# M. Tech. Syllabus

## Department of Textile Technology

**M. Tech. (Textile Technology)**

Curriculum (With effect from academic year 2018-19)

(L-T-P) indicates L-Lecture, T-Tutorial and P-Practical

<table>
<thead>
<tr>
<th>M. Tech. Semester-I</th>
<th>Course Contents Number</th>
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<th>LTP Scheme per Week</th>
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<td>PCC-TT-501</td>
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<td>Smart Textiles</td>
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<td>PEC-TT-505</td>
<td>Fiber Characterization &amp; Mechanical Properties</td>
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<td>High Performance Fibres</td>
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List of Course Contentss for Elective-II - (Any One)

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<td>Textile Project Planning &amp; Implementation</td>
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<tr>
<td>PEC-TT-508</td>
<td>Industrial Engineering &amp; Management</td>
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<td>PEC-TT-509</td>
<td>Industrial Law and Economics</td>
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List of Course Contentss for Elective-III -(Any One)

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<td>Technical Textile - I</td>
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<td>PEC-TT-519</td>
<td>Advanced Textile Wet Processing</td>
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List of Course Contentss for Elective-IV - (Any One)

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<td>Knitting &amp; Nonwoven Technology</td>
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<td>PEC-TT-508</td>
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List of Course Contentss for Open Elective

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<td>AUD-903</td>
<td>Sanskrit for Technical Knowledge</td>
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<td>AUD-904</td>
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<td>AUD-906</td>
<td>Pedagogy Studies</td>
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<td>Stress Management by Yoga</td>
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<td>AUD-908</td>
<td>Personality Development through Life Enlightenment Skills</td>
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SEMESTER-I

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<td>PCC-TT-501</td>
<td>Advanced yarn production</td>
<td>04</td>
<td>03</td>
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</table>

**Course Contents Objectives:**
1. To explain opening and cleaning aspects of modern blow room machinery and process parameters involved in it.
2. To describe design aspects of different zones of modern card to process parameters involved in it.
3. To describe design aspects of various components of a comber & theories of drafting.
4. To describe fibre blending and process parameters involved in it.
5. To describe advance aspects of various spinning technologies.

**Course Contents Outcomes:**
**At the end of the Course Contents students will be able to**
1. Critically analyze various aspects of opening and cleaning in modern blow room machinery and also process parameters involved in it.
2. Critically analyze design aspects of different zones of modern card and process parameters involved in it.
3. Critically analyze design aspects of various components of a comber & theories of drafting.
4. Critically analyze fibre blending and process parameters involved in it.
5. Critically study advance aspects of various spinning technologies.

**Course Contents :-**
**Unit I - Spinning Preparations:** Fibre mixing and blending practices in industry, Bale Management, Blending Performance Evaluation – Degree of Mixing, Index of Blend Irregularity, Hamburger model - yarn tenacity prediction from fiber properties, Evaluation of blow room performances and AFIS applications

**Unit II - Fibre separation in carding:** Design and actions of wire points in carding, Transfer efficiency in carding, Roller drafting, Irregularity in textile strands, Limit irregularity, Index of irregularity, Causes of generation of irregularities, Hook removal in drawframe, Autolevellers in carding/drawframe, Details of combing preparation, Process parameters in speedframe and roving quality

**Unit III - Ringframe:** Twisting and winding process in ring spinning, Yarn tension in spinning balloon and its effect on yarn quality, Mass variation in ring spun yarns - basics, causes, measurements and detections

**Unit IV - Rotor Spinning:** Productivity - Charka, Ring and Rotor spinning, Fibre properties and yarn quality, Yarn tension in rotor spinning, Process and machine parameters and yarn properties

**Unit V - Air-Jet Spinning:** Twisting and yarn formation, Process and machine parameters and yarn properties, Yarn structure and properties

Department of Textile Technology
Unit VI - Friction Spinning: Mechanism of yarn formation, Production of multi-layer and multi-component yarns by friction spinning, Yarn structure and property relation

**References Books:**

1. *Spinning of Manmade and Blends on Cotton System*, K. R. Salhotra
3. *The Technology of Short Staple Spinning*, (Short Staple Spinning Series, Vol.-I), W. Klein
8. *Fundamentals of Spun Yarn Technology* (CRC Press), Carl A. Lawrence
10. *Open-end Spinning* (Elsevier Science), V. Rohlena
12. *Rotor Spinning* (The Textile Institute, Manchester), C. A. Lawrence and K. Z. Chen

**Practical:**

Practicals are to be conducted based on the above Course Contents.
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<tr>
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<tr>
<td>PCC-TT-502</td>
<td>Melt spinning &amp; Texturizing</td>
<td>04</td>
<td>03</td>
<td>02</td>
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</table>

**Course Contents Objectives**

1. To describe the requirements of Melt spinning process
2. To explain the details of spinneret design
3. To illustrate the different parameters needed and raw material properties in spinning process
4. To understand the texturizing processes and different parameters needed therein.

**Course Contents Outcomes:**

**At the end of the Course Contents students will be able to**

1. Describe the significance and scope of synthetic fibres in textiles
2. Explain the technical details spinneret design.
3. Complete understanding the properties needed for synthetic yarn manufacturing
4. Complete understanding the manufacturing of textured yarn

**Course Contents :-**

**Unit I - Introduction**, melt spinning concepts of polyester, polypropylene, Nylon, spinning of LOY, POY, FDY, BCF, Flow chart & various components of a melt spinning line, functions and design of the extruder, manifold,

**Unit II** - dynamic mixer, spinning beam, metering pump, melt filters, spinning pack, spinneret, types, design & role of quench chamber, spin finish applicator, winder, dryer, spin finish pump, intermingling device, Drawing & heat setting.

**Unit III** - Raw material, types of chips, storage & conveying of chips, Chips properties, dew point, melt spinning line parameters & their controls, quench air parameters, winding parameters & calculations, testing & properties of raw materials & filament yarn, packaging of spools, norms for gradation,

**Unit IV**- problems & remedial action during process, burn-out section, spin finish oil preparation, auto control systems, oil heating systems, Air treatment plant

**Unit V** - Procedure for starting up of line, mounting & removal of spinning pumps, spin packs, Post spinning processes: texturizing, types, basic principles of draw & air jet texturising, yarn processing on texturising machine, processing parameters, yarn properties, problems & remedial actions during texturising,

**Unit VI**- comparative study of texturising machines, modern developments, texturising for fancy yarn production. Modern developments in twisting & rewinding.

**Reference books:**

1. Manufactured fibre technology, V B Gupta & V K Kothari, Chapman & Hall
2. [http://nptel.ac.in/Course Contents/](http://nptel.ac.in/Course Contents/)
3. Winter School on Manmade Fibres Vol-I; Edited By Gupta & Kothari; 1988, IITD
4. Winter School on Manmade Fibres Vol-II; Edited By Gupta & Kothari; 1988, IITD Man-made fibres -
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<tr>
<td>7.</td>
<td>A Guide to Crimping/Texturising Technology by MANTRA, Surat</td>
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**Practical:**
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<td>PCC-TT-503</td>
<td>Computer Applications in Textile:</td>
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**Course Contents Objectives**
1. To describe the Object-oriented Programming using C++.
2. To explain the Relational Databases & E Commerce.
3. To illustrate the applications of ERP and Its Related Technologies with real life examples.
4. To explain the applications of SAP & its advantages.

**Course Contents Outcomes:**
At the end of the Course Contents students will be able to
1. Describe the significance and scope of Programming using C++
2. Explain the technical details of Relational Databases & E Commerce
3. Compile the various properties, merits and applications of ERP.
4. Evaluate the suitability of SAP for various applications

**Course Contents**

**Unit I - Object-oriented Programming using C++:** Introduction to object oriented programming, basic program construction, variable types, loops & decisions, structures, functions, objects & classes, arrays, polymorphism, operator overloading, function overloading, inheritance

**Unit II - Relational Databases:** Relational Model, Database Users, Roles of Database Administrator, keys, Domain Constraints, Referential Integrity, Structured Query Language (SQL), Database recovery methods

**Unit III - E-Commerce:** The scope of electronic commerce, definition of electronic commerce - e-commerce and the trade cycle, Electronic markets, Electronic data interchange, Internet Commerce, Business Strategy in E-commerce. The value chain, supply chain, Porter’s value chain model. Inter organization value chains, Business to business E-commerce, Inter organizational transaction, the credit transaction trade cycle. Advantages & disadvantages of Electronic markets. Application of E-commerce in textile industries.


**Unit VI - Business Intelligence System:** Technical Architecture overview, Back room Architecture, Presentation Server Architecture, Front room Architecture, Metadata, Standard Reports, Dashboards and Scorecards
### Reference Books

1. Object Oriented Programming with C++ - E. Balagurusamy.
2. Database System Concept by Henry F. Korth, Abraham Silberschatz, Sudarshan (McGraw Hill Inc.)
3. E-Commerce – David Whiteley, TMH.
4. ERP Demystified - Alexis Leon, TMH
5. Enterprise Resource Planning – Alexis Leon, TMH.
6. SAP R/3 SAP Architecture, Administration, Basis, ABAP Programming with MM and SD Modules – Dreamtech Press.
7. The Data Warehouse Lifecycle Toolkit By Ralph Kimball,Ross, 2nd edition, Wiley Publication

### Practical:

Practical’s are to be conducted based on the above Course Contents.
List of Course Contents for Elective-I – (Any One)

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**Course Contents objectives:**
1. To describe general introduction of smart textiles and modelling of intelligent materials.
2. To elucidate temperature sensitive shape memory polymers.
3. To explain solar textiles and introduction to conductive materials.
4. To understand applications of smart / intelligent textiles.

**Course Contents Outcomes:** At the end of the Course Contents students will be able to
1. Remember general introduction of smart textiles and modelling of intelligent materials.
2. Understand solar textiles and conductive materials.
3. Annalise temperature sensitive shape memory polymers.
4. Interpret applications of smart / intelligent textiles.

**Course Contents**

**Unit I - General introduction:** Definition, classification, intelligent systems and general applications.

**Unit II - Modelling of intelligent materials:** Background, underpinnings of interdisciplinary, scientific practices and research strategies for intelligent garments

**Unit III - Phase change materials:** Heat balance and thermo-physiological comfort, Phase change technology, PCM in textiles, Future prospects of PCM in textiles and clothing

Intelligent textiles with PCMs: Basic information of phase change materials, Phase change properties of linear alkyl hydrocarbons, Textiles f

**Unit IV - Temperature sensitive shape memory polymers:** A concept of smart materials, Shape memory polymer and smart materials, Some examples of shape memory polymer for textile applications, Potential use of shape memory polymer in smart textile, General field of application, Challenges and opportunities. Study of shape memory polymer films for breathable textiles: Breathability and clothing comfort, Breathable fabrics, Water vapor permeability (WVP) through shape memory polyurethane Chromic and conductive materials: Photo chromic materials, Thermochromics materials, Color changing, Electro chromic materials

**Unit V - Solar textiles:** production and distribution of electricity coming from solar radiation: Solar cells, Textiles as substrates, Technological specifications, Challenges to be met, Suitable textile constructions.

**Introduction to conductive materials:** Electric conductivity, Metal conductors, Ionic conductors, inherently conducting polymers, Application technologies for conducting fibre materials Multipurpose textile based sensors: Introduction, Conductive polymer textile sensors, Conductive polymer composites (CPCs) textile sensors Textile micro system technology: Textile micro system technology, Textiles are inherent microstructures, Textile-based
compliant mechanisms in micro-engineering and mechatronics

**Unit VI - Applications:** Intelligent textiles for medical and monitoring applications, Context aware textiles for wearable health assistants, Intelligent garments in prehospital emergency care, Intelligent textiles for children, Wearable biofeedback systems, Applications for woven electrical fabrics

<table>
<thead>
<tr>
<th>Reference Books</th>
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<tbody>
<tr>
<td>1. Smart fibres, fabrics and clothing edited by Xiaoping Tao, Wood head publishing Ltd., England.</td>
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**Course Contents Objectives**

1. To describe the fibre structure and morphology
2. To explain the Tensile properties of fibres
3. To illustrate the Theories of mechanical properties with numerical examples
4. To evaluate the structural parameters by investigation techniques.

**Course Contents Outcomes**

At the end of the Course Contents students will be able to

1. Understand the fibre structure and morphology
2. Analysis the technical details of Tensile properties of fibres
3. Illustrate the theories of mechanical properties with numerical examples
4. Analysis and evaluation of fiber structure by different methods & Techniques.

**Course Contents**

Unit I - Mechanism of deformation in fibres, Principles of elasticity & Visco elasticity,
Unit II - Stress-strain relations, Creep, Stress-relaxation, Time-temperature effects,
Unit III - Dynamic mechanical properties, Model theory of visco-elasticity,
Unit IV - Thermodynamic analysis of mechanical deformation & rubber elasticity,
Unit V - fibre friction optical properties of fibers,
Unit VI - Refractive index & birefringence. X-ray diffraction, Electron microscopy, IR spectroscopy, Scanning electron microscopy & study of fine structure, Surface structure of different textile fibres.
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<td>Elective-I High Performance Fibres:</td>
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<td>03</td>
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**Course Contents Objectives**

1. To describe the Requirements of high performance (HP) fibres
2. To explain the Manufacturing of aramids, carbon, glass and chemical resistant fibres
3. To illustrate the properties of aramids, carbon, glass and chemical resistant fibres
4. To explain the applications of aramids, carbon, glass and chemical resistant fibres

**Course Contents Outcomes**

At the end of the Course Contents students will be able to

1. Describe the significance and scope of HP fibres in technical textiles
2. Explain the technical details of Glass, Aramids, Carbon and other HP fibres
3. Compile the various properties and merits of above stated fibres in technical textiles
4. Evaluate the criteria for applications in technical textiles and their cost.

**Course Contents**

**Unit I** - Significance of high performance fibres. Critical comparison of Regular and High performance fibres, Review of various fibre manufacturing processes.

**Unit II** - Manufacturing of aramid fibres, Analysis of structure and characteristics of important aramid fibres, Comparison of characteristics of important commercially available aramid fibres, Studies on the applications of aramid fibres.

**Unit III** - Manufacturing of high performance polyethylene and fully aromatic polyester fibres, analyses of characteristics of high performance polyethylene fibres and fully aromatic polyester fibres.

**Unit IV** - Studies on the applications of these fibres Inorganic high performance fibres: Glass fibre manufacture, properties and Applications Ceramic Fibres: Analysis of characteristics and applications of silicon carbide based fibres, Alumina based fibres. Single crystal oxide fibres.

**Unit V** - Critical analyses of fibre characteristics and applications of Chlorinated fibres: PVDC Fluorinated Fibres: PTFE, PVF, PVDF and FEP Poly (etheretherketones): PEEK Poly (phenylene sulphide): PPS Poly (ether imide) : PEI, PBI, and PBO

**Unit VI** - Technological developments in the manufacturing of bicomponent fibres, importance and applications of bicomponent fibres.

**Reference Books**

1. High Performance Fibres, Edited by J. W. S. Hearle, Published by wood head publishing Ltd., England in association with Textile Institute Manchester
2. Carbon fibers by J. P. Donnet and R. C. Bansal, Marcel Dekker, New York
5. New fibers. T. Hongu and G. O. Phillips Ellis Horwood Ltd, Chichester,

**Practical:**
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<td>Textile Project Planning &amp; Implementation</td>
<td>04</td>
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</table>

**Course Contents Objectives:**
1. To explain the logic of project concept and its development cycle
2. To describe in detail the technical analysis for raw material and utilities
3. To illustrate the correlation of money with time with examples
4. To explain requirements for appraisal and project implementation

**Course Contents Outcomes:**
At the end of the Course Contents students will be able to
1. Describe the logic of Project development cycle & identification of Investment
2. Explain the Basics of Technical Analysis for Material inputs & utilities
3. Explain the Time value of money with numerical examples
4. Discuss the study on Appraisal criteria & Project implementation steps

**Course Contents :-**

**Unit I - Overview.**
Project development cycle, Objectives of investment, decision-making, Risk & return Identification of investment opportunities – Governmental regulatory framework – Generation & screening of project ideas – Project Identifications for an existing company.


**Unit V - Time value of money** – Future value of single amount, Future value of an annuity –Present value of single amount – Present value of an annuity. Analysis of Risk – Types & measurement of project risk – Analytical derivation or simple estimation – Sensitivity Analysis – Scenario analysis–Selection of a project-Risk analysis in practice

**Unit VI - Appraisal criteria** – Urgency, Payback period – Accounting, Debt service coverage ratio, Rate of Return, Net present value – Internal rate of return – Annual capital charge – Investment appraisal in practice.
Project implementation – Forms of project organization – Project planning – project control –
Human aspects of project management – Prerequisites for successful project implementation

**References Books:**
2. Goal Directed Project Management by E.S. Andersen, K.V. Grude & Tor Hang, Coopers & Cybranl Publication.

**Practical:**
Practicals are to be conducted based on the above Course Contents.
List of Course Contentss for Elective-II - (Any One)

<table>
<thead>
<tr>
<th>Code</th>
<th>Name of the Course Contents</th>
<th>Total credits</th>
<th>Lectures /week</th>
<th>Practical/Week</th>
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<tbody>
<tr>
<td>PEC-TT-508</td>
<td>Elective-II Industrial Engineering and Management :</td>
<td>04</td>
<td>03</td>
<td>02</td>
</tr>
</tbody>
</table>

Course Contents Objectives:
2. To explain need of industrial engineering and principles of management
3. To understand theoretical concepts and practical aspects of work studies.
4. To learn theoretical concepts ergonomics.
5. To understand theories of TQM.

Course Contents Outcomes: At the end of the Course Contents students will be able to
1. Understand importance of industrial engineering and principles of management
2. Understand theoretical concepts and apply work studies.
3. Understand and apply theories of TQM.
4. Evaluate and design Work system design ergonomically.

Course Contents :-

Unit I - Introduction to Work Study: Definition: Purpose of study, objectives, brief history and evolution, work study and productivity, human factor in application of work study, scope, applications, relationship, between Productivity & standard of living, basic work content, excess work content Management, techniques to reduce excess work content due to product process and ineffective time in control of workers and Management.

Unit II - Ergonomics: Introduction, Principles, Work system design, Man-machine system, Human behaviour and equipment design, Tools, Techniques and applications, Effect of environment on performance of worker, working conditions, prevention accidents and hazards, lighting, ventilation etc.

Unit III - Method Study: Definition, Concept, Objectives and Procedure of method study, Flow and handling of materials; Process chart symbols, recording techniques like Flow process charts, Operation, Flow and Two handed Process charts, Flow diagram, String diagram, Multiple Activity chart, travel chart, Operation Analysis, Analysis of motion, analysis and critical examination of existing methods and development of improved methods, Motion economy, Design of work place layout, Therbligs, SIMO chart.

Unit IV - Work Measurement: Definition, significance of work measurement; origin, development and procedure of work measurement, introduction to various work measurement techniques.

Time Study and Other Works Measurement Techniques: Time study: definition, equipment for basic time study, time study forms and other equipment. Steps in use of techniques of time study; selecting the job, breaking the job into elements, approach to the worker, the elements, timing each element, Maynard Operation Sequencing Technique (MOST),Average and qualified worker, rating procedures, criteria affecting the choice of rating procedures, criteria affecting the choice of
rating procedures, continuous timing, fly back timing, accumulative timing; standard ratings.

**Unit V -** Comparison of observed and standard ratings, factors affecting the rate of working, scales of rating, rating factors, recording the rating, summarizing the study, allowances, calculation and application of allowances.

Work sampling and production studies; General study of standard data & PTS.

**Unit VI - Quality management:**

Quality as a Corporate Strategy, What is Quality?, New Quality Concepts, Quality Circles, Kaizen, Contributions of Quality Management scientists- Dr. Deming, Crosby, Dr. Armrod V. Feigen Baum, Dr. Ishikawa- Seven tools of quality management. Total Quality Management, Roadmap for TQM, Implementation of TQM, Six Sigma, Five ‘S’, TIMWOOD 7-Seven Wastes, ERP etc.

**Reference Books:**

1. Introduction to work study - ILO
4. Hand Book of Industrial Engineering - Irson& Grant.
7. Testing and quality management by DR. V. K. Kothari

**Practical:**

Practicals and assignments are to be conducted based on the above Course Contents.
PEC-TT-509 Elective-II Industrial Law and Economics 03 03 00

Course Contents Objectives:
1. To understand principles of economics and entrepreneurship
2. To know labor legislations
3. To apply statistical methods for data analysis.
4. To learn and apply DEA model for productivity measurement.
5. To do SWOT analysis of Indian Textile Industry

Course Contents Outcomes:
1. Remember principles of economics and entrepreneurship
2. Knowledge of labor legislations
3. Use statistical methods for data analysis.
4. Apply DEA model for productivity measurement.
5. SWOT analysis of Indian Textile Industry

Course Contents
Unit I Basic concepts of micro and macroeconomics:
Supply and demand, demand schedule and demand curve, demand function, supply schedule and supply curve, production function, factors of production, returns to scale, economies of scale, balance sheet of the company

Unit II Basic econometrics:
Definition, methodology of econometrics, regression analysis, regression versus correlation, nature and sources of data for econometric analysis, two variable regression analysis, use of EXCEL and SPSS for regression analysis

Unit III Efficiency and productivity measurement:
Basic concepts of efficiency measurement, selection of input and output variables, mathematical aspects of Data Envelopment Analysis, application of computer based softwares such as DEAP, EMS, productivity measurement approaches, partial factor productivity with its limitations, total factor productivity, productivity measurement using DEA software

Unit IV Structure of Indian textile industry:
Functions & organizational set-up of cotton and man-made industry, jute, silk, wool and woollen textiles industry, decentralized power loom sector, handlooms, handicrafts, public sector undertakings, textile research associations, government textile policies, export/import trends, domestic market, SWOT analysis of Indian textile industry, globalization and effect of WTO on Indian textile industry

Unit V Industrial relations & Labour laws:
Definitions & objectives of industrial relation, charge procedure, punishment & appeal, collective bargaining, employee grievances - nature, grievance handling procedure, workers participation in

**Unit VI Entrepreneurship development:**
Introduction, entrepreneur, modern concepts and qualities required, classification of entrepreneur, factors conductive for promoting entrepreneurship, EDC/EDP–training and development of women entrepreneur

<table>
<thead>
<tr>
<th>Reference Books:</th>
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</thead>
<tbody>
<tr>
<td>1. Principles of Economics by Alfred Marshall</td>
</tr>
<tr>
<td>2. Principles of Economics by H. S. Agrawal</td>
</tr>
<tr>
<td>3. An Introduction to Data Envelopment Analysis by R. Ramanathan</td>
</tr>
<tr>
<td>4. Basic Econometrics by Damodar N. Gujarati</td>
</tr>
<tr>
<td>5. Annual report of Ministry of Textiles, <a href="http://www.textilemin.nic.in">www.textilemin.nic.in</a></td>
</tr>
<tr>
<td>6. Compendium of Textile Industry by Textile Commissioner</td>
</tr>
<tr>
<td>7. Labour &amp; Industrial Law by S. K. Mishra</td>
</tr>
<tr>
<td>8. Industrial &amp; Business Management by Martand T. Telsang</td>
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</table>

**Practical:**
Case Studies and assignments are to be conducted based on the above Course Contents.
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<th>Code</th>
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<th>Total credits</th>
<th>Lectures/week</th>
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<tr>
<td>PCC-TT-510</td>
<td>Modern Weaving Technology</td>
<td>04</td>
<td>03</td>
<td>02</td>
</tr>
</tbody>
</table>

**Course Contents Objectives:**

1. To explain technological significance in the design development of automatic winding machine and process parameters involved in it.
2. To explain technological significance in the design developments of beam and sectional warping machine and process parameters involved in it.
3. To explain technological significance in the design development of sizing machine.
4. To explain technological significance in the design development of unconventional weaving machines machine and process parameters involved in it.

**Course Contents Outcomes:**

At the end of the Course Contents students will be able to

1. Understand technological significance in the design development of automatic winding machine and process parameters involved in it.
2. Critically analyze technological significance in the design developments of beam and sectional warping machine and process parameters involved in it.
3. Critically analyze technological significance in the design development of sizing machine.
4. Evaluate design, functional and constructional aspects of unconventional weaving machines.

**Course Contents**

**Unit I - Need of modern developments in weaving and its benefits Modern developments in Winding:**

**Introduction:** Yarn count monitoring, online classification of yarn defects, classification of foreign fibres. Joining of yarns, splicing: Pneumatic splicing, Electrostatic splicing, Mechanical splicing. Precision winder, auto speed control, automation, spindle identification, waste control, environment controls.


**Unit II - Modern Warping and Sizing:** Concept of modern warping, developments in creel, head stock and different control systems. Concept of modern sizing, developments in sow box, driving of cylinders and head stock, Development in sizing ingredients and different control systems.

**Unit II - Modern Looms:** Suitability of H.S. weaving machines. Technical aspects, economic aspects, manufacturer and machine related criteria, growth of technology, economics.

**Air-Jet Looms:** Principles of weft insertion, weft tensioning, weft length measurement, sley movement, take-up motion. Equation of motion for weft yarn. Air-jet velocity profile, main
nozzle, air guides, relay nozzle, weft travel position in air-jet, energy requirements. Method of operation of main jet. The air stream in the main nozzle area and its action on the weft thread. Improvement jet system. Study on pneumatic weft insertion behavior in main nozzle. Interaction between air, yarn and guide system to increase the yarn velocity. Advancement of Air-jet looms. Range of applications.

**Unit III - Rapier weaving:** Recent developments, development in filling insertion, picking speed, secure filling transfer, and versatility of Rapier of Rapier gripper. Free flight rapier, light rapier head, electronic filling tension controller, pre winder switch-off monitoring, filling detection at the end of insertion, pick finding, rapier cleaning devices. Electronic controls, developments in let-off mechanism and take-up mechanism, selvedges. Efficiency of rapier loom.

**Unit IV - Gripper Projectile Loom:** Ballistic weft insertion, velocity and acceleration of projectile, work done in picking. Different kinds of projectiles uses, colour change at thread transfer. Some features of modern Sulzer looms. PU & PS series machines, Sulzer P7100. Economics of projectile weaving machine. Range of applications.


**Unit VI - The position of cloth fell under stable weaving conditions:** The function of take-up motion, the physical aspect of the cloth fell equation, the relation between beat-up force & pick spacing (the inverse distance equation). Bumping conditions, cloth fell equation under bumping condition.

**Reference Books:**

3. Weaving machincs, mechanisms management – M.K.Talukdar,
4. High speed weaving-K.Jaychandran at all-PSG College of Technology, Coimbatore
5. SIZING-Materials, Methods, Machines- Ajgaonkar, Talukdar and Wadekar

**Practical:**

Practicals are to be conducted based on the above Course Contents.
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<tr>
<th>Code</th>
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<tr>
<td>PCC-TT-511</td>
<td>Evaluation Techniques of Textiles</td>
<td>04</td>
<td>03</td>
<td>02</td>
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**Course Contents objectives:**
1. To learn basic science of testing of fibre, yarn and fabric.
2. Understand quality measurement systems.
3. Learn the functional testing methods.
4. Study in deep the Spectrometer and its application in textile measuring techniques.

**Course Contents outcome:**
1. Apply knowledge of science & engineering for textile testing
2. Analyze textile material using various test methods
3. Learning new methods/technology for testing Understand textile testing from environmental angle
   Writing textile testing reports
4. Assess textile material in relation to health and safety

**Course Contents**

**Unit I - Textile Quality Management Overview:** Quality and its importance, ISO system

**Unit II - Fiber Testing:** AFIS- Principle, working and applications, Advantages over HVI

**Yarn Testing:** CTT- Principle, working and applications

**Unit III - Fabric Testing:** KES- Principle, working and applications; FAST- Principle, working and applications

**Unit IV - Functional Testing:** Tests for Thermal Transmission, Moisture Vapour Transport,
Combined Effect of Thermal and Moisture properties, Electrical Properties, Flammability

**Unit V - IR Spectroscopy:** Principle and its applications for Cotton, Blend Analysis

**Testing for UV Protection:** In vitro and In vivo

**Unit VI - Labelling:** Woolmark, Care, etc.

**References:**
6. www.nptel.ac.in

**Practical:**
Practicals are to be conducted based on the above Course Contents.
List of Course Contentss for Elective-III -(Any One)

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<tr>
<td>PEC-TT-518</td>
<td>Technical Textile - I</td>
<td>04</td>
<td>03</td>
<td>02</td>
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**Course Contents Objectives:**
1. To introduce technical yarns and technical textiles.
2. To describe Coating & Lamination Textiles and application of technical textiles.
3. To explain different finishes on yarn.
4. To describe Miscellaneous Applications.

**Course Contents Outcomes:**

At the end of the Course Contents students will be able to
1. Describe introduction of technical textiles
2. Explain Coating & Lamination Textiles and application of technical textiles.
3. Describe different Novel finishes on yarn.
4. Describe Shape memory polymer and its outcomes
5. Explain Miscellaneous Applications.

**Course Contents :-**

**Unit I -** Introduction, types of technical yarn, yarn characteristics: monofilament, multifilament, intermingled yarn, tape yarn, core spun yarn-Non elastic core and elastic core, plied/ folded yarn, cabled yarn, braided yarn.

**Unit II -** Tape yarn production technique, fibrillated tape yarns. Filament wrapped yarns. Properties and performance of technical yarns.

**Unit III -** Textile Coating & Laminating: Coating materials, coating polymers such as PVC, PVDC, PU, PTFE, Acrylic polymers, rubber and its derivatives, EVA, CARBON NANO TUBES.

**Unit IV -** Principles of coating, aqueous coating, hot melting coating, metal coating, plaiting, plasma treatment. Different methods of coating.


**Unit VI -** Electro conductive yarns, manufacturing process, Measurements, EMSE, applications
High modules yarns such as Glass, Carbon, and Ceramic, Basalt fibers, HPPE fibres, their properties and uses. Shape memory polymer yarns, manufacturing process, applications. Plasma treated yarns for biomedical applications. Chemistry of plasma processing. Industrial sewing threads, structure of sewing threads, thread finishing, yarn numbering. Threads for very high
temperature. Surgical threads, classifications, manufacturing process, characterization

<table>
<thead>
<tr>
<th>References Books:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. R. Alagiruswami and A. Das, Technical Textile yarns, The Textile Institute, Wood Head Publication Ltd., 2010</td>
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<tr>
<td>PEC-TT-519</td>
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**Course Contents Objectives:**
1. To educate basic knowledge of procedures, machinery & chemistry of different dyeing processes.
2. To educate basic developments of dyeing machines.
3. To know the colour measurement techniques.
4. To understand the modern printing, advanced finishing and eco treatments.

**Course Contents Outcomes:**
1. Student developed understanding of engineering knowledge in different dyeing and finishing operation & technology for textile fabrics.
2. Student developed understanding of problem analysis skills in identifying different types of dyes and finishes applied in textile & their quality evaluation.
3. Student developed understanding of modern tools & machines required for different dyeing, printing and finishes application in fabrics.
4. Students developed understanding to work as individual & team work through conducting different individual & group assignment & practical job work.
5. Students developed understanding in effective communication through repeated written and oral test & assignment of the subject

**Course Contents**

**Unit I - Dyeing Process Developments & Kinetics:** Influence of fibre structure on dye uptake; Kinetics of Dyeing; Developments in dyes and dyeing processes for the dyeing of various textile substrates with various dye classes. Advances in Mass coloration.

**Unit II - Dyeing Machines Developments:** Advances in cheese dyeing machines. Advances in Beam dyeing; Advances in soft flow dyeing machines, Advances in jet dyeing machines. Developments in jiggers, Continuous dyeing machineries & its developments, Various dyeing defects caused by the above machineries; Garment Dyeing & it’s modern machineries.

**Unit III - Color Measurements:** Spectrophotometric color measurement & analysis of dye solutions; Fastness properties of dyed materials and their assessment. Identification of dyes on fibres.

**Unit IV - Pollution & Eco Treatments:** Pollution aspects of textile dyeing; Modern approaches to eco-friendly wet processing of woven and knitted textiles. Eco-friendly dyes and their method of dyeing; Technology and principles of effluent treatment. Advanced color removal technologies, recovery and reuse of water and chemicals.

**Unit V - Modern Printing:** Principle and working of fully automatic flatbed screen printing machine; Rotary Printing machine; Transfer Printing machine-Digital Printing; Garment Printing machines; Various practical problems & possible remedies in the above printing machineries;
Modern developments in textile printing machines/techniques.

Unit VI - Modern Finishing: General overview of the recent technological developments in the area of textile finishing machines/techniques. Formaldehyde free finishes; stone wash, Enzyme wash, Bio – polishing, Acid wash, sand blasting, leather finish, rubbery touch, feather touch, easy care finishes, wrinkle free and wrinkle resistant finish, water repellent finish, UV protective garments, Anti – microbial/ anti – bacterial inhibition finish, silicone softeners, fire retardant finishes for garments, functional finishes for garments; Micro- encapsulation and its relevance in textile finishing application.

Reference Books:
1. Dyeing & Chemical Technology of Textile Fibres, By: E. R. Trotman; Published By: Charles Griffin & Company Ltd.
3. Technology of Textile Printing; By- R.S.Prayag; Published By: Mrs. R.S.Prayag, Dharwad, and Karnataka State.
5. Technology of Textile Processing – Vol-IV "Technology of Printing” By: Dr.V.A.Shenai.; Published By: Sevak Publications, Mumbai.
6. Technology of Textile Processing - Vol.6, "Technology of Dyeing" By: Dr. V. A. Shenai; Published By: Sevak Publications, Mumbai.
7. Technology of Textile Processing - Vol.2,"Chemistry of dyes & Principle of dyeing” By: Dr. V. A. Shenai. ; Published By: Sevak Publications, Mumbai.
8. Book of Papers: Convention on Natural Dyes-Dec-1999; Published By: IITD.
10. Chemistry & Technology of Fabric Preparation & Finishing, By: Dr. Charles Tomasino, Published By: Dept. Of Textile Engg, Chemistry & Science, College of Textiles, North Carolina State University, North Carolina.
11. Textile Finishing; By: R.S Prayag; Published By: Mrs. L.R.Prayag, Dharwad, Karnataka State.

Practical:
Practicals are to be conducted based on the above Course Contents.
Course Contents Educational Objectives (CEO): The student should learn-
1. Apply basic elements and principles of garment manufacturing.
2. Learn garment manufacturing process
3. Design and produce a buyer specification garment
4. Elucidate the management of the Garment business
5. Illustrate the fashion marketing and merchandising process.
6. Study Retailing and Global Sourcing Strategies, Supply Chain and demand chain analysis

Course Contents Outcomes (COs):
Upon successful completion of this Course Contents, the student will be able to:
1. Remember basic elements and principles of garment manufacturing.
2. Handle and control garment manufacturing process
3. Create a Design and produce a buyer specification garment
4. Evaluate the management of the Garment business
5. Apply the fashion marketing and merchandising process.
6. Depict Retailing and Global Sourcing Strategies, Supply Chain and demand chain analysis

Course Contents

Unit I - Introduction – Sectors and structure of apparel industry, Overview of Indian garment industry, Nature & scope of apparel manufacturing industry and its developments in recent years.

Unit II - Sequence of garment manufacturing process. Latest developments in garment technology.
Grading, Types and making of lay plan, Requirements of spreading, types and methods of spreading, spreading equipment’s and tools, cutting equipment’s and tools and their modernization, size charts etc.

Unit III - Technology of Sewing machines, Sewing defects. Fabric sew ability, principles of selecting proper stitch and seam types, Effect of stitch type on elasticity and strength, Effect of stitch type on seam slippage. Stitch less garments.
Garment dyeing and finishing, Value added garments. Pressing & finishing: objec, classifications, means, components, machinery and equipment’s, garment finishing and inspection, Quality Standards of some giant retailers, TUV, SGS and ASTM testing standards.

Unit IV - Production technology: Manual systems make through systems, straight line systems, modular production systems, unit production systems, quick response systems.

Ware housing: Handling equipment’s, storage equipment’s, packing equipment’s. Application of CAD/CAM in garment manufacturing

Unit V - Definition and role of merchandiser, Buying indication, Market structure in export markets. Design buying influences. Merchandising and Range Development: Fashion forecast for
Europe and USA, elements of design, Interpretation of forecast for brands in color, silhouette and fabrics.


**Reference Books:**
1. The Technology of clothing manufacturing by Harold Carr, Barbara Latham, Publisher – Blackwell scientific publications
2. Handbook for designing by Ritu Jindal, S. Malhan, Publisher - Mittal Publications
3. Managing Productivity in the apparel Industry by Rajesh Bheda, Michael T. Fralix, Publisher – CBS publications & distributors
4. The apparel industry in India, Ila Kantilal
6. Fashion Buying, Elain Stone
7. Principles of Fashion Merchandising, Sidney Packard

**Practical:**
Practicals are to be conducted based on the above Course Contents.
List of Course Contents for Elective-IV - (Any One)

<table>
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<th>Code</th>
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<tbody>
<tr>
<td>PEC-TT-507</td>
<td>Elective-IV Knitting &amp; Nonwoven Technology:</td>
<td>04</td>
<td>03</td>
<td>02</td>
</tr>
</tbody>
</table>

**Course Contents Objectives:**

1. This Course Contents work will help the student to enhance their knowledge in knitting & nonwovens process.
2. Also give the student an independent knowledge of machine & structure about knitting & nonwoven.
3. To learn about variables, testing, defects in process and products.
4. To study techno economics, uses & applications
5. To study calculations involved in knitting & nonwovens.

**Course Contents Outcome:**

1. It will update the knowledge about modern aspects of warp knitting and non-woven production and application.
2. Students will gain detailed knowledge of machine & structure.
3. Students will be able to set the process and testing of products produced.
4. Student will come to know techno economics, uses & applications
5. Students will evaluate and analyze calculations involved in knitting & nonwovens.

**Course Contents**

**Unit I** - Warp knit fabrics; warp knit v/s woven construction, warp knits vs weft knit.


**Unit II** - Classes of warp knitting machinery, knitting cycle, Tricot, Raschel machines. Knitting elements 7 cycles of Tricot and Raschel machine.

**Unit III** - Plain Tricot structures, knitted with two full set guide bars, two bar Tricot, Shark skin, Queens cord, Velour and Velvet structures, Satin, overfed pile structures, reverse lock knit. Differences between Tricot and Rachel machines and fabrics. Yarns for warp knitting:- Materials for warp knitting, filament and spun yarns, unconventional yarns, important yarn properties for warp knitting, winding and warping for warp knitting. Faults in warp knits. warp knitting calculations

**Unit IV** - Classification & process of nonwovens, web forming, laying and bonding different techniques

**Unit V** - Melt spun and melts blown nonwovens, process, variables, defects & applications.

**Unit VI** - Nonwoven fabric finishing: types of finishing techniques, Fabric inspection, Testing & study of process variables, advantages, disadvantages and techno economics of all above nonwoven technologies.
Reference Books:
1. Fundamentals & advances in Knitting Technology- S C Ray, WPI
2. Knitting Technology by David J. Spencer, WPI

Practical:
Practicals are to be conducted based on the above Course Contents.
**PEC-TT-508  Elective-IV Textile Composites**

<table>
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<tr>
<th>Code</th>
<th>Name of the Course Contents</th>
<th>Total Credits</th>
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<th>Practical/Week</th>
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<tbody>
<tr>
<td>PEC-TT-508</td>
<td>Elective-IV Textile Composites</td>
<td>04</td>
<td>03</td>
<td>02</td>
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</table>

**Course Contents Objectives**

1. To explain requirements of fibre and matrix for composite fabrication & their types
2. To describe the fibre-matrix interactions in unidirectional lamina
3. To explain details of various methods of composite fabrication
4. To explain properties of composites and their applications

**Course Contents Outcomes**

At the end of the Course Contents students will be able to

1. Understand the logic, need, requirements of composites based on end use
2. Elucidate the manufacturing of the composites and fibre used for fabrication
3. Evaluate the performance of composites including fibre matrix interactions
4. Discuss the 3D textile structural composites

**Course Contents**

1. **Composites**: Definition, Objectives, Classification, Applications
2. **Matrix Materials**: Polymers used, Properties of polymers, Thermoset and thermoplastic resins, Nonpolymeric materials
3. **Fabrication**: Hand lay, Bag molding, Pultrusion, Blow molding, Preformed molding, etc.
4. **Mechanics**: Isostress, isostrain conditions, Critical Fiber Length, Critical Fiber volume, Calculations for stress, strain and modulus; changes for continuous to discontinuous fibers, Failure mechanism
5. **Applications**: For structural engineering, electrical, civil, aerospace, defense, automobile, sports, medicine and others
6. Surface treatments, Flamability and fire resistance of composites, Laminated composite

**Reference Books:**

1. Design and Manufacture of Textile Composites, Long C A, Publisher Woodhead Publishing Series in Textiles
2. Composite Materials, K Srinivasan, Publisher Narosa Publishing House, Delhi
5. Composite Material Science & Engineering, Spring Verlag
6. 3D Textile Reinforcements in composite Materials, Antonio Miravete, Publisher Woodhead Publishing Series in Textiles
7. www.nptel.ac.in
<table>
<thead>
<tr>
<th>Code</th>
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<th>Lectures /week</th>
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<tr>
<td>PEC-TT-509</td>
<td>Elective-IV Technical Textile - II</td>
<td>04</td>
<td>03</td>
<td>02</td>
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**Course Contents Objectives:**
1. To develop core knowledge of technical textiles to serve industry.
2. Understand different applications of medical textiles, sports textiles, protective clothing and geotextiles
3. Study different design techniques of construction of technical textiles
4. Design methods for stabilization of soil
5. Create new design with all your knowledge.

**Course Contents Outcomes:**
1. Fundamental of science of Technical Textiles.
2. The subject requires collection of information from journals, net and understands the complex problem deeply to design different protective clothing such as EMI protective clothing, radiation protective clothing and other mechanical protective clothing.
3. Design of different Technical Textiles such as flame retardant fabrics, chemical protective clothing, sports textiles, medical textiles, geotextiles
4. Application of Technical Textile and safety of human life & society using mechanical protective clothing, bullet proof cloth for military uses etc.
5. Designing and analysis of medical textiles, sports textiles, protective clothing and geotextiles

**Course Contents**

**Unit I - Medical textiles:**
Introduction, textile materials used-category wise, fibre used, wound care, bandages, extracorporeal devices, implantable materials, sutures, soft tissue implants, orthopaedic implants, cardiovascular implants, healthcare and hygiene products.

**Unit II - Sports footwear:**
Functional design of sportswear, functional fit of sport footwear, biomechanics of the foot, functional materials and components in sport footwear

**Unit III - Mechanical protective clothing:**
Introduction, materials used, gloves, chain saw clothing, electrostatic protection, Physical requirements for military textiles, military combat clothing systems, Bullet proof fabrics principles & designs, mechanics of ballistic impact, textile materials for ballistic protection, design of ballistic vests and helmets, ballistic testing and evaluation, Clean room fabric, radiation protection, Protective clothing for space.
Unit IV - Chemical protective clothing
Different types of protective materials, components, clothing materials, protection from liquid, toxic fumes and gases, Performance evaluation of chemical protective clothing, chemical, biological and radiation hazards and their prevention.

Unit V - Heat and flame protection:
Fire fighter’s protective clothing, Military flame-retardant, heat protective textiles, military flame and heat threat, criteria for protection of individual, toxic fumes and smoke, thermoplastic melt hazard, flame retardant textiles in military use.

Unit V - Geo-textiles:

Reference Books:
1. Soil Mechanics-B.C.Punmia
2. Non-woven bonded fabrics- J.Lunenschlos, Publisher- Ellis Harwood Series.
3. Designing with Geosynthetics-Robert M.Koerner, Publisher-Prentice Halla, Englewood cliff
5. R. Alagiruswami and A. Das, Technical Textile yarns, The Textile Institute, Wood Head Publication Ltd., 2010

Practical:
Practicals are to be conducted based on the above Course Contents.
### Course Contents Outcomes:

At the end of the Course Contents students will be able to

1. Describe the problem /idea and review and summarize the literature for the topic of the identified problem
2. Illustrate the suitable design of experiments including experimental plan.
3. Explain the concepts of design, development, construction, and fabrication of innovative product/system for the project title
4. Use various tools of testing and statistical analysis for the data in order to draw relevant conclusions.

### Rationale:

The mini project will involve the design, development, construction, and fabrication of innovative product/system approved by the department. This is a laboratory oriented Course Contents which will provide a platform to students to enhance their practical knowledge and skills. Each student must keep a project notebook The notebooks will be checked periodically throughout the semester by the guide and also during the internal viva, as part of the project grade.

### Guidelines:

1. Students should select a problem which addresses some textile industry problem, or other product developments in textiles. One mini project per semester per student
2. The selected topic for mini project should be based on development/fabrication of innovative product which he/she learnt during Course Contents work.
3. Students should understand testing of various instruments relating to topic of mini project.
4. Execution of mini project should be carried out by students only under guidance of allotted faculty. One faculty per student.
5. Students should develop a necessary product with product specifications with reference to end use.
6. Students should see that final product submitted by them is in working condition.
7. 15-20 pages report to be submitted by students in prescribed guide lines. Presentation is for 10 minutes.
   - Group of students cannot be permitted to work on a single mini project. Individual student has to carry out mini project.
   - A demonstration and internal oral examination on the mini project also should be done at the end of the semester.
   - Department may arrange demonstration with poster presentation of all mini projects developed by the students at the end of semester.
   - It is desirable that the product developed by the students have some novel features.
   - A test of significance should be applied to the test results to ascertain the conformity of significant difference.
SEMESTER-III

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<th>Code</th>
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<tbody>
<tr>
<td>DIS-TT-601</td>
<td>Dissertation Part I</td>
<td>14</td>
<td>00</td>
<td>28</td>
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</table>

**Course Contents Objectives:**
1. To identify the problem /idea and review and summarize the literature for the topic of the identified problem
2. To describe the process flow for undertaking the research/survey trials with appropriate standards and process variables
3. To design, development, construction, and fabrication of innovative product/system for the final submission
4. To explain various tools of testing and statistical analysis for the data in order to draw relevant conclusions

**Course Contents Outcomes:**
At the end of the Course Contents students will be able to
1. Describe the problem /idea and review and summarize the literature for the topic of the identified problem
2. Illustrate the suitable design of experiments including experimental plan.
3. Explain the concepts of design, development, construction, and fabrication of innovative product/system for the project title
4. Use various tools of testing and statistical analysis for the data in order to draw relevant conclusions.

**Rationale:** The Dissertation work of Phase I is mainly the 50% of the project work. This includes literature review, design of experiment, selection of proper method of experiment, starting of work.

**Guidelines for Dissertation Phase I:**
1. Students should complete the literature review.
2. Students should design the experiment
3. Select the proper method of testing
4. Select the materials
5. start the work and get result
6. Mid - Project Evaluation will be done at the end of Semester.
# SEMESTER-IV

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<th>Code</th>
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<tbody>
<tr>
<td>DIS-TT-602</td>
<td>Dissertation Part II</td>
<td>14</td>
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<td>28</td>
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</table>

**Course Contents Objectives:**
1. Continuation of problem given in third semester
3. Validation of results, paper publishing.
4. To design, development, construction, and fabrication of innovative product/system for the final submission

**Course Contents Outcomes:**
At the end of the Course Contents students will be able to
1. Describe the problem /idea and review and summarize the literature for the topic of the identified problem
2. Illustrate the suitable design of experiments including experimental plan.
3. Explain the concepts of design, development, construction, and fabrication of innovative product/system for the project title
4. Use various tools of testing and statistical analysis for the data in order to draw relevant conclusions.

**Rationale:** The Dissertation work of Phase II is mainly the completion of the remaining 50% of the project work. This includes the compilation of results, results and discussions, conclusions.

**Guidelines for Dissertation Phase II:**
1. Students should complete and compile the trials, testing.
2. Students should propose a complete thesis writing with given guidelines
3. Students will be ready for the internal Viva with synopsis, objectives, plan of work and results and discussion.
4. The results and discussion will be as per in line with the plan of work. No deviation is allowed.
5. Project Evaluation will be done at the end of Semester.
OPEN ELECTIVE

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<th>Code</th>
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<tr>
<td>OEC-801</td>
<td>Business Analytics</td>
<td>03</td>
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</table>

**Course Contents Objectives:**

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predictive and prescriptive modeling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

**Course Contents Outcome :-**

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

**Course Contents**

**Unit 1:**

**Unit 2:**

**Unit 3:**
Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

**Unit 4:**
Unit 5:

Unit 6:
Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Reference:
2. *Business Analytics* by James Evans, persons Education.
<table>
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<th>Code</th>
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<tr>
<td>OEC-802</td>
<td>Industrial Safety</td>
<td>03</td>
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</table>

**Course Contents**

**Unit 1:** Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

**Unit 2:** Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost and its relation with replacement economy, Service life of equipment.


**Unit 4:** Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment’s like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

**Unit 5:** Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance.

**Unit 6:** Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

**Reference:**

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<tr>
<td>OEC-803</td>
<td>Operations Research</td>
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**Course Contents Outcomes:**

At the end of the Course Contents students will be able to

1. Students should be able to apply the dynamic programming to solve problems of discrete and continuous variables.
2. Students should be able to apply the concept of non-linear programming.
3. Students should be able to carry out sensitivity analysis.
4. Student should be able to model the real world problem and simulate it.

**Course Contents**

**Unit 1:**
Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

**Unit 2**
Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

**Unit 3:**
Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

**Unit 4**
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

**Unit 5**
Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

**References:**

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<tr>
<td>OEC-804</td>
<td>Cost Management of Engineering Projects</td>
<td>03</td>
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</table>

**Course Contents**

Introduction and Overview of the Strategic Cost Management Process


Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Cost Behavior and Profit Planning


**References:**

1. *Cost Accounting A Managerial Emphasis*, Prentice Hall of India, New Delhi
2. *Charles T. Horngren and George Foster*, Advanced Management Accounting
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<tr>
<th>Code</th>
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<tr>
<td>OEC-805</td>
<td>Composite Materials</td>
<td>03</td>
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</table>

**Course Contents**

**UNIT – I:**

**UNIT – II:**

**UNIT – III:**

**UNIT – IV:**

**UNIT – V:**
Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

**TEXT BOOKS:**


**References:**

M. Tech Syllabus 2018

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<tr>
<td>OEC-806</td>
<td>Waste to Energy</td>
<td>03</td>
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</table>

**Course Contents**

**Unit-I:** Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

**Unit-II:** Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.


**Unit-IV:** Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

**Unit-V:** Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

**References:**

AUDIT COURSE CONTENTS

<table>
<thead>
<tr>
<th>Code</th>
<th>Name of the Course Contents</th>
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<th>Lectures /week</th>
<th>Practical/Week</th>
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<tr>
<td>AUD-901</td>
<td>Project Management</td>
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Course Contents Objectives:
1. Understand the fundamental principles of Software Project management and also have a good knowledge of responsibilities of project manager and how to handle these.
2. Be familiar with the different methods and techniques used for project management
3. To do the Project Scheduling, tracking, Risk analysis, Quality management and Project Cost estimation using different techniques.
4. To highlight different techniques for software cost estimation and activity planning.

Course Contents Outcomes:

At the end of the Course Contents students will be able to
1. Understand the concept of concepts of project management, Managing requirements, and Software lifecycles.
2. Deliver successful software projects that support organization’s strategic goals.
3. Apply the project plan; monitoring the project.
4. Analyze organizational needs to the most effective software development model.
5. Design and develop projects at each stage of the software development life cycle (SDLC).

Course Contents

Unit 1: Project Evaluation and Project Planning

Unit 2: Project Life Cycle and Effort Estimation

Unit 3: ACTIVITY PLANNING AND RISK MANAGEMENT

Unit 4: PROJECT MANAGEMENT AND CONTROL

Unit 5: STAFFING IN SOFTWARE PROJECTS

Unit 6: Topics of current research.
References:
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<tr>
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<tr>
<td>MAC-591</td>
<td>English for Research Paper Writing</td>
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**Course Contents Objectives:**

1. Understand that how to improve your writing skills and level of readability.
2. Learn about what to write in each section.
3. Understand the skills needed when writing a Title.
4. Ensure the good quality of paper at very first-time submission.

**Course Contents**

**Unit 1:** Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

**Unit 2:** Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

**Unit 3:** Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

**Unit 4:** Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

**Unit 5:** Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

**Unit 6:** Useful phrases, how to ensure paper is as good as it could possibly be the first-time submission

**Suggested Studies:**

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<tr>
<td>AUD-902</td>
<td>Disaster Management</td>
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**Course Contents Objectives:**

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

**Course Contents**

**Unit 1:** Introduction Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

**Unit 2:** Repercussions Of Disasters And Hazards: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

**Unit 3:** Disaster Prone Areas In India Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases and Epidemics.

**Unit 4:** Disaster Preparedness And Management Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

**Unit 5:** Risk Assessment Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co Operation In Risk Assessment And Warning, People’s Participation In Risk Assessment. Strategies for Survival.

**Unit 6:** Disaster Mitigation Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

**Suggested Readings:**

2. Sahni, Pardeep Et.Al. (Eds.),” Disaster Mitigation Experiences And Reflections”, Prentice Hall Of India, New Delhi.
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<td>AUD-903</td>
<td>Sanskrit for Technical Knowledge</td>
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**Course Contents Objectives:**

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world.
2. Learning of Sanskrit to improve brain functioning.
3. Learning of Sanskrit to develop the logic in mathematics, science and other subjects enhancing the memory power.
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

**Course Contents Outcomes:**

At the end of the Course Contents students will be able to

1. Understanding basic Sanskrit language.
2. Ancient Sanskrit literature about science and technology can be understood.
3. Being a logical language will help to develop logic in students.

**Course Contents**

**Unit 1:** Alphabets in Sanskrit,
**Unit 2:** Past/Present/Future Tense
**Unit 3:** Simple Sentences, Order
**Unit 4:** Introduction of roots
**Unit 5:** Technical information about Sanskrit Literature
**Unit 6:** Technical concepts of Engineering - Electrical, Mechanical, Architecture, Mathematics

**Suggested reading**

1. “Abhyaspustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
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<tr>
<td>AUD-904</td>
<td>Value Education</td>
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**Course Contents Objectives:**
2. Imbibe good values in students.
3. Let the students know about the importance of character.

**Course Contents Outcomes:**
2. Learn the importance of Human values.
3. Developing the overall personality.

**Course Contents**

**Unit 1:** Values and self-development – Social values and individual attitudes. Work ethics, Indian vision of humanism.
Moral and non-moral valuation. Standards and principles.
Value judgements

**Unit 2:** Importance of cultivation of values.

**Unit 3:** Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline.
Punctuality, Love and Kindness.
Avoid fault Thinking.
Free from anger, Dignity of labour.

**Unit 4:** Universal brotherhood and religious tolerance.
True friendship.
Happiness Vs suffering, love for truth.
Aware of self-destructive habits. Association and Cooperation.
Doing best for saving nature

**Unit 5:** Character and Competence – Holy books vs Blind faith.
Self-management and Good health.
Science of reincarnation.

**Unit 6:** Equality, Nonviolence, Humility, Role of Women.
All religions and same message. Mind your Mind, Self-control.
Honesty, Studying effectively

**Suggested reading**
Course Contents Objectives:
1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Contents Outcomes:
1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

Course Contents
Unit 1: History of Making of the Indian Constitution:
   History
   Drafting Committee, (Composition and Working)
Unit 2: Philosophy of the Indian Constitution:
   Preamble
   Salient Features
Unit 3: Contours of Constitutional Rights and Duties:
   • Fundamental Rights
   • Right to Equality
   • Right to Freedom
   • Right against Exploitation
   • Right to Freedom of Religion
   • Cultural and Educational Rights
   • Right to Constitutional Remedies
   • Directive Principles of State Policy
   • Fundamental Duties.
Unit 4: Organs of Governance:
   • Parliament
   • Composition
   • Qualifications and Disqualifications
   • Powers and Functions
• Executive
• President
• Governor
• Council of Ministers
• Judiciary, Appointment and Transfer of Judges, Qualifications
• Powers and Functions

**Unit 5: Local Administration:**
- District’s Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.
- Elected officials and their roles, CEO Zila Pachayat: Position and role.
- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials,
- Importance of grass root democracy

**Unit 6: Election Commission:**
- Election Commission: Role and Functioning,
- Chief Election Commissioner and Election Commissioners.
- State Election Commission: Role and Functioning.
- Institute and Bodies for the welfare of SC/ST/OBC and women.

**Suggested reading**

**Course Contents Objectives:**

1. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

**Course Contents Outcomes:**

**At the end of the Course Contents students will be able to**

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

**Course Contents**

**Unit 1: Introduction and Methodology:**

- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions.
- Overview of methodology and Searching.

**Unit 2:**

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

**Unit 3:**

- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

**Unit 4:**

- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers’ attitudes and beliefs and Pedagogic strategies.

**Unit 5:**

- Professional development: alignment with classroom practices and follow-up support
- Peer support
- Support from the head teacher and the community.
• Curriculum and assessment
• Barriers to learning: limited resources and large class sizes

Unit 6: Research gaps and future directions
• Research design
• Contexts
• Pedagogy
• Teacher education
• Curriculum and assessment
• Dissemination and research impact.

Suggested reading
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<tbody>
<tr>
<td>AUD-907</td>
<td>Stress Management By Yoga</td>
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**Course Contents Objectives:**
1. To achieve overall health of body and mind.
2. To overcome stress.

**Course Contents Outcomes:**

At the end of the Course Contents students will be able to
1. Develop healthy mind in a healthy body thus improving social health also.
2. Improve efficiency.

**Course Contents**

**Unit 1:** Definitions of Eight parts of yog. (Ashtanga)

**Unit 2:** Yam and Niyam.

**Unit 3:** Do’s and Don’t’s in life.
   i) Ahinsa, satya, astheya, bramhacharya and aparigraha

**Unit 4:** Do’s and Don’t’s in life.
   ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

**Unit 5:** Asan and Pranayam
   i) Various yog poses and their benefits for mind and body

**Unit 6:** Asan and Pranayam
   Regularization of breathing techniques and its effects - Types of pranayam

**Suggested reading**

1. ‘Yogic Asanas for Group Training-Part-I’ : Janardan Swami Yogabhyasi Mandal, Nagpur.
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
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<td>AUD-908</td>
<td><strong>Personality Development Through Life Enlightenment Skills</strong></td>
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**Course Contents Objectives:**
1. To learn to achieve the highest goal happily.
2. To become a person with stable mind, pleasing personality and determination.
3. To awaken wisdom in students

**Course Contents Outcomes:**
At the end of the Course Contents students will be able to
1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life.
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity.
3. Study of Neetishatakam will help in developing versatile personality of students.

**Course Contents**

**Unit 1:** Neetisatakam-Holistic development of personality
- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride and heroism)
- Verses- 26,28,63,65 (virtue)

**Unit 2:**
- Verses- 52,53,59 (don’ts)
- Verses- 71,73,75,78 (do’s)

**Unit 3:** Approach to day to day work and duties.
- Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48,

**Unit 4:**
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

**Unit 5:** Statements of basic knowledge.
- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18

**Unit 6:**
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

**Suggested reading**
1. “Srimad Bhagavad Gita” by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari’s Three Satakam (Niti-sringar-vairagyga) by P. Gopinath,
3. Rashtriya Sanskrit Sansthanam, New Delhi.