

1. Study of the passage of yarn through winding machine and its various parts.
2. To convert some ring bobbins to cone/cheese by adjusting the tension and slub catcher.
3. Study of mechanism of a pirn-winding machine.
4. Study of passage of yarn through a sectional warping m/c and its different parts.
5. Study of path of warp sheet in a multi cylinder-sizing machine.
6. To prepare a size paste for a given sort.
7. To study the working of a automatic knotter on a winding machine
8. To study the passage of yarn and different parts of a plain loom.
9. To study the operational mechanism and different motion in a Power loom
10. To have practice of synchronizing body movements for shedding, picking and beat-up on the handloom by producing a meter of fabric with least fabric faults.

## BECS7208 **Database Managements System Lab**

1. Use of SQL syntax: insertion, deletion, join, updation using SQL. (1 class)
2. Programs on join statements and SQL queries including where clause. (1 class)
3. Programs on procedures and functions. (1 class)
4. Programs on database triggers. (1 class)
5. Programs on packages. (1 class)
6. Programs on data recovery using check point technique. (1 class)
7. Concurrency control problem using lock operations. (1 class)
8. Programs on ODBC using either VB or VC++. (1 class)
9. Programs on JDBC. (1 class)
10. Programs on embedded SQL using C / C++ as host language. (1 class)

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# BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ORISSA

## TEXTILE ENGINEERING

5 <sup>th</sup> Semester				6 <sup>th</sup> Semester			
Theory		Credit Hrs	Credit	Theory		Credit Hrs	Credit
HSSM3301	Principles of Management OR	3-0-0	3	HSSM3302	Optimisation Engineering OR	3-0-0	3
HSSM3302	Optimisation Engineering			HSSM3301	Principles Management		
PCTX4301	Fabric Manufacture-II	3-1-0	4	PCTX 4305	Textile Chemical Processing-II	3-0-0	3
PCTX4302	Textile Chemical Processing-I	3-0-0	3	PCTX4306	Fabric Manufacture-III	3-0-0	3
PCTX4304	Fabric Structure & Design Analysis	3-0-0	3		<b>Professional Elective-I (Any One)</b>	3-0-0	3
PCTX4303	Testing of Textile Materials	3-0-0	3	PETX5305	Technical Textile		
	<b>Free Elective-I(Any one)</b>	3-0-0	3	PETX5303	Manufacture of Special Textile	3-0-0	3
PETX5301	Computer Aided Garment Design				<b>Professional Elective-II (Any One)</b>		
HSSM3303	Environmental Engineering & Safety			PETX5304	Quality Management in Textile Mill		
PEIT5302	Data mining and Data ware housing.			PETX5302	Garment Technology	3-0-0	3
					<b>Free Elective-II (Any One)</b>		
				PEME5305	Robotics & Robot Application		
				FEFT6302	Intelligent & Functional Clothing		
	<b>Total</b>		<b>19</b>		<b>Total</b>		<b>18</b>
<b>Practical / sessional</b>				<b>Practical / sessional</b>			
PCTX7301	Fabric Manufacture-II Lab.	0-0-3	2	PCTX7305	Textile Chemical Processing-II Lab	0-0-3	2
PCTX7302	Textile Chemical Processing-I	0-0-3	2	PCTX7306	Fabric Manufacture-III Lab	0-0-3	2
PCTX7303	Testing of Textile Materials Lab	0-0-3	2	PCTX7307	Textile Design Lab-II	0-0-3	2
PCTX7304	Textile Design Lab-I	0-0-3	2		<b>Total</b>		<b>6</b>
	<b>Total</b>		<b>8</b>				
			<b>27</b>				<b>24</b>

## HSSM3301 **PRINCIPLES OF MANAGEMENT** (3-0-0)

### **Module I: Functions of Management**

Concept of Management, Management as an Art or Science, The Process of Management, Managerial Skills, Good Managers are Born, not Made, Management is concerned with Ideas, Things and People, How a Manager Induces Workers to Put in Their Best, Levels and Types of Management, **Evolution of Management Thought:** Managerial Environment, The process of Management-Planning, Organizing, Directing, Staffing, Controlling.

### **Module II: Marketing Function of Management.**

Modern Concept of Marketing, The Functional Classification of Marketing, Functions of a Marketing Management, Marketing Mix, Fundamental Needs of Customers, The Role of Distribution channels in Marketing, Advertising, Marketing, Consumerism and Environmentalism.

### **Module III: Financial Function & HRM Functions.**

Financial Functions, Concept of Financial Management, Project Appraisal, Tools of Financial decisions making, Overview of Working Capital.

**HRM Function of Management:** Human Resource Management, Human Resource Development, Importance of HRM, Overview of Job Analysis, Job Description, Job Specification, Labour Turnover. Manpower Planning, Recruitment, Selection, Induction, Training and Development, Placement, Wage and Salary Administration, Performance Appraisal, Grievance Handling, Welfare Aspects.

### **Reference Books:**

1. *Business Organization & Management*, CR Basu, TMH
2. *Business Organization & Management*, Tulsia, Pandey, Pearson
3. *Marketing Management*, Kotler, Keller, Koshi, Jha, Pearson
4. *Financial Management*, I.M. Pandey, Vikas
5. *Human Resource Management*, Aswasthapa, TMH.
6. *Modern Business Organisation & Management* by Sherlekar, Himalaya Publishing House.

# HSSM3302 **OPTIMIZATION IN ENGINEERING** (3-0-0)

## **Unit-I (10 Hours)**

Idea of Engineering optimization problems, Classification of optimization algorithms, Modeling of problems and principle of modeling.

**Linear programming:** Formulation of LPP, Graphical solution, Simplex method, Big-M method, Revised simplex method, Duality theory and its application, Dual simplex method, Sensitivity analysis in linear programming

## **Unit-II (10 Hours)**

**Transportation problems:** Finding an initial basic feasible solution by Northwest Corner rule, Least Cost rule, Vogel's approximation method, Degeneracy, Optimality test, MODI method, Stepping stone method

**Assignment problems:** Hungarian method for solution of Assignment problems

**Integer Programming:** Branch and Bound algorithm for solution of integer Programming Problems

**Queuing models:** General characteristics, Markovian queuing model, M/M/1 model, Limited queue capacity, Multiple server, Finite sources, Queue discipline.

## **Unit-III (10 Hours)**

**Non-linear programming:** Introduction to non-linear programming.

**Unconstrained optimization:** Fibonacci and Golden Section Search method.

**Constrained optimization with equality constraint:** Lagrange multiplier, Projected gradient method

**Constrained optimization with inequality constraint:** Kuhn-Tucker condition, Quadratic programming

Introduction to Genetic Algorithm.

### **Recommended text books**

1. A. Ravindran, D. T. Philips, J. Solberg, " *Operations Research- Principle and Practice*", Second edition, Wiley India Pvt Ltd
2. Kalyanmoy Deb, " *Optimization for Engineering Design*", PHI Learning Pvt Ltd

### **Recommended Reference books:**

1. Stephen G. Nash, A. Sofer, " *Linear and Non-linear Programming*", McGraw Hill
2. A.Ravindran, K.M.Ragsdell, G.V.Reklaitis," *Engineering Optimization*", Second edition, Wiley India Pvt. Ltd
3. H.A.Taha,A.M.Natarajan, P.Balasubramanie, A.Tamilarasi, " *Operations Research*", Eighth Edition, Pearson Education
4. F.S.Hiller, G.J.Lieberman, " *Operations Research*", Eighth Edition, Tata McDraw Hill
5. P.K.Gupta, D.S.Hira, " *Operations Research*", S.Chand and Company Ltd.

## PCTX4301 **FABRIC MANUFACTURE-II** (3-1-0)

### **Module – I (20 hours)**

Secondary Motions and Auxiliary Motions of Plain loom: Take up and let-off motions used in power looms. Cloth wind-up system. Warp protector mechanism. Principle and working of loose reed and fast reed warp protector mechanism. Principle and working of weft fork motion and warp stop motion.

Functions and working principles of dobby and jacquards, electronic jacquards, Working of multiple box motions and Card saving device attachment

### **Module-II (10 hours)**

Features of an automatic loom, Types of weft feeler mechanism (mechanical, electrical and photo electric type), Automatic cop changing mechanism, Automatic shuttle changing mechanism, Functions of shuttle eye and selvedge weft cutters, automatic weft replenishment-feelers, specialty of automatic shuttle

### **Module-III (15 hours)**

Origin of shuttleless looms, Salient features and motions of shuttle less looms (Gripper, Rapier, Water Jet & Air Jet looms), Mechanisms of weft insertion by projectile, rapier, air jet and water jet. Techno-economics of shuttleless weft insertion systems. Weft accumulators and selvedges used in shuttle less looms.

Production Calculations related to various shuttle and shuttleless loom.

### **REFERENCE BOOKS:**

1. Principle of Weaving , R. Marks and A. T. C. Robinson
2. Weaving Machine, Mechanism, Management, M. K. Talukdar, P. K. Sriramulu & D. B. Ajgaonkar
3. Weaving Mechanism, N.N. Banerjee
4. Weaving Calculation, Sengupta
5. Weaving – Technology and Operations, A. Ormerod & W. S. Sondhelm
6. Cotton Weaving, V. Goordev
7. Weaving Tablets, TAI
8. Weaving: Conversion from yarn to Fabric, P. R. Lord & Mohamad

# PCTX4302 **TEXTILE CHEMICAL PROCESSING –I** ( 3-0-0 )

## **Module-I (10 hours)**

**Dry preparatory process:** Mending, Stamping, Shearing and cropping. Singeing- Different methods of singeing (Plate, Roller and Gas Singeing), drawbacks and advantages.

**Desizing:** Object, types, method details and mechanism of removal of starch. Efficiency of desizing.

**Scouring:** Objectives, mechanism of removal of impurities, recipe and controlling parameters. Scouring of textiles, evaluation of scouring efficiency. Scouring of natural, man-made and blended textiles.

## **Module-II (15 hours)**

**Bleaching:** Objectives of bleaching, hypochlorite, peroxide and chlorite bleaching. Field of application - Bleaching of cotton, silk, wool, and man-made blended textiles by suitable bleaching agents. Controlling parameters and mechanism. Principles and application of optical brightening and blueing agents.

**Mercerization:** Objectives, Process parameters and operation, mechanism related to various physical and chemical changes in cotton during mercerization. Causticization, Barium activity number - its determination and interpretation. Brief idea of hot and cold ammonia mercerization.

## **Module-III (20 hours)**

**Theory of dyeing:** Classification of Dyes, Dye-fibre interaction, Dyeing technology of textiles of natural fibres (Cotton, Silk and Wool) with direct, reactive, vat, azoic, sulphur, acid and basic dyes.

Machineries used in wet processing: Jigger, Kier and J-Box system; Hydro-extractor, Drying processes of textile materials (Hot air stenter, cylinder dryer and infrared / RF dryer). Working principles of Winch, Jet, Beam, Hank and Package Dyeing machine.

## **Books for References:**

1. Textile Chemistry, Part-I & II : R.H. Peters, Elsevier
2. Chemical Technology of Scouring and Bleaching: E. R. Trotman, Griffin.
3. Technology of Bleaching and Mercerisation: V.A. Shenai, Sevak Publication,
4. Technology of Dyeing: V.A. Shenai, Sevak Publication.
5. Dyeing & Chemical Technology of Textile Fibres : E. R. Trotman,
6. Chemistry of Dyes and Principle of Dyeing : V.A. Shenai, Sevak Publication
7. The Dyeing of Synthetic Polymer and Acetate Fibres: Nunn D M, Dyers Company Publication Trust, London (1979).
8. Chemical Processing of polyester / cellulosic Blends: Mittal R M and Trivedi S S, Ahmedabad Textile Industries Research Association, Ahmedabad, India (1983).

# PCTX4304 **FABRIC STRUCTURE AND DESIGN**

## **ANALYSIS** (3-0-0)

### **Module-I (15 Hrs)**

1. Classification of fabrics; concept of fabric structure; representation of weave; use of point paper, repeat of weave; drafts and peg plan; relationship between weave, draft and peg plan;

**Basic Weaves:** Method of construction, features and uses of plain weave and its derivatives, twill weave and its derivatives, Satin and sateen weaves and their derivatives.

### **Module-II (15 hours)**

Method of preparation, features and uses of Diamond weaves, Honey comb weaves-ordinary and brighton, Huck-a-back and Mockleno weaves, crepe weave.

**Cord weaves:** Method of construction, features, cross-sectional view, and uses – Bedford cord, welt and cork screw

**Stripe and Check Weaves:** Features, Methods of preparation and uses.

**Extra warp and extra weft designs:** Extra weft figuring-concepts of simple techniques; idea of continuous figuring in one extra warp and extra weft.

### **Module-III (15 hours)**

**Terry Weaves:** Definition, classification, process of formation of pile, graphical representation of terry weaves.

**Backed fabrics:** Definition, features, classification and uses of backed fabrics. Graphical representation of warp backed, weft backed cloth, reversible backed fabric and wadded backed fabric.

**Double Cloth:** Definition, features, classification and uses. Method of preparation of self stitched and centre stitched double cloths, their salient feature and uses. Wadded double cloth.

Brief idea on cross-woven designs and floral designs.

### **Books Recommended**

1. Groscicki Z J, "*Watsons Textile Design and Colour*", Newnes Buttersworth (1988).
2. Groscicki Z J, "*Watsons Advanced Textile Design*", Newnes Buttersworth (1989).
3. Klibbe J W, "*Structural Fabric Design*", Revised Edition, 1965, North Carolina State University.
4. Nisbeth H, "*Grammer of Textile Design*", 3<sup>rd</sup> Ed., D B Tarapore Wala sons and Co. (1994).
5. Gokarneshan N, "*Fabric Structure and Design*", New Age International, New Delhi (2004)

## PCTX4303 **TESTING OF TEXTILE MATERIALS** ( 3-0-0 )

### **Module- I (15 Hrs )**

**Introduction to textile testing:** Relative and absolute humidity and standard testing atmosphere, conditioning

**Yarn dimension:** Yarn linear density-direct and indirect system; Conversion from one system to another, Measurement of yarn count, linear density of plied and cable structure, Yarn diameter and packing density. Yarn twist – its type and its relation with yarn strength, measurement of yarn twist.

**Yarn Irregularity** – types of irregularities, limit irregularity, irregularity index, causes of irregularity, short and long term irregularity, V-L curves, spectrograms, effects of doubling on irregularity. Testing of yarn irregularity - capacitance type and photoelectric type instruments. Calculations of yarn irregularity. ASTM yarn grading Definitions of yarn hairiness. Yarn fault analyzer (Uster Classimat).

### **Module-II (15 Hrs)**

**Fabric Dimension-** Measurements of different dimensions properties like length, width, thread density, yarn number, yarn crimp, weave, cover factor, weight, and thickness.

**Physical properties of fabrics-** shrinkage, air permeability, water permeability, crease recovery, stiffness, drape and handle. Determination of abrasion resistance and pilling

### **Module- III (15 Hrs)**

**Mechanical properties of Textiles:** Characterization of mechanical behaviour of textiles; stress strain curve; mechanics of CRT, CRE & CRL type testers and their comparisons,

**Measurement of Yarn strength** – lea strength, single yarn strength

**Measurement of Fabric strength:** Tensile strength, Tearing strength and Bursting strength of cloth.

### **Books for References:**

1. Principle of Textile Testing: J.E. Booth
2. Textile Mathematics, Vol-I, II, III: J. E. Booth
3. Physical Properties of Textile Fibres: W.E. Morton & J.W.S. Hearle



# Free Electives

## PETX5301 **COMPUTER AIDED GARMENT DESIGN** (3-0-0)

### **Module – I (10 hours)**

Elements of designs and their development using CAD software. Principles of motif generation on computers / motif for border, motif for all over design. Principles & elements of colour. Colour selection & application through CAD.

### **Module – II (10 hours)**

Operational principles of various tools of CAD software for woven knitted & Printed design. Weave simulation, Draping & 3D image on CAD. Principles of Development of basic weave design & their derivatives. Concept of garment design developing & cutting in fashion studio using CAD software.

### **Module – III (10 hours)**

Principles of CAD for pattern making , Pattern grading and pattern layout. Use of Anthropometric data for CAD based garment manufacturing. Detailed study on various Computer Aided Cutting & sewing machineries.

### **REFERENCE BOOK:**

1.CAD/CAM by Groover & zimmer

# HSSM3303 **ENVIRONMENTAL ENGINEERING & SAFETY** (3-0-0)

## **Module – I**

Ecological Concepts: Biotic components, Ecosystem Process: Energy, Food Chain, Water cycle, Oxygen cycle, Nitrogen cycle etc., Environmental gradients, Tolerance levels of environment factor, EU, US and Indian Environmental Law. Chemistry in Environmental Engineering: Atmospheric chemistry, Soil chemistry. Noise pollution- Noise standards, measurement and control. Water Treatment: water quality standards and parameters, Ground water. Water treatment processes, Pre-treatment of water, Conventional process, Advanced water treatment process.

## **Module – II**

(a)Waste Water Treatment: DO and BOD of Waste water treatment process, pretreatment, primary and secondary treatment of waste water, Activated sludge treatment: Anaerobic digestion, Reactor configurations and methane production.

(b)Air Pollution : Air pollution and pollutants, criteria pollutants, Acid deposition, Global climate change –greenhouse gases, non-criteria pollutants, air pollution meteorology, Atmospheric dispersion. Industrial Air Emission Control. Flue gas desulphurization, NO<sub>x</sub> removal, Fugitive emissions.

(c) Solid waste, Hazardous waste management, Solid Waste Management, Source classification and composition of MSW: Separation, storage and transportation, Reuse and recycling, Waste Minimization Techniques. Hazardous Waste Management, Hazardous waste and their generation, Transportation and treatment: Incinerators, Inorganic waste treatment. E.I.A., Environmental auditing,

## **Module – III**

Occupational Safety and Health Acts, Safety procedures, Type of Accidents, Chemical and Heat Burns, Prevention of Accidents involving Hazardous substances, Human error and Hazard Analysis. Hazard Control Measures in integrated steel industry, Petroleum Refinery, L.P.G. Bottling, Pharmaceutical industry. Fire Prevention – Detection, Extinguishing Fire, Electrical Safety, Product Safety. Safety Management- Safety Handling and Storage of Hazardous Materials, Corrosive Substances, Gas Cylinders, Hydro Carbons and Wastes. Personal Protective Equipments.

## **Text Book :**

1. Environmental Engineering Irwin/ McGraw Hill International Edition, 1997, G. Kiely,
2. Environmental Engineering by Prof B.K. Mohapatra, Dhanpat Rai & Co Publication
3. Industrial Safety Management, L. M. Deshmukh, Tata McGraw Hill Publication.

## **Reference Books**

1. Environmental Engineering by Arcadio P. Sincero & Gergoria A. Sincero PHI Publication
2. Principles of Environmental Engineering and Science, M. L. Davis and S. J. Masen, McGraw Hill International Edition, 2004
3. Environmental Science, Curringham & Saigo, TMH,
4. Man and Environment by Dash & Mishra
5. An Introduction to Environmental Engineering and Science by Gilbert M. Masters & Wendell P. Ela - PHI Publication.
6. Industrial Safety Management and Technology, Colling. D A – Prentice Hall, New Delhi.

# PEIT5302 **DATA MINING & DATA WAREHOUSING** (3-0-0)

## **Module - I**

**12 Hours**

Overview: Data warehousing, The compelling need for data warehousing, the Building blocks of data warehouse, data warehouses and data marts, overview of the components, metadata in the data warehouse, trends In data warehousing, emergence of standards, OLAP, web enabled data warehouse, Introduction to the data warehouse project, understanding data warehousing Architecture, Data warehousing implementation, from data warehousing to data mining.

## **Module - II**

**14 Hours**

Introduction to Data mining, Data mining Functionalities, Data preprocessing (data summarization, data cleaning, data integration and transformation, data reduction, data discretization),

Mining frequent patterns, associations, correlations (market basket analysis, the apriori algorithm, mining various kinds of association rules, from association mining to correlation analysis)

Classification: classification by decision tree induction, Rule based classification, classification by neural networks, classification by genetic algorithm

## **Module - III**

**10 Hours**

Cluster Analysis: types of data in cluster analysis, A categorization of major clustering methods(partitioning methods, hierarchical methods),clustering high dimensional data, outlier analysis

Advanced techniques: web mining, spatial mining, temporal mining, Data mining applications in (financial data Analysis, retail industry, telecommunication industry, Biological data analysis, intrusion detection, in other scientific applications)

### **Text Books:**

1. Data warehousing Fundamentals: Paulraj Ponniah, Willey India.
2. Data Mining: Concepts and techniques: J.Han and M.Camber, Elsevier.

### **Reference books:**

1. Data Mining: Arun Pujari, University Press
2. Data Mining –a Tutorial based primer by R.J.Roiger, M.W.Geatz, Pearson Education.
3. Data Mining & Data Warehousing Using OLAP: Berson, TMH.
4. Data Warehousing: Reema Thareja, Oxford University Press

## PCTX7301 **FABRIC MANUFACTURE – II LAB** (0-0-3)

1. To study the working of five wheel take up mechanism and calculation of dividend.
2. To study the working of seven wheel take up mechanism and calculation of dividend.
3. To study the negative let off motion.
4. To study the loose reed and fast reed warp protector mechanism.
5. Study of side weft fork motion.
6. Study of warp stop motion.
7. Study of 4 x 1 drop box mechanism and preparation of pattern card.
8. Study of automatic cop changing mechanism with mechanical weft feeler.
9. To study and sketch the working of ordinary climax dobbie,
10. To study and sketch the working of ordinary paper dobbie.
11. To study pegging the lattice for the desired peg plan.
12. To study and sketch working of a double lift jacquard along with its types of needles, cylinders and their mounting.
13. To study the different mechanism of Air-jet loom.
14. To study the different mechanism of Rapier loom.
15. To find out the loom speed and production calculation of different types of loom available in laboratory.

## PCTX7302 **TEXTILE CHEMICAL PROCESSING –I Lab** (0-0-3)

Desizing and Scouring of Cotton yarn / Fabric.

Bleaching of Cotton yarn / Fabric with Bleaching powder ,  $\text{NaClO}_2/\text{NaOCl}$

3. Bleaching of Cotton yarn / Fabric with Hydrogen Peroxide.
4. Mercerisation of Cotton yarn / fabric.
5. Degumming of Silk
6. Scouring and Bleaching of Wool.
7. Dyeing of cotton yarn/fabric by Direct, Reactive, Vat, Azoic and Sulphur Dyes.
8. Dyeing of Wool yarn / fabric with Acid and reactive dyes.
9. Dyeing of Silk yarn / fabric with Acid dyes.
10. Measurement of fastness properties to washing, light , rubbing.

## PCTX7303 **TESTING OF TEXTILE MATERIAL LAB** (0-0-3)

### Yarn Testing

1. To determine the hank of a Drawing sliver and Roving by using physical balance
2. To determine the count of a yarn by using physical/electronic balance.
3. To measure the TPI of given yarn sample using Twist Tester.
4. To determine the Count and CSP by using Knowle's balance and lea strength tester
5. To determine the single yarn strength.
6. To measure U% /CV% of a yarn

## Fabric Testing

1. To characterize a woven fabric with respect to its dimensional properties:  
Thread density, yarn number, yarn crimp, weave, cover factor, weight(GSM), areal density, skewness, thickness
2. To determine the tensile strength of a woven fabric by strip test method. Draw load-elongation curve of a woven fabric.
3. To determine the tear strength of a fabric using Elmendorf tear tester or ballistic tester.
4. To determine the bursting strength of a fabric using hydraulic bursting tester.
5. To determine the abrasion resistance of a fabric.
6. To determine the bending length and flexural rigidity of a woven fabric using the Shirley tester.
7. To determine the crease recovery of fabric and observe the effect of loading time and recovery time on crease recovery.
8. To determine the drape coefficient of woven and knitted fabric using the drape meter.

## PCTX7304 **TEXTILE DESIGN LAB-I** (0-0-3)

1. Analysis of the following Cloths in respect to fabric parameters and design with drafting and lifting plan, denting order, colour plan and use :

Plain and its derivatives  
Twill and its derivatives  
Diamonds and Drapers  
Honey comb  
Huck-a-back  
Mockleno  
Welts and Piques  
Stripe and Cheques  
Satin / Sateen  
Terry pile  
Colour and Weave effect.  
Double Cloth  
Extra warp and weft

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## **6<sup>TH</sup> SEMESTER**

### **PCTX4305 TEXTILE CHEMICAL PROCESSING- II (3-0-0)**

#### **Module-I (15 Hours)**

Dyeing of polyester fabric using disperse dye by HT&HP, Carrier and Thermosol processes; Dyeing of cationic dyeable polyester fabrics; dyeing of P/C and P/W blended fabrics with suitable dyes; Dyeing of Nylon with acid dyes; dyeing of acrylic with basic dyes.

#### **Module-II (15 Hours)**

Printing: Object of Printing, Difference between dyeing and printing, ingredients of printing paste.

Discuss different styles of printing: Direct, Discharge and Resist.

Methods of printing- Block printing, Screen printing, Roller printing, Rotary Screen printing, Transfer printing. Printing of cotton (with reactive, vat and azoic dyes and pigment), Silk (with acid dyes), Polyester (with disperse dye) and Acrylic (with basic dyes) .

#### **Module-III (15 Hours)**

Finishing: Classification and importance of finishing.

Mechanical finish: Calendaring and working of different calendaring machines; Sanforizing.

Chemical finish: Anti crease finish , water proof and water repellent finish; flame retardant and fire proof finish; Moth proof finish; Soil release finish; Organdi finish; Bio-polishing, Stonewashing of denim , Anti-bacterial finish, UV finish.

#### **Books for References:**

1. Dyeing & Chemical Technology of Textile Fibres : E. R. Trotman,
2. Technology of Dyeing : V.A.Shenai , Sevak Publication.
3. Chemistry of the Textiles Industry: C. M. Carr
4. Textile Printing: L.W.C. Miles
5. Technology of Textile Printing: R. S. Prayog
6. An Introduction of Textile Finishing: J. T. Marsh
7. Technology of Textile Finishing: V. A. Shenai

**Module I (15 Hours)**

Introduction to Braiding, Needle (Tape) loom weaving, multiphase weaving and circular weaving

**KNITTING:** Introduction to Knitting: Difference between woven and knitted products and process. Classification of knitting machines and mechanisms, terms and definitions used in knitting. Elements of knitting: needles, sinker and cam.

Yarn requirement for knitting, norms of cotton yarn for knitting, fibres used in knitting for both weft and warp knitting.

Weft Knitting: Classification and representation of weft knit structures, structures and characteristics of plain, rib, interlock and purl structures.

**MODULE II (10 Hours)**

Float & Tuck Stitches and their effects on fabrics. Derivatives of Weft Knit Structures. Devices for needle selection. Yarn feeding and creels.

WARP KNITTING : basic principle, types of warp knitting machines, different motions, basic warp knitted structures, fabrics and their uses.

Fabric defects, Fabric parameters and constants, Fabric relaxation treatments, Calculation related to knitting.

**MODULE-III (20 HOURS)**

**NON-WOVEN:** Introduction to non-woven technology. Types of fibres used and end uses of nonwovens, Methods of web preparation, Orientation of fibres in the web, Methods of bonding of web, Production of non-woven fabrics by needle punching technique, Effects of process and machine variables on properties of nonwoven, Production of stitch bonding, spun bonding, thermal bonding nonwovens. Production of non-woven fabrics by Adhesive bonding, Characteristics and properties of adhesives. Developments and new trends in nonwoven techniques.

**Book Recommended:**

1. Mark R and Robinson A T C, "*Principles of Weaving*", The Textile Institute, Manchester (1986).
2. Talukdar M K, Sriramulu P K and Ajgaokar D B, "*Weaving – Machine, Mechanism and Management*", Mahajan Publisher Private Ltd., Ahmedabad, India (1998).
3. Aswani K T, "*Fancy Weaving mechanism*", Mahajan Publisher Private Ltd., Ahmedabad, India (1990)
4. Lunenschloss J and Albrecht W, "*Non-woven Bonded Fabric*", Ellis and Horwood Ltd, U.K. (1985).
5. Lord P R and Mohamad M H, "*Weaving: Conversion of Yarn to Fabric*", Merrow Technical Library, UK (1988).
6. Ormerod, "Modern Preparation and Weaving Machinery "Shuttleless Looms by J.J. Vincent,
7. Spencer D J, "*Knitting Technology*", 2<sup>nd</sup> Ed., Pergamon Press (1989)
8. Ajgaonkar D B, "*Knitting Technology*", Universal Publishing Corporation (1998).
9. Booth J E, "*Textile Mathematics*", Vol. 3, Textile Institute, Manchester (1977).
10. Iyer C, Mammel B and Schach W, "*Circular Knitting*", Meisenbach Bamberg

# PETX5305 **TECHNICAL TEXTILES** (3-0-0 )

## **Module-I (15 hours)**

**Introduction:** Definition and scope for technical textiles, present status and future of technical textile. Brief idea about technical fibres - Carbon fibres-Aramid and related fibres, Glass threads, composite material.

**Filtration textiles:** Definition of filtration parameters, theory of dust collection and solid liquid separation, filtration requirements, concept of pore size and particle size, role of fiber, fabric construction and finishing treatments.

**Geotextiles:** Brief idea about geo-synthetics and their uses, essential properties of geotextiles, geotextile testing and evaluation, application examples of geotextiles.

## **Module-II (15 hours)**

**Medical textiles:** Classification of medical textiles. Medical Textiles: Surgical Textiles and Sutures. Cardio Vascular Textiles (Knitted cardiac biological valves). Dialytic Textiles, Hollow fibres as dialysis membrane, Hospital Textiles- operating and post operating clothing, disposable drapes. Textiles for sanitary applications.

**Protective Clothing:** Brief idea about different type of protective clothing, functional requirement of textiles in defence including ballistic protection materials and parachute cloth, temperature and flame retardant clothing, chemical protective clothing, water proof breathable fabrics.

## **Module-III (15 hours)**

**Sports and recreation textiles:** Functional requirement of different types of product and their construction.

**Automotive textiles:** Brief idea about the important properties and requirements in automotive textiles, textiles components in tyre, tyre structure and design.

**Other uses of technical textile:** Textiles in agriculture, electronics, power transmission belting, hoses, canvas covers and tarpaulins.

## **Books Remmended**

1. "*Handbook of Technical Textiles*", Ed. A R Horrocks and S C Anand, Woodhead Publication Ltd., Cambridge (2000).
2. "*Engineering with Geosynthetics*", Ed. G V Rao and G V S Raju, Tata McGraw Hill Publishing Co. Ltd., New Delhi (1990).
3. "*Industrial Textile*", Ed., J Svedova, Elsevier, New York (1990).
4. "*Modern Textile Characterization Methods*", Ed. M Raheel, Marcel Dekker, Inc. (1996).
5. Mukhopadhyay S K and Partridge J F, "*Automotive Textiles*", Vol. 29, No. ½, The Textile Institute (1999).
6. Sabit Adanur, "Wellington Sears Handbook of Industrial Textiles", Technomic publishing company Inc., USA, 1995
7. Pushpa, B., and Sengupta, A.K., "Industrial Application of Textiles for Filtration and Coated fabrics", Textile Progress Vol.14, 1992



# PETX5303 **MANUFACTURE OF SPECIAL TEXTILES(3-0-0)**

## **Module-I (15 hours)**

**Overview Of Special Textiles:** Definition, Significance of special textiles, Differences between conventional and special textiles, classification of special textiles, scope for special textiles.

**Cross Woven structure:** Principles of leno structures; bottom and top doubling, methods of producing leno and idea of simple constructions; half and full cross leno; net leno; structural difference between gauge and leno. Cellular and Russian leno Principles of Developing design for Tapestry and Quilts

**Braided and Pile Fabrics:** 2-D Braiding – Circular braiding; Flat braiding, 3-D braiding. Formation of Pile structures – Loop pile, cut pile.

## **Module-II (15 hours)**

**Coated and Laminated fabrics:** Coating by Direct Method - Foam finishing - foamed and crushed foam coating - Transfer coating - coagulated polyurethane coating - ball licking roller technique - hot melt extrusion coating - calendar coating - rotary screen coating - fabric impregnation method. Testing for adhesion, Flexing, Abrasion resistance. Lamination techniques – Flame, Hot melt. Lamination machines – types, advantages, disadvantages.

**Textile Reinforced Composites Materials:** Introduction to composite materials- Textile reinforcement- woven fabric reinforced, knitted fabrics reinforced, Braided fabric reinforced composites, stitched fabrics.

## **Module-III (15 hours)**

**Textiles in Defence:** Manufacturing process of military textiles – ballistic protection, chemical & biological protection, environmental protection, nuclear protective fabrics, thermal insulation and High altitude fabric. Specific testing methods for Technical textiles

**Medical Textiles:** Manufacturing process of Medical Textiles. Testing methods for Medical Textiles – Knot-pull tensile strength

**Geo-Textile:** Geo-Textile Materials and Manufacturing – woven, non-woven, Properties required for geo-textiles evaluation.

**Industrial fabrics:** Canvases, Belts, Parachute Fabrics and umbrella cloth. High stretch fabric (Lycra Fabric)

### **Books for references:**

1. Sabit Adanur, “ Wellington Sears Handbook of Industrial Textiles”, Technomic publishing company Inc., USA, 1995
2. Walter Fung , “ Coated and Laminated Textiles”, Wood head publishing Limited, Cambridge, England, 2000.
3. Horrocks. A. R and Anand S.C, “ Handbook of Technical Textiles”, Wood head publishing Limited, Cambridge, England, 2000.
4. Wilhelm Albrecht, Hilmar Fuchs and Walter Kittelmann “Non woven fabrics”, Wile – VCH Verlag Gmbh & Co, KGaA Weinheim, 2003
5. Antonio Mirarete, “3-D Textile reinforcement in Composite materials” Wood head publishing Limited, Cambridge, England, 1999.
6. Brody. H, “ Synthetic fibre materials”, Longman Scientific and Technical, England, 1994.

# PETX5304 **QUALITY MANAGEMENT IN TEXTILE MILL**

(3-0-0)

## **Module-I (15 hours)**

**Introduction:** Definition of quality and its importance, different approaches to quality, Description of Deming's fourteen points and Ishikawa's seven tools of quality. Utility of statistical method for quality control with special reference to textile industry

**Statistical Analysis for Continuous Function:** Population and sampling distribution of mean, statistical estimation theory, points estimates, concept of single tail and double tail test, confidence limit, statistical decision theory, tests of hypotheses and significances, type I and type II errors. Test for single variance, F-test, test for the difference between two variances, confidence limits for variance and ratio of two variances, choice of sample size.

**Statistical Analysis for Discrete Function:** Application of binomial and Poisson's distribution, normal approximation, test for a single proportion and difference between two proportions, application of  $\chi^2$  distribution.

## **Module-II (15 hours)**

### **Statistical Process Control:**

**Control Charts:** Advantages using quality control charts, random and assignable causes, action and warning limits,  $\bar{X}$ , R,  $\bar{p}$ ,  $n\bar{p}$  and  $\bar{c}$  chart, Process Capability Ratio ( $C_P$  and  $C_{PK}$ ), concept of 6 sigma process control.

**Acceptance Sampling:** Basic idea about acceptance sampling, OC curve, producer's risk and customer's risk.

**ANOVA and Regression:** Some basic concept of Analysis of Variance, method of least squares, linear regression methodology, correlation and standard error.

## **Module-III (15 hours)**

### **Total Quality Management (TQM),**

Concept of Total Quality Management, Need for ISO 9000 series Standards, Elements of ISO 9000 standard, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function,

**Quality circles:** Back ground to quality circle, essential preconditions for successful quality circles, organizing and training for quality control (with special reference to Textile Industry).

### **Books Recommended**

1. Leaf G A V, "*Practical Statistics for the Textile Industry*", Part-I and II, The Textile Institute, U.K (1984).
2. Montgomery D C, "*Introduction to Statistical Quality Control*", Fourth Ed., John Wiley and Sons (Asia) Pte. Ltd., Singapore (2004).
3. Mehta P V, "Quality Management: An Overview", in '*Testing and Quality Management*', Vol. 1, Ed. V K Kothari, IAFL Publication, New Delhi (1999).
4. Spiegel M R and Stephens L J, "*Schaum's Outlines Statistics*", Third Ed., Tata McGraw Hill, New Delhi (2000).

# PETX 5302 **GARMENT TECHNOLOGY**(3-0-0)

## **Module-I**

**Garment Manufacturing:** Introduction, Indian apparel industry. Different garment production systems.

**Selection of Fabrics:** Garment from Woven and knitted fabrics, Various fabrics available in market, their characteristics and applications to suit to different purposes

**Pattern making:** Introduction to pattern making and garment, Construction. Different terminologies. Drafting, Basic bodies blocks, Muslin pattern. Commercial pattern, Methods of making basic pattern, grading of pattern, size, size charts.

**Spreading and lay planning:** Introduction to symmetrical and asymmetrical fabrics, criteria of spreading, methods of spreading, spreading m/cs. Principles of lay plan, types of lay plan.

## **Module-II**

**Garment Cutting:** Introduction to cutting room processes, cutting methods and their merit demerits. Bundling system.

**Garment Sewing:** Introduction to sewing m/c and its parts, sewing room processes and working details. Different types of sewing m/c and its suitability, Different sewing m/c driving system. Attachment of sewing m/c, Sewing needle and its sizes.

**Sewing stitches and seams types:** Stitch formation, types of stitches, seam classification, seam geometry seam strength and slippage, seam puckering. Thread calculation and its consumption

**Trimming and Garment accessories:** Definition, types, trimming methodologies and accessories application.

## **Module-III**

**Garment finishing:** Fasteners, thread tucking, care and size labeling system, checking, pressing, folding and packing, packing standards for domestic and export markets.

**Quality Control in Garment manufacturing:** Control in pattern making, grading, fabric laying, marking, sewing and finishing, control of garment defects.

**Computer Application in Garment Manufacturing:** Application in pattern making, grading, lay planning, sewing and finishing, computer aided embroidery designs. Concepts of computer integrated manufacturing (CIM) to the garment industry.

## **Books Recommended**

1. Carr H and Lantham B, "*The Technology of Clothing Manufacture*", Om Book Service, Delhi.
2. Mehta P V and Bhardwaj S K, "*Managing Quality in apparel industry*", Om Book Service, New Delhi
3. Aldrich W, "*Metric Pattern Cutting*", OM Book Service, New Delhi (1998).
4. Cooklin Gerry, "*Garment Technology for Fashion Designers*", OM Book Service, New Delhi (1997).
5. Eveleyn M and Ucas, "*Clothing Construction*", 2<sup>nd</sup> Ed., Hughton Mifflin Co, Boston (1974).

# PEME5305 **ROBOTICS & ROBOT APPLICATIONS** (3-0-0)

## **Module – I**

1. Fundamentals of Robotics: Evolution of robots and robotics, Definition of industrial robot, Laws of Robotics, Classification, Robot Anatomy, Work volume and work envelope, Human arm characteristics, Design and control issues, Manipulation and control, Resolution; accuracy and repeatability, Robot configuration, Economic and social issues, Present and future application.
2. Mathematical modeling of a robot: Mapping between frames, Description of objects in space, Transformation of vectors.  
Direct Kinematic model: Mechanical Structure and notations, Description of links and joints, Kinematic modeling of the manipulator, Denavit-Hartenberg Notation, Kinematic relationship between adjacent links, Manipulator Transformation matrix.

## **Module – II**

3. Inverse Kinematics: Manipulator workspace, Solvable of inverse kinematic model, Manipulator Jacobian, Jacobian inverse, Jacobian singularity, Static analysis.
4. Dynamic modeling: Lagrangian mechanics, 2D- Dynamic model, Lagrange-Euler formulation, Newton-Euler formulation.
5. Robot Sensors: Internal and external sensors, force sensors, Thermocouples, Performance characteristic of a robot.

## **Module – III**

6. Robot Actuators: Hydraulic and pneumatic actuators, Electrical actuators, Brushless permanent magnet DC motor, Servomotor, Stepper motor, Micro actuator, Micro gripper, Micro motor, Drive selection.
7. Trajectory Planning: Definition and planning tasks, Joint space planning, Cartesian space planning.
8. Applications of Robotics: Capabilities of robots, Material handling, Machine loading and unloading, Robot assembly, Inspection, Welding, Obstacle avoidance.

## **Text Books:**

1. Robotics and Control, R.K. Mittal and I.J. Nagrath, Tata McGraw Hill
2. Introduction to Robotics: Mechanics and control, John J Craig, PHI
3. Robotics Technology and Flexible Automation, S.R.Deb and S. Deb, Tata McGraw Hill

## **Reference Books:**

1. Introduction to Robotics, S. K. Saha, Tata McGraw Hill
2. Robotics: Control, Sensing, Vision and Intelligence, K.S.Fu, R.C.Gonzalez and C.S.G.Lee, McGraw Hill
3. Robotics, Appuu Kuttan K.K., I.K. international
4. Robot Dynamics and Control, M.W.Spong and M. Vidyasagar , Wiley India.
5. Industrial Robotics Technology, programming and application, M.P.Groover, TMH
6. Introduction to Robotics: Analysis, Systems, Applications, S.B.Niku, PHI
7. Robotics: Fundamental Concepts and Analysis, A. Ghosal, Oxford University Press
8. Fundamentals of Robotics: Analysis and Control, R. J. Schilling, PHI
9. Robotic Engineering: An Integrated Approach, R.D. KLAFTER, T. A. Chmielewski, and M. Negin, PHI
10. Robot Technology: Fundamentals: J. G. Keramas, Cengage Learning

# **FEFT6302 INTELLIGENT AND FUNCTIONAL CLOTHING**

**(3-0-0)**

## **MODULE –I**

**(10 hours)**

Study of the Basic Principle of manufacturing technology and functional Properties of Garment used for specific purpose.

Protective Garment: Thermal protective Garments, water proof & water breathable fabric etc. Garment for medical & hospital use, Antimicrobial textile wear, Pathogen resistant surgical gown. High performance Sports wear.

## **MODULE –II**

**(10 hours)**

Protective clothing from x-rays, gamma chamber, Bullet proof and ballistic protective clothing. Detailed study of Space suit.

## **MODULE –III**

**(10 hours)**

Smart Garment: Chameleonic Garments, Communicative Garment, Shape memory Garment, Responsive Garment.

Wearable electronics: Musical Jacket, Garment fitted with electronics appliances like torch, mobile, calculator, motherboard etc.

### **Reference Books:**

1. Industrial Textile by Sabit Adnoor.

## **PCTX7305 TEXTILE CHEMICAL PROCESSING - II LAB.**

1. Dyeing of Polyester yarn/ fabric with Disperse Dye
2. Dyeing of Nylon yarn/fabric with Acid Dye.
3. Dyeing of Acrylic yarn/fabric with Basic Dye
4. Dyeing of blended fabric with various dyes
5. Block/Screen printing of cotton and silk fabric with suitable dyes.
6. Resist printing (Batik and Tie & dye of cotton and silk yarn/fabric).
7. Discharge printing of cotton fabric.
8. Resin finishing treatment on cotton fabric.
9. Application bio-enzymes on cotton fabric.
- 10.** Determination of the dye exertion, shade % by spectrophotometer.

## PCTX7306 **FABRIC MANUFACTURE - III LAB** (0-0-2)

To study the path of yarn through plain knitting machine.

To study the different knitting elements including the cam system.

To study the driving mechanism of plain knitting m/c.

To study the cloth take-down mechanism of plain knitting m/c.

To study the rib knitting m/c including arrangement of dial and cylinder needles, cam system and driving mechanism.

To study the Interlock knitting m/c including arrangement of dial and cylinder needles, cam system and driving mechanism.

To study cam system of V - bed rib knitting m/c.

To study driving mechanism of V - bed rib knitting m/c.

Preparation of Fabric sample (rib, circular, half cardigan and full cardigan) in V-bed rib knitting machine.

To study the effect on loop length with the change in cam setting in flat knitting machine.

To study the effect of variation in yarn input tension on the loop length in V-bed rib flat knitting machine.

To study plain, rib and Interlock knitted fabrics (course per inch, wales per inch, loop length etc.)

## PCTX7307 **TEXTILE DESIGN LAB - II**

1. Free hand sketching, arrangement of motifs on different bases.
2. Practice in colour mixing - Light theory, pigment theory charts.
3. Preparation of painted designs for stripe, check, spotted and diaper fabrics.
4. Development of point paper design for dobby weaving.  
( Extra warp/Extra weft/ double cloth/backed cloth)
5. Development of point paper design for jacquard weaving.
6. Working with Corel draw & Making of a sari design on Corel draw.
7. Working with CAD software and designing different colour pattern, motif for dobby weaving.
8. Working with CAD software and designing different colour pattern, motif for Jacquard weaving

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# BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ORISSA

## Textile Engineering

7 <sup>th</sup> Semester				8 <sup>th</sup> Semester			
Theory		Credit Hrs	Credit	Theory		Credit Hrs	Credit
PCTX4401	Theory of Textile Structure	3-0-0	3	HSSM3402	Environment Engineering	3-0-0	3
	<b>Professional Elective-III (Any One)</b>	3-0-0	3		<b>Professional Elective-VI</b>	3-0-0	3
PETX5401	Textile Mechanics			PETX5408	Textile Mill Planning & organization		
PETX5402	Theory & Design of Textile Machines	3-0-0	3	PETX5409	Entrepreneurship in Textile		
PETX5403	Process Control in Yarn and fabric Manufacture			PETX5410	Clothing Science & Technology	3-0-0	3
	<b>Professional Elective-IV</b>			PETX5411	Textile Finishing & Clothing Care		
PETX5404	Process Control in Textile Chemical Processing	3-0-0	3		<b>Free Elective-V</b>		
	<b>Professional Elective-V</b>			PECS5406	Digital Image Processing		
PETX5405	Manufacture of Specialty Yarn						
PETX5406	Developments in Fabric Manufacture			PETX5413	Apparel Production, planning & control scheduling	3-0-0	3
PETX5407	Development in man-made fibre			PETX5414	Microbial Technology		
	<b>Free Elective-III</b>				<b>Total</b>		
PECS5401	Artificial Intelligence	3-0-0	3				
PCFT4403	Apparel Marketing, Retailing and Merchandising.	3-0-0	3				
PCBT4402	Bioreactor Design and Analysis						
	<b>Free Elective-IV</b>		18				12
FETX6401	Process Control in Apparel Manufacturing & quality control						
PCCS4401	Computer Graphics						
	<b>Total</b>						
<b>Practical / Sessional</b>				<b>Practical / Sessional</b>			
PCTX7401	Minor Project	0-0-4	4	PCTX7403	Major Project	0-0-6	6
PCTX7402	Industrial Internship Seminar	0-0-2	2	PCTX7404	Seminar	0-0-2	1
	<b>Total</b>		6	PCTX7405	Comprehensive Viva	0-0-2	2
					<b>Total</b>		9
			<b>24</b>				<b>21</b>

**Module-I (14 Hours)**

**1. Yarn Geometry:** Basic geometry of twisted yarns, the idealized helical yarn structure and its deviation. Yarn diameter and count, Twist contraction and retraction, specific volume, packing of the fibres in yarn, packing fraction of yarn

**2. Fibre Migration:** Ideal migration, Parameters affecting migration, characterization of migration behaviour, mechanism of migration in single and plied structure.

**Module-II (14 Hours)**

**3. Structural Mechanics:** Analysis of tensile behaviour of continuous filament. Small extension theory without and with considering lateral contraction, prediction of breakage, nature of rupture for continuous filament yarn, extension and breakage of spun yarn: traditional view and approach by Hearle and E1-Sheikh.

4. Study of the blended yarn structure, Hamburgers Theory. Structure- property relationship of ring, rotor, air-jet, friction spun yarn.

**Module-III (12 Hours)**

**5. Fabric Geometry:** Engineering approach to the analysis of fabric, Pierce geometrical model relationship between  $h$ ,  $p$  and  $c$ , Crimp interchange, Jammed Structure, concept of similar cloth. Maximum possible cover factor, Race track geometry, close limit of weaving, concept of pierce elastic thread model, Geometry of plain knitted fabric.

**6. Fabric Properties:** An elementary idea about tensile, bending, shear and drape behaviour of fabric. An elementary idea about fabric objective measurement

**Books Recommended**

1. Hearle J W S, Grosberg P and Backer S, "*Structural Mechanics of Fibres Yarns and Fabrics*", Wiley Interscience, New York (1969).
2. Goswami B C, Martindale J G and Scardino F, "*Textured yarn technology, structure and applications*", Wiley Interscience Publisher, New York (1995).
3. Peirce F T and Womersley J R, "*Cloth Geometry*", reprint, The Textile Institute, Manchester (1978).
4. Hearle J W S, Thwaites J J and Amirbayat, "*Mechanics of Flexible Fibre Assemblies*", Sijthff and Noordhoff International Publishers BV, Alphen aan den Rijn, Netherlands (1980).
5. "*Textile Research Journal*", Princeton, USA and "*Journal of Textile Institute*", Manchester, UK



## **Module-I (14 Hours)**

### **1. Drives and Power Transmission:**

Belt Drives (mathematical representation of open and cross drives), Concept of Flat and V pulley, timing belt drive. Chain & sprocket drive, Gear Drives- study of gears, type of gears in spinning preparatory machines, Ring frame, looms etc., worm and worm wheels in looms and ring frames, Bevel gears in carding, speed frames etc., epicyclic and differential gearing in comber and speed frames, rack & pinion, movement of bobbin drive in speed frame, idea of double hook joint, planetary mechanism in coiling. Screw traversing mechanism.

### **2. Intermittent Rotary motion:**

Ratchet and pawl mechanism, Let off and Take up motion in weaving machines, Geneva wheel, special oscillatory mechanism, detaching roller drive in combing

### **3. Cams:**

Introduction, types of cams, types of follower, follower displacement programming, motions of the follower, cams with specified contours- tappets, winding cams, ring frame builder cams, picking cam, knitting cam, etc.

### **4. Clutches & Brake:**

Clutches- Jaw/toothed clutches, friction clutches, cone clutches. Brakes-Mechanical brakes, Block brake with short shoe, Pivotal double block brake, Internal expanding brake, Band brake.

## **Module-II (14 Hours)**

**5. Linkage Mechanisms:** Link, kinematic pair, degrees of freedom, kinematic chain, linkage mechanism and structure, Classification of mechanisms, Velocity & acceleration diagrams of four and six bar linkage mechanisms, Relative velocity and instantaneous method. Applications of different mechanism for the sley driving.

**6. Control mechanisms:** Introduction- elements of control mechanism- open loop and closed loop systems, the detecting elements - detection of broken yarns and slivers, pick finding devices on loom, control of yarn and cloth tension, stretch control in sizing, control of temperature and liquor ratio in textile processing.

**7. Friction and lubrication:** introduction, the nature of friction, lubrication by means of chemical films, lubrication by thick films of fluid, the use rolling instead of sliding contact, journal and roller bearing - classification of bearings used in textile machines, special lubrication techniques in textile machines, friction in textile materials, friction clutches and brakes in textile machines, friction drives, cone drum drives in speed frame, indirect loom beam drive, friction tensioner in winding etc.

## **Module-III (12 Hours)**

**8. Balancing of Machine parts:** Basic concepts with reference to balancing of card cylinder, bobbin rail of speed frame, flyer balancing, ring rail & spindle in ring frame, rotor, crank shaft balancing etc.

**9. Vibration:** Basic concepts, vibration in looms, ring frame, speed frame etc.

### **10. Static and Dynamic force analysis:**

Introduction, basic concepts, static equilibrium; concept of dynamic analysis, D'Alembert's principle, dynamic analysis of crank sley mechanism, turning moment of ring frame main shaft, crank shaft of loom etc., fly wheels on looms etc., moment of inertia, centripetal and centrifugal forces, Mathematical concept of balloon formation in ring frame and winding, Forces acting on yarn in ring frame, roller movement and loading in drafting, motion of winding traverse, motion of beams and drums, Mathematical analysis of beat-up mechanism. Dynamics of shedding, dynamics of Torsion bar picking mechanism.

### **Books Recommended**

1. Mechanics for Textile Students –W.A.Hantoon, Textile Institute, Butterworth,1960.
2. Textile Mechanics Vol. I & II – K. Slater, Textile Institute, Manchester, 1977
3. Textile Mechanics – W.M.Taggart
4. An Introduction to Textile Mechanisms – P. Grosberg, Ernest Benn Ltd., London,1968
5. Textile Mathematics, Vol-I, II & III - J.E.Booth, Textile Institute, Butterworth
6. Mechanics of Spinning Machines-R.S.Rengaswamy, NCUTE Publication

# PETX THEORY AND DESIGN OF TEXTILE MACHINES (3-0-0)

## Module-I (12 Hours)

1. Design of various opener and cleaning and their position in a modern Blow room line, Analysis of piano feed regulating motion. Theories of carding and transfer mechanism of fibres – design aspects and factors for cylinder load and transfer efficiency, Improvement in technology of carding for increased production and improved quality of sliver, high speed carding: designs of carding machines for improved performances. Theories of drafting- Design features of high drafting system and roller weighting in draw frame, speed frame and ring frame. Recent developments in design of drawing, lap preparation, combing processes, speed frames, basic principle of design of autolevellers. Differential motion used in speed frames, Designing of cone drums for speed frame.

## Module-II (14 Hours)

2. Design changes in drafting zone of ring frame for compact spinning system, Theory of ballooning in ring spinning, Forces acting and yarn tension in ring spinning, Development in design of spindle, ring and traveller, Design of cam and building mechanism in modern ring frame, drives on modern ring frames.

Design of opening roller, naval and rotor in rotor spinning system  
Design features of TFO twister and its advantages over ring twister.

3. Mechanics of winding and tension variation in winding. Winding parameters, uniform build of conical packages. Design and operation of modern winding machine, design of grooved drum for various packages, package density analysis of yarn tension, Different yarn clearing systems. Patterning, modern anti-patterning process

## Module-III (14 Hours)

3. Design of Beam warping drive for high speed warping machine, Design of sectional warping drum, Cone angle and traverse in sectional warping, Principle of latest automatic control in sizing machine, Stretch control in sizing, Design of modern sow box, squeezing, drying.

4. Kinematics of sley and heald motion, Shed depth and interference factor, Shedding cam design, Mechanism of picking, Shuttle retardation and its importance, Causes of pick variation, Cloth fell equation, Bumping condition.

### Books recommended

1. Chattopadhyay R, "*Advances in Technology of Yarn Production*", 1<sup>st</sup> Ed, NCUTE, IIT Delhi (2002).
2. Mechanics of Spinning Machines-R.S.Rengaswamy, NCUTE Publication
3. "*Winding*", BTRA Monograph series, The Bombay Textile Research Association, Bombay (1981).
4. "*Warping and Sizing*", BTRA Monograph Series, The Bombay Textile Research Association, Bombay (1981).
5. Marks R and Robinson A T C, "*Principle of Weaving*", The Textile Institute, Manchester (1986).
6. Mechanics for Textile Students –W.A.Hantoon, Textile Institute, Butterworth, 1960.
7. Textile Mechanics Vol. I & II – K. Slater, Textile Institute, Manchester, 1977.
8. An Introduction to Textile Mechanisms – P. Grosberg, Ernest Benn Ltd., London, 1968
9. Textile Mathematics, Vol-I,II&III - J.E.Booth, Textile Institute, Butterworth

# PETX      **PROCESS CONTROL IN YARN AND FABRIC MANUFACTURE (3-0-0)**

## **Module-I (12 Hours)**

- 1. System of process control in spinning:** Role and scope, establishing norms or standards, collection and interpretation of data and corrective actions.
- 2. Mixing quality and Cost:** Control of mixing quality through fibre characteristics, control of mixing cost and quality, LP approach for cotton mixing. Applications of AFIS and HVI
- 3. Productivity and waste control in spinning:** Assessing the performance of a Blowroom and card with reference to the cleaning efficiency, control of waste, neps and fibre rupture. Importance of lap preparation, and the technological considerations involved in combing process, evaluation of comber performance by the optimum waste level, fractionating and combing efficiency. Influence of the various factors on combing performance.
- 4. Measurement and analysis of productivity,** means to improve it by control of the end breaks in spinning. Controlling end breakage rate- causes and remedies, Controlling of soft waste and hard waste generation. Yarn realization – Importance, estimation of yarn realization, norms for yarn realization

## **Module-II(14 Hours)**

- 5. Control of yarn quality:** Control of count at various stages during yarn manufacture, Improving Sliver Evenness in Draw Frame, Improving Roving Evenness. Computation of within bobbin and between bobbins lea count variations, strength, unevenness and imperfections of yarn. Causes and remedies of yarn faults and package defects, assessment of yarn appearance, standard process and quality parameters for different counts, on line and off line monitoring systems
- 6. Process Control in Winding:** Control of quality of knot, characteristics of good splice-appearance and strength rating, yarn faults classification by Classimat, yarn clearer setting adjustment and removal of yarn faults, package defects, performance in winding, control of productivity, calculation of expected efficiency of an Autoconer. Control of Tension level, Relative humidity and temperature,
- 7. Process Control in warping:** Control of end breaks, tension levels, quality and the productivity in warping.
- 8. Process Control in Pirn Winding:** Minimising End breaks, stoppages due to mechanical failure, Improving build of pirn, control of speed and efficiency.

## **Module-III (14 Hours)**

- 9. Process Control in Sizing :** Choice of size recipe and preparation, control of size pick-up, control of yarn stretch in different zones and measurement of stretch in sizing, Control of moisture in sized yarns, quality of sized beam, Improvement of weavability of sized yarns, expected efficiency in sizing, Direct control of size losses.
- 10, Process Control in Drawing-in and Tying:** Care in use and selection of healds and reeds; Drop Pins, Care in Drawing-in and Warp tying.
- 11. Control of Productivity in Loom Shed:** Control of Loom Speed, efficiency and stoppages, quality of yarn. Calculations on loom efficiency, expected loom efficiency of Automatic Looms,
- 12. Control of Hard Waste and Consumption of Accessories:** Control of waste in winding, warping, sizing and drawing-in, pirn winding and loom shed. Selection and care of accessories
- 13. Fabrics Quality in Weaving:** Control of fabric defects and quality in weaving, grey fabric inspection.

## **Books Recommended**

1. Process control in Spinning by A R Garde, T A Subramanian, ATIRA Publication.
2. Monograph series in spinning, BTRA Publication
3. Quality Control in spinning, Ratanam T V SITRA Publication
4. End breaks in Ring Spinning, ATIRA Publication.
5. Process control in weaving by M C Paliwal and P D Kimothi, ATIRA Publication.
6. Process control in spinning, Salhotra K R, Chattopadhyay R and Ishtiaque S M, IIT, Delhi, CD cell (2001)

# PETX      **PROCESS CONTROL IN TEXTILE CHEMICAL PROCESSING (3-0-0)**

## **Module-I (14 Hours)**

**1. Introduction:** Definition of process control and Quality control. Need for quality control in textile chemical processing – Flowcharts indicating process control and quality control tests to be carried out in Desizing, Scouring, Bleaching, Souring, Mercerizing, Dyeing, Printing and Finishing.

**2. Analysis of Desizing and Scouring:** Inspection of grey fabric. Identification and estimation of residual starch, determination of weight loss during desizing and scouring, estimation of residual wax content by Soxhlet extraction method, estimation of copper number, determination of cupprammonium fluidity, determination of acid groups by Methylene blue absorption method.

**3. Analysis of Bleaching and Mercerizing:** Absorbency tests by Drop test method and Wicks method, determination of ash content, determination of whiteness and whiteness retention, determination of caustic soda concentration and silica in peroxide bleach bath, determination of Barium Activity Number, determination of fabric shrinkage, lustre number and deconvolution count.

## **Module-II (14 Hours)**

**4. Analysis of Dyeing and Printing:** Determination of concentration of caustic soda and sodium hydrosulphite in vat dye liquor, testing of suitability of thickener in print paste formulation, analysis of print paste formulation.

**5. Fastness Testing:** Methods of determination of fastness to washing, light, perspiration, rubbing, hot pressing, dry cleaning, sublimation and bleaching-norms and standards.

## **Module-III (12 Hours)**

**6. Analysis of Finishing:** Determination of efficiency of water proofing, flame proofing, starching & resin finishing. Estimation of residual formaldehyde present in resin finished fabric, optical brightener test for uniformity of cross-linking in resin finished fabric, Assessment of degree of heat setting in polyester by Iodine absorption method.

**7. Computer Colour Matching:** Concept of Computer Colour Matching (CCM), working principle of CCM, advantages and limitations of CCM, applications of CCM.

**8. Quality Control and Productivity:** Quality control and productivity in Bleaching, dyeing, printing and finishing, control of damages in chemical processing.

## **Books Recommended:**

1. Vaidya.A.A, and Trivedi.S.S "Textile Auxiliaries and Finishing Chemicals", ATIRA, Ahmedabad, 1985
2. Shenai.V.A., "Evaluation of Textile Chemicals" Sevak Pub., Bombay, 1980.
3. "ISI Handbook of Textile Testing", Indian Standards Institution, New Delhi, 1982
4. Volz.H.Z, "Industrial Colour Testing – Fundamentals and Techniques", VCH, 1994
5. Vaidya.A.A and Datya.K.V, " Chemical Processing of Synthetic fibres and blends", John Wiley and Sons, New York, 1984.
6. Slater.K., "Chemical Testing and Analysis", Textile Progress Vol.25 No.1/2 , Textile Institute, 1994.
7. Doshi.S.M and Shah.H.A, " Quality and Process Control", Chemical Processing Tablet IX, The Textile Association, Bombay, 1984

**Module – I (16 Hours)**

1. Long Staple Spinning:

Principle ,working and process parameters of spinning system for long staple fibres and their blends -such as woollen , worsted, spun silk , flax and jute spinning system.

**Module – II (14Hours)**

2. Study of the spinning of man- made staple fibres. Spinning of dyed fibres, Spinning of micro fibres

3. Tow to sliver formation and bulked Acrylic yarn production.

4. Production of Fancy yarn – Methods of producing slub yarn- Drawn-and-spun yarn, Methods of producing fancy yarns on conventional Ring doubler .

Methods of producing fancy yarn on specialized folding machine - Knop yarn, Snarl yarn, Loop yarn, Spiral yarn etc. Methods of producing mélange yarn.

**Module-III (10 Hours)**

5. Principle and mechanism of yarn formation by Siro Spinning system -.

6 Principle and mechanism of formation of core-spun yarn on various spinning system

7. Principle and mechanism of yarn formation by some unconventional spinning system:

- Self-twisted yarn- concept of Repco spinning
- Twist less yarn- concept of Twilo and Bobtex process,
- Wrap-spun yarn- concept of wrap spinning
- Concept of electrostatic spinning.

**Books Recommended:**

1. Spun Yarn Technology – ERIC OXTOBY
2. Textile Yarn- Goswami., Martindle, Scardino
3. New Spinning Technology,W. Klien ,
4. Spinning of Manmades and blends on cotton system -Salhotra K R, 2<sup>nd</sup> Ed; The textile Association, India (1989).
5. Fundamentals of Spun Yarn Technology- Lawrence C A, 1<sup>st</sup> Ed; CRC Press LLC, Florida, USA (2003)
6. Advance in Technology of yarn Production -Chattopadhyay R, 1<sup>st</sup> Ed; Nodal Centre for Upgradation of Textile Education, IIT, Delhi (2002).
7. Jute fibre to Yarn- Atkinson R R, 1<sup>st</sup> Amercian Edition; Chemical Publishing Co., INC., New York (1965).
8. Advances in Wool Technology, Jhonson, Woodhead Publication.
9. Woollen Yarn Manufacture,Richards, Woodhead Publication

## PETX      DEVELOPMENTS IN FABRIC MANUFACTURE (3-0-0)

### Module- I (12 Hours)

#### 1. Development in Weaving Preparatory Processes:

Winding-Modern Developments in winding machine, Concept of Gain and its control with calculation. Development in warping machines, modern developments and new trends in sizing, Stretch of warp and its control in Sizing. Preparation of yarn for shuttleless weaving

2. **Unconventional Weaving:** Modern Developments in Projectile, Rrapier, Air jet, and Water jet machines, measurement and control of tension variation on Unconventional weaving m/c.

### Module-II (13 Hours)

3. **Production of Terry/Pile Fabrics:** Essential features and production techniques of terry/pile fabrics in weaving, knitting and nonwoven machines.

4. **Developments in Knitting:** Development in weft and warp knitting, New structures, mechanics of knitting, production of shaped garments/panels in knitting

5. **Developments in Nonwoven:** Developments in web formation, bonding of web and structures in nonwoven fabrics

### Module-III (15 Hours)

6. **3D Fabrics:** Concept of manufacturing 3D fabrics using different techniques of fabric formation and their uses.

7. **Textile Composites:** Introduction to textile composites - definition, classification and applications of composite materials. Manufacturing techniques details of textile composites.

#### 8. Complex Textiles:

Gauge and leno structure with their production techniques.

Type of Carpets, production of hand knotted carpets and machine made carpets (Brussels, Wilton, Tufted and Face to Face Carpets), Unconventional methods of making carpets – thermal bonding, stitch bonding, flocking and knitting

Narrow fabrics: Weaving machines for narrow fabrics. Ribbon, tapes & webbings manufacturing techniques

#### Books Recommended:

1. Marks R and Robinsons A T C, "*Principles of weaving*", Textile Institute, UK (1986).
2. Lord P R and Mohamad M H, "*Weaving: Conversion of Yarn to Fabric*", Merrow Technical Library, UK (1988).
3. Ormerod A, "*Modern preparations and weaving machinery*", Butterworth and co., UK (1983).
4. Talavasek O and Svaty V, "*Shuttleless weaving machine*", Elsevier Scientific Publishing Co., Amsterdam (1981).
5. Lunenschloss J and Albrecht W, "*Non-Woven Bonded Fabric*", Ellis and Horwood Ltd., UK (1985)
6. Talukdar, Sriramulu & Ajgaonkar – 'Weaving Machines, Mechanisms & Management', Mahajan Publ., Ahmedabad-380015

## PETX DEVELOPMENT IN MAN-MADE FIBRE (3-0-0)

### Module-I (10 Hours)

**1. Cellulosic fibres:** New cellulosic fibre derivatives and their production systems, new environmental friendly and cost saving developments.

**2. Synthetic fibres :** Development of properties/structure like antistatic, hydrophilic, hollow, multi-lobal cross-section, micro voids, microgrooves, low pilling, flame retardant, carrier free dye able, cationic dye able, silk like appearance in synthetic fibres (polyester, nylon, acrylic, poly-propylene etc).

### Module-II (15 Hours)

#### 3. High performance fibres:

Production process outline and properties of elastomeric fibres (lycra)

Production process outline and properties of high performance fibres like Kevlar & Nomex (aramid), spectrum and dynema (HDPE), aromatic polyesters etc.

Production process outline, properties and applications of carbon fibres

Production process outline, properties and applications of Glass, ceramic, metallic, silicon carbide and other fibres

### Module-III (15 Hours)

4. Introduction to health fibres like Polylactic acid (PLA), Hydrogel fibre etc.

5. Production process outline, characteristics and applications of micro-denier fibres and Nano fibres.

6. Introduction to specialty fibres for using in technical textiles like Geo-tech, sport- tech, mobil- tech. etc,

#### Books Recommended:

1. New Fibres by Hongu and Phillips,
2. Polymers for Engineering Applications by R. B. Seymour,
3. High technology Fibres: Handbook of Fibre Science and Technology, Vol. III, Ed. by Lewin and Preston.

# ARTIFICIAL INTELLIGENCE

## Module 1

12Hrs

What is Artificial Intelligence? AI Technique, Level of the Model, Problem Spaces, and Search: Defining the Problem as a State Space Search, Production Systems, Problem Characteristics, Production System Characteristics, Issues in the Design of Search Programs. Heuristic Search Techniques: Generate-and-Test, Hill Climbing, Best-first Search, Problem Reduction, Constraint Satisfaction, Means-ends Analysis, **Knowledge Representation**: Representations and Mappings, Approaches to Knowledge Representation, **Using Predicate Logic**: Representing Simple Facts in Logic, Representing Instance and ISA Relationships, Computable Functions and Predicates, Resolution, Natural Deduction. **Using Rules**: Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning, Matching, Control Knowledge. **Symbolic Reasoning Under Uncertainty**: Introduction to Nonmonotonic Reasoning, Logics for Nonmonotonic Reasoning, Implementation Issues, Augmenting a Problem-solver, Depth-first Search, Breadth-first Search. **Weak and Strong Slot-and-Filler Structures**: Semantic Nets, Frames, Conceptual Dependency Scripts, CYC.

## Module 2

10Hrs

**Game Playing**: The Minimax Search Procedure, Adding Alpha-beta Cutoffs, Iterative Deepening. **Planning**: The Blocks World, Components of a Planning System, Goal Stack Planning, Nonlinear Planning Using Constraint Posting, Hierarchical Planning Other Planning Techniques. **Understanding**: What is Understanding, What Makes Understanding Hard?, Understanding as Constraint Satisfaction. **Natural Language Processing**: Introduction, Syntactic Processing, Semantic Analysis, Discourse and Pragmatic Processing, Statistical Natural Language Processing, Spell Checking.

## Module 3

8Hrs

**Learning**: Rote Learning, Learning by Taking Advice, Learning in Problem-solving, Learning from Examples: Induction, Explanation-based Learning, Discovery, Analogy, Formal Learning Theory, Neural Net Learning and Genetic Learning. **Expert Systems**: Representing and Using Domain Knowledge, Expert System Shells, Explanation, Knowledge Acquisition.

### Text Book:

1. Elaine Rich, Kevin Knight, & Shivashankar B Nair, Artificial Intelligence, McGraw Hill, 3rd ed., 2009

### References:

- 1) Introduction to Artificial Intelligence & Expert Systems, Dan W Patterson, PHI., 2010
- 2) S Kaushik, Artificial Intelligence, Cengage Learning, 1st ed. 2011



**PCFT APPAREL MARKETING, RETAILING AND  
MERCHANDISING (3-0-0)**

**Module-1**

**(12hours)**

Introduction to apparel marketing, objectives of marketing. Scope & potential of apparel product in domestic & International market, exploration of fashion industry , concept of fashion forecasting.

Present scenario of apparel industry in India – challenges & prospects of these industries.

Instruments of trade policy

**Module – II**

**(15 hours)**

Introduction to retailing. Types of retailers, Types of retail ownership, elements of retail mix, types of retail locations, Benefits of retailing, Role of a retail merchandiser and buyer. Merchandise planning, Retail pricing and repricing, Retail pricing polies/ strategies (Market Skimming, Market Penetration, Price bundling, Leader pricing, Everyday low pricing, Odd pricing, etc.) Retail Store Design & Visual merchandising. Promotion of fashion.

**Module-III**

**(13 hours)**

International marketing environment, identifying foreign apparel markets, International marketing mix- PLC model, pricing decision, channels of distribution.

Export procedure & documentation, export assistance- various scheme, sources of information, role of export promotion counseling, INCO terms, terms of payment, export finance.

Working of export houses, categories – star trading export house & buying houses. Concept of Out sourcing

**Reference Books:**

1. International marketing management – Vasshney & Bhattachary
2. Nabhi's Publication on export- Govt. Handbook
3. International marketing – Cateora
4. Retail Management Text & Cases 2<sup>nd</sup> Edition (Tata McGraw-Hill)- Swapna Pradhan,

# **BIOREACTOR DESIGN AND ANALYSIS (3-0-0)**

## **Module- I: Principles and concepts**

Recapitulation of the principles of Kinetics for chemical and Bio-chemical Reactions. Fundamentals of homogeneous reactions for batch / semi-batch, plug flow reactor (PFR), continuous stirred tank reactors (CSTR), fluidized bed reactor bubble column, air lift fermenter etc, stirred tank/mixed reactors., adiabatic and programmed reactors. Unconventional bioreactors: Hollow fiber reactor, membrane reactor, perfusion reactor for animal and plant cell culture.

## **Module- II: Bioreactor Analysis**

Analysis of ideal bioreactors: Fed-Batch reactors, Enzyme catalyzed reactions in CSTRs, CSTR reactors with Recycle and Wall growth, Ideal Plug- Flow Tubular reactor. Analysis of Non-ideal Reactor Analysis: Concept of ideal and non-ideal reactor; residence time distribution; models of non-ideal reactors – plug flow reactor for microbial processes; Mass transfer in biochemical processes; Multiphase bioreactors – packed bed with immobilized enzymes or microbial cells; three – phase fluidized bed trickling bed reactor; Design and analysis of the above reactor systems; Gas liquid reactors, Reactor stability.

## **Module- III: Bioreactor Design**

Design considerations: oxygen transfer, heat transfer, rheology, mixing. Scale up and scale down concepts. Bioprocess control and computer coupled bioreactors; Growth and product formation by recombinant cells. Mechanical fittings in a bioreactor: vessel, agitation system materials, welds, finish, valves, piping and valves for biotechnology, special requirements of utilities and cleaning of production plants. Instrumentation and control of bioprocesses: Physical and chemical sensors, online sensors for cell properties, off-line analytical methods; Biosensors. Bioreactor design calculation.

## **Text Books**

1. Levenspiel, O., Chemical Reaction Engineering, Wiley Eastern Ltd.
2. Bailey & Olis, Biochemical Engg. Fundamentals, MGH., 1990
3. Atkinson, B., Biological Reactors, pion Ltd., London, 1974.
4. Coulson, Richardson, Sinnott, An introduction to chemical engineering design, Pergamon Press. Lydersen, D'Elia, Nelson, Bioprocess engineering: Systems and equipment.

**PCFT      PROCESS CONTROL IN APPAREL MANUFACTURING  
& QUALITY CONTROL (3-0-0)**

**Module-I**

**(12hours)**

1. Application of process control approach in apparel manufacturing through estimation of labor productivity, m/c productivity, quality and cost control
2. Quality control parameters from raw fabric to finished garment for monitoring Process. -Raw material stage, In process, pattern to finishing, Final:- Assessment of fit while final inspection to be tested against size chart for specific garments.

**Module-II**

**(14hours)**

3. Quality parameters to be checked for finished garment to eliminate rejection- garment checking in 3 zones on basis of specification sheet.
4. Quality parameters in trims- buttons, linings, interlinings, zippers and others
5. Inspection, defects analysis and estimation of value loss both for fabric and Finished garment, classification of on 4-point system, 6-point system, 10-point System, major and minor defects, garments rejection. AQL, AOQL estimation.

**Module-III**

**(14hours)**

6. Evaluation of sewing process to assist process control in apparel manufacturing
  - Evaluation of sewability.
  - Evaluation of thread tension.
  - Evaluation of damage on thread, fabric needle for control of sewing speed, needle heating, thread tension.

Modern Fabric evaluation technique to support product development : KES instrument, FAST instrument and other subjective and objective evaluation methods for assessing product performances. HVI instrument.

7. Knowledge on standard norms for various process and quality parameters. Statistical Quality Control (SQC)- acceptance sampling. Introduction to TQM, ISO, six sigma

**REFERENCE BOOKS:**

1. Basic process and clothing construction: SHERIE DOONGALI
2. Managing productivity in apparel industry: Rajesh Bheda
3. Apparel manufacturing hand book: Jacob Solinger
4. Journals on Apparel Industry/Manufacturing
5. Apparel production: sewn product analysis: Glock and Kunz- Prentice Hall
6. Managing quality in apparel industry- Mehta P V and Bhardwaj ,Blackwell/ Om book service
7. An introduction to quality control for apparel industry- P Mehta

# COMPUTER GRAPHICS

## **Module – I (10 hours)**

Overview of Graphics System: Video Display Units, Raster-Scan and Random Scan Systems, Graphics Input and Output Devices.

Output Primitives: Line drawing Algorithms: DDA and Bresenham's Line Algorithm, Circle drawing Algorithms: Midpoint Circle Algorithm and Bresenham's Circle drawing Algorithm.

Two Dimensional Geometric Transformation: Basic Transformation (Translation, rotation, Scaling) Matrix Representation, Composite Transformations, Reflection, Shear, Transformation between coordinate systems.

Two Dimensional Viewing: Window-to- View port Coordinate Transformation.

## **Module –II (12 hours)**

Line Clipping (Cohen-Sutherland Algorithm) and Polygon Clipping (Sutherland-Hodgeman Algorithm).

Aliasing and Antialiasing, Half toning, Thresholding and Dithering, Scan conversion of Character.

Polygon Filling: Seed Fill Algorithm, Scan line Algorithm.

Two Dimensional Object Representation: Spline Representation, Bezier Curves and B-Spline Curves.

Fractal Geometry: Fractal Classification and Fractal Dimension.

Three Dimensional Geometric and Modeling Transformations: Translation Rotation, Scaling, Reflections, shear, Composite Transformation.

Projections: Parallel Projection and Perspective Projection.

## **Module –III (8 hours)**

Visible Surface Detection Methods: Back-face Detection, Depth Buffer, A- Buffer, Scan-line Algorithm and Painters Algorithm.

Illumination Models: Basic Models, Displaying Light Intensities.

Surface Rendering Methods: Polygon Rendering Methods: Gouraud Shading and Phong Shading.

Computer Animation: Types of Animation, Key frame Vs. Procedural Animation, methods of controlling Animation, Morphing.

Virtual Reality: Types of Virtual reality systems, Input and Output Virtual Reality devices.

### **Textbook**

1. Computer Graphics with Virtual Reality System, Rajesh K.Maurya, Wiley-Dreamtech.
2. Computer Graphics, D. Hearn and M.P. Baker (C Version), Pearson Education

### **Reference Books**

1. Computer Graphics Principle and Practice , J.D. Foley, A.Dam, S.K. Feiner, Addison, Wesley
2. Procedural Elements of Computer Graphics- David Rogers (TMH)
3. Computer Graphics: Algorithms and Implementations – D.P Mukherjee & Debasish Jana (PHI)
4. Introduction to Computer Graphics & Multimedia – Anirban Mukhopadhyay & Arup Chattopadhyay (Vikas)

## **PCTX            INDUSTRIAL INTERNSHIP SEMINAR**

Students will present seminar on one month Industrial Internship, they use to undergo in summer vacation after 6<sup>th</sup> Semester Examination. Seminar topics will cover the following information to be learned during the industrial training.

1. Orientation of the mill, name and address, area and site details of the mill, product range of the mill, rules and regulations of the mill
2. Organizational setup, category wise number of workers, number of supervisory staff and general staff, yearly turnover.
3. Manufacturing process followed by the mill, significance of the plant layout with respect to the manufacturing process, technical details of the manufacturing department, maintenance management.
4. Technical project work taken if any

## **PCTX            MINOR PROJECT**

In this semester, students are required to define the problem, to review scientific literatures, identify possible solutions, select the best solution, develop an action plan, submit a written report and present the initial progress of the work in a seminar for assessment as per university norms.

**ENVIRONMENTAL ENGINEERING (3-0-0)**

**Objective:** This course introduces the students to the environmental consequences of Industries, development actions etc. and the methods of minimizing their impact through technology and legal systems.

**Module – I**

Ecological Concepts and Natural Resources: Ecological perspective and value of environment. Environmental auditing, Biotic components, Ecosystem Process: Energy, Food Chain, Water cycle, Oxygen cycle, Nitrogen cycle etc., Environmental gradients, Tolerance levels of environment factor, EU, US and Indian Environmental Law, Global Perspective.

Chemistry in Environmental Engineering: Atmospheric chemistry, Soil chemistry, Material balances and Reactor configurations.

**Module – II**

Water Pollution: water quality standards and parameters, Assessment of water quality, Aquatic pollution, Estuarine water quality, Marine pollution, Organic content parameters, Ground water Contamination, Water table and Aquifer, Ground water recharge. Water quality parameter and standards.

Water Treatment: Water treatment processes, Pre-treatment of water, Conventional process, Advanced water treatment process.

Waste Water Treatment: DO and BOD of Waste water treatment process, pretreatment, primary and secondary treatment of waste water, Activated sludge treatment: Anaerobic digestion and its microbiology, Reactor configurations and methane production. Application of anaerobic digestion.

Air Pollution : Air pollution and pollutants, criteria pollutants, Acid deposition, Global climate change –green house gases, non-criteria pollutants, emission standard form industrial sources, air pollution meteorology, Atmospheric dispersion.

Industrial Air Emission Control:

Characterization of air stream, Equipment selection, Equipment design, Special Methods: Flue gas desulphurization, NO<sub>x</sub> removal, Fugitive emissions.

**Module – III**

Solid Waste Management Source classification and composition of MSW: properties and separation, storage and transportation, MSW Management, Waste minimization of MSW, Reuse and recycling,

Hazardous Waste Management, Hazardous waste and their generation, Transportation and treatment of hazardous waste: Incinerators, Inorganic waste treatment, handling of treatment plant residue. Waste minimization techniques.

Noise Pollution: Physical Properties of sound, Noise criteria, Noise Standards, Noise measurement, Noise control.

Environment impact Assessment, Origin and procedure of EIA, Project Screening for EIA, Scope studies, Preparation and review of EIS.

**Text Book**

1. Environmental Engineering Irwin/ McGraw Hill International Edition, 1997, G. Kiely,
2. Environmental Engineering & Safety by Prof B.K. Mohapatra, Seven Seas Publication, Cuttack

**Reference Books**

1. Environmental Engineering by Arcadio P. Sincero & Gergoria A.Sincero PHI Publication
2. Principles of Environmental Engineering and Science, M. L. Davis and S. J. Masen, McGraw Hill International Edition, 2004
3. Environmental Science, Curringham & Saigo, TMH,
4. Man and Environment by Dash & Mishra
5. An Introduction to Environmental Engineering and Science by Gilbert M. Masters & Wendell P. Ela - PHI Publication.

# PETX TEXTILE MILL PLANNING & ORGANISATION (3-0-0)

## Module-I (15 Hours)

- 1. Location and Layout Planning :** Plant location and site selection, Factors affecting location, Plant layout, Different types of layouts, Principles of machinery lay-outs and different flow plans of material for spinning , weaving and process house. Calculation for balancing of different machines in a Textile mill
- 2. Plant services:** Ventilation and lighting plan. Humidification systems used in Textile Mills, Developments in humidification systems, Utilization of steam and power, Power consumption - Energy consumption in textile machines, Measures to reduce power consumption.
- 3. Material handling:** Importance of material handling, Methods and equipment employed- classification of material handling equipments, control of wastes.
- 4. Store Routine –** Function of stores, procedure for material procurement, effective stores management, ABC analysis, basic inventory control; stock evaluation.

## Module-II (15 Hours)

**5. Human Resource Management:** Organizational structure, patterns, communication. Selection, recruitment and training, Different categories of labour required in various section of spinning, weaving and processing departments, work load, work assignment, Calculation for work assignment, Idea of productivity calculations of spinning / weaving mill and factors affecting productivity.

Labour laws, labour welfare activities, methods of wage remuneration, wage determination process, job evaluation, payments by results, motivation, financial & non-financial incentives, disciplinary action – warning, showcause notice, suspension and dismissals, retrenchment & VRS

**6. Maintenance Management:** Maintenance systems - types of maintenance practices and concepts, planned & unplanned maintenance, corrective & design maintenance, routine and preventive maintenance, Work Study in maintenance and, planning of maintenance work, making schedules, recording of maintenance activities. Accidents and safety engineering, Fire prevention and protection

## Module-III(10 Hours)

**7. Cost Accounting and Control :** Introduction, costing - its importance & use, Elements of cost -Cost classification - Total cost analysis, Costing the products, Control and accounting of materials, labour and overhead.

**8. Financial Management:** Preparation of Balance sheet - Capital and running cost - profit and loss account, Break even analysis. Financial ratios - their analysis and interpretation

## Books Recommended

1. Dudeja V D, "*Management of Textile Industry*", Textile Trade Press, Ahmedabad (1981).
2. Ormerod A, "*Textile Project Management*", The Textile Institute, Manchester UK (1992).
3. Talukdar M K, Sriramulu P K and Ajgaokar D B, "*Weaving – Machine, Mechanism and Management*", Mahajan Publisher Private Ltd., Ahmedabad, India (1998).
4. Garde A R and Subramanian T A, "*Process Control in Spinning*", 3<sup>rd</sup> Ed., ATIRA Ahmedabad, (1987).
5. Higgins, "*Handbook of Maintenance Management*", Prentice Hall New York (1999).

## PETX **ENTREPRENEURSHIP IN TEXTILE (3-0-0)**

### **Module-I (10 Hours)**

1. **Entrepreneurship:** Definition and significance of entrepreneurship. Entrepreneur: Their Characteristics, Role of an entrepreneur in Industrial development - innovations – Risk taking, Management of Business-Training & Development-Entrepreneur Development programme-Schemes etc.

2. **Basic Knowledge of Business Organisation:** Form of Business Organization – Types - Sole traders, partnership, Joint Hindu family, company, co-operatives. Meaning and definition of SSI, ancillary industry, importance of SSI, government policies for SSI, Basic criteria for final selection of a business opportunity, Amount of investment, Nature of technology. Input requirement for setting up SSI, Institutional support to SSI at State & National level. Organization and management of SSI

### **Module-II (15 Hours)**

3. **Project Formulation** (special reference to textile ): Identification of Business opportunities- Project ideas & Identification through Trade Fair, Exhibition, Selection of products - basis for selection, sources of information about products, Product design and development, market survey, identifying market tastes and requirement of prospective buyers.

4. **Mobilisation of Resources** : Materials, human resources, machines and methods, selection of equipment and other infrastructure; plant location-factors for selection of site, vicinity of production and marketing; location and layout of plant to suit local requirements. Finance – Self financing- loan from financing Institutions& Banks. Incentives & subsidies

### **Module-III (15 Hours)**

5. **Financial Management:** Importance of financial management in context to small scale industry. Budgeting, investment for capital equipment, working capital, costing and other related economic aspects

6. **Preparation of Project Report:** Preparation of project report in accordance with guidelines laid down by government and controlling institutions regarding environment aspects, feasibility reports, production feasibility, quality feasibility, market feasibility and economic feasibility.

7. **Marketing Product:** Creating the Marketing Plan, Pricing for Profit, Creative Advertising and Promotion.

### **Books Recommended:**

1. Entrepreneurial Development, P. Saravanel
2. Business Organisation- Bhusan Y.K
3. Principle of Economics – M.C.Seth
4. Organisation and Management of Small Scale Industries-Vasanth Desai.
5. Developing New Entrepreneurs; Entrepreneurs Development Institute of India, Ahmedabad.
8. Starting and Managing the Small Business; Arthur M. Kuriloff, John M.Hemphill, Jr., and Dougless Cloud; McGraw Hill, 1993



**Module-I (10 Hours)**

1. **Apparel Industry:** Introduction to Apparel industry - Different garment manufacturing sectors and their production flow chart.
2. **Selection of Fabrics:** Various fabrics for apparel use, their characteristics and applications to suit to different purposes, criteria for selection of fabrics. Determination of quality requirements of the fabrics including comfort, handle and tailorability
3. **Product Design:** Factors to be considered, different techniques.
4. **Garment Size and Fit:** Scientific basis of garment sizing and size charts, assessment of garment fit and different fitting scales

**Module-II (18 Hours)**

4. **Pattern Making:** Introduction to pattern making, Drafting, Basic bodies blocks, Methods of making basic pattern, grading of pattern, pattern marker.
5. **Spreading and Lay Planning:** Introduction to symmetrical and asymmetrical fabrics, criteria of spreading, methods of spreading, spreading m/cs. Principles of lay plan, types of lay plan.
6. **Cutting:** Introduction to cutting room processes, cutting tools and methods and their merit & demerits. Bundling system
7. **Garment Sewing:** Introduction to sewing m/c and sewing room processes. Different types of sewing m/c and their suitability, Sewing needle and its sizes. Stitch formation, types of stitches, seam classification, seam geometry seam strength and slippage, seam puckering. Thread calculation and its consumption
8. **Trimming and accessories:** Definition, types, trimming methodologies and accessories application.

**Module-III(12 Hours)**

9. **Folding and Packaging :** Thread tucking, care and size labeling system, checking, pressing, folding and packing, packing standards for domestic and export markets.
10. **Quality Control in Garment manufacturing:** Control in pattern making, grading, fabric laying, marking, sewing and finishing, control of garment defects.
11. **Computer Application in Garment Manufacturing:** Application in pattern making, grading, lay planning, sewing and finishing, computer aided embroidery designs. Concepts of computer integrated manufacturing (CIM) to the garment industry

**Books Recommended**

1. Carr H and Lantham B, "*The Technology of Clothing Manufacture*", Om Book Service, Delhi.
2. Mehta P V and Bhardwaj S K, "*Managing Quality in apparel industry*", Om Book Service, New Delhi
3. Aldrich W, "*Metric Pattern Cutting*", OM Book Service, New Delhi (1998).
4. Cooklin Gerry, "*Garment Technology for Fashion Designers*", OM Book Service, New Delhi (1997).
5. Eveleyn M and Ucas, "*Clothing Construction*", 2<sup>nd</sup> Ed., Hughton Mifflin Co, Boston (1974).

**Module-I (12 Hours)**

**1. Introduction:** Consideration for finishing, various terms used in finishing, classification of finishing, types of finishing.

**2. Finishing Chemicals:** Stiffening agents, cross-linking agents, resins, softening agents, silicones, polymers, bleaching agents, optical brightening agents.

**3. Finishing Machines:** Padding mangle, calender, sanforizer, Stenter, Raising, Milling, Decatizer, Emerizer

**Module-II(16 Hours)**

**4. Various Functional Finishes:** Water repellent/proof, fire repellent, mildew/moth proof, soil release finish, anti static, miscellaneous finishes.

**5. Special Finishes:** Anti crease, Anti shrinkage, anti-microbial, UV resisting finish, softening, stiffening, raising, embossing, felting, non- felting new finishes, Biopolishing.

**6. Finishing of Garments:** Introduction to garment dyeing and printing - Flock printing, foam printing, transfer printing, wet transfer, film release, sublimation transfer printing - Preparations of logo and motifs for fixing on garments. Durable press finish - resin, wash and wear, acid wash, stone wash, bio-stoning, crinkled effect, softening, chemical and enzyme, denim and blast finishing and controlling factors. Brushing of garments.

**Module-III (12 Hours)**

**7. Spotting and Laundering of Garments:** Identification of stains, characteristics and history, selection of spotting chemicals, factors for spotting, dry cleaning, washing machine equipments and processing conditions, pressing.

**8. Applications of enzymes in Textile Processing and finishing:** Types of enzymes and their uses in retting process of linen fibres, textile processing- biodesizing, bioscouring,biobleaching,wool processing, biostoning, biopolishing, textile after care

**Books Recommended:**

1. Whittall.N.S., "Laundering and dry cleaning", vol.8, Textile Progress, 1996.
2. Goldman.R.F., and LyleD.S "Performance of textiles" John Wiley and sons, New York, 1997
3. Ashelfrd, " Care of Clothes ", National Trust, 1997.
4. "Garment wet processing technical manual", AATCC/SDC, 1994.
5. Pradip V. Mehta, "An Introduction to quality control for the apparel industry", ASQC quality press, New York, 1992.
6. Biotechnology edited by H J Retim and G Reed

# DIGITAL IMAGE PROCESSING

## **Module: 1** (12 hours)

**Introduction:** Digital Image fundamentals: Image sampling and quantization, relationship between pixels, Intensity transformations and spatial filtering, some basic intensity transformation functions, Histogram processing, spatial filters for smoothing and sharpening (Chapt: 2 & 3 of Text book 1)

## **Module: 2** (12 hours)

**Filtering in the Frequency Domain:** preliminary concepts, 2D DFT and its properties, basic filtering in the frequency domain, image smoothing and sharpening (Chapt: 4 of Text book 1)

**Image Restoration and Reconstruction:** Image restoration/degradation model, noise models, restoration in the presence of noise only, estimating the degradation function (Chapt: 5 of Text Book 1)

## **Module: 3** (12 hours)

**Color Image Processing:** color models, Color transformation (Chapt: 6 of Text book 1)

**Wavelets and Multi-resolution Processing:** multiresolution expansions, wavelet transforms in one and two dimension (Chapt: 7 of Text book 1)

**Image Compression:** Fundamentals, Some basic compression methods (Chapt: 8 of Text book 1)

**Morphological Image Processing:** Erosion and Dilation, opening and closing (Chapt: 9 of Text book 1)

### **Text Books:**

1. R.C. Gonzalez, R.E. Woods, *Digital Image Processing*, 3rd Edition, Pearson Education
2. R C Gonzalez, Woods and Eddins, *Digital Image Processing using Matlab*, 2nd Edition, Tata McGraw Hill

### **Reference Books:**

1. S.Sridhar, *Digital Image Processing*, Oxford University Press, 2011

# **PEFT APPAREL PRODUCTION PLANNING , CONTROLLING & SCHEDULING (3-0-0)**

## **Module-I**

**(14 hours)**

1. Introduction to production ,Operations ,Concept of production, Productivity components of production, Different production systems (customized, divisional, batch. Progressive bundle, line, Modular production system, unit production system & mass customization)
2. Definition, Objectives and fuctions of Production planning, control, loading and Scheduling, organization of various departments in apparel industry. Development of MIS for production.
3. Introduction to plant layout- criteria for evaluation, determining minimum space requirement, calculation grid, plant size location, basic production layout

## **Module-II**

**(15 hours)**

4. Work measurement: Uses of work measurement, data, and basic procedure of work measurement.
5. Motion & Time study: Definition & scope of motion & time study, Data for sewing work study & GSD, improvement of production efficiency, principle of work cycle timing, concept of measuring operator efficiency, Quantitative Production analysis, Line balancing. Calculation of SMV and SAM
6. Introduction to supply chain management

## **Module-III**

**(11hours)**

7. Production planning order preparation, material resource planning and Material management  
Co-ordination of activities in a garment manufacturing unit: Layering & marker planning , Cutting room planning, planning of sewing room, in clothing production.
8. Quick response in apparel manufacturing- concept of lean manufacturing, kanban, JIT, ERP

## **Reference Books:**

1. Introduction to clothing production management : A.J. Chutter
2. production management in apparel industry : Rajesh Bheda
3. Plant layout & materials handling- Apple J M- Ronald Press
4. Motion and time study- Barnes Ralph- John Wiley & Sons

## **FEBT MICROBIAL TECHNOLOGY (3-0-0)**

### **Module-I (10 Hours)**

Introduction to Microbial Kingdom- Bacteria, Viruses, Fungi and Yeast; Classical and Modern approaches of microbial taxonomy; Methods of Microbiology- Culture media, Sterilization, Establishment of pure culture, Staining of bacteria (Gram's, Acid Fast, Capsule), Micrometry and Microscopy(Bright Field, Fluorescence, Phase Contrast and Electron).

### **Module-II (15 Hours)**

Microbial Processes and fermentation technology: Introduction to fermentation technology, Microbial growth and product formation kinetics in batch, continuous and feed batch fermentation, Large scale production: submerged, solid and semi-solid fermentation; Microbiological processes for production of antibiotics, enzymes.

### **Module-III (15 Hours)**

Enzyme technology – nature of enzymes, application of enzymes, limitations of microbial cells used as catalysts in fermentation, multi-enzyme reactors, genetic engineering & protein engineering of enzymes, technology of enzyme production, use of immobilized cells and enzymes (Ca-alginate beads, polyacrylamide), industrial applications of immobilized enzymes.

### **Books Recommended:**

1. Text book of Microbiology by Stanier.
2. Microbiology, R.S. Mehrotra, Tata McGraw Hill
3. Microbiology by Pelczar
4. Brock Biology of micro-organisms
5. Microbiology by Presscott.
6. Microbial Genetics- Freifelder
7. Microbiology by Atlas
- 8..Principle of Fermentation Technology , P.F.Stanbury,A. Whitaker & S.J.Hall, Elsevier
9. Industrial Microbiology, Prescott and Dunn,

## **PCTX MAJOR PROJECT**

In this semester, students are required to present a dissertation reporting all the aspects of the research work and defend the reports. The final assessment is to be done through a viva-voce test in presence of external examiner and the quality of report writing as per university norms.

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