1. PROGRAM EDUCATIONAL OBJECTIVES (PEOs):
Master of Textile Technology curriculum is designed to prepare the graduates to
1. Have attitude and knowledge for the successful professional and technical career
2. Design and conduct experiments and interpret the results, Design new process and product for textile industry
3. Manage research and development activities in textile industry and research organizations and
4. Enhance their skills for managing textile manufacturing industry

2. PROGRAM OUTCOMES(POs):
The Textile Technology Post Graduates will have the ability to
1. Independently carry out research/investigation and development work to solve practical problems
2. Write and present a substantial technical report/document
3. Demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
4. Apply the knowledge of textile technology to develop new process or product at the textile research organizations and effectively manage textile industry
5. Understand the professional and ethical responsibility
6. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

3. Mapping of Programme Educational Objective with Programme Outcomes

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**ANNA UNIVERSITY:: CHENNAI**  
**NON-AUTONOMOUS COLLEGES AFFILIATED TO ANNA UNIVERSITY**  
**REGULATIONS 2021**  
**M.TECH. TEXTILE TECHNOLOGY**  
**CHOICE BASED CREDIT SYSTEM**  
**I TO IV SEMESTERS CURRICULA AND SYLLABUS**

### SEMESTER I

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**TOTAL CREDITS 27**
# List of Professional Elective Courses

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RESEARCH METHODOLOGY AND IPR COURSES (RMC)

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### AUDIT COURSES - I (AC)

REGISTRATION FOR ANY OF THESE COURSES IS OPTIONAL TO STUDENTS

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### LIST OF OPEN ELECTIVES FOR PG PROGRAMMES

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MA4158 STATISTICAL APPLICATIONS IN TEXTILE ENGINEERING L T P C 4 0 0 4

COURSE OBJECTIVES:
- To understand the basics of random variables and point estimation with emphasis on the standard distributions.
- To apply the small and large sample tests through Tests of hypothesis.
- To understand the concept of analysis of variance and use it to investigate non-parametric model.
- To monitor a process and detect a situation when the process is out of control.
- To apply the concept of analysis of variance and use it to investigate factorial dependence.

UNIT I PROBABILITY DISTRIBUTION AND ESTIMATIONS 12
Applications of Binomial, Poisson, Normal, t, Exponential, Chi-square, F and Weibull distributions in textile engineering - Point estimates and interval estimations of the parameters of the distribution functions.

UNIT II HYPOTHESIS TESTING 12
Sampling distribution - Significance tests applicable to textile parameters – Normal test, t-test, Chi-square test and F-test - p-values - Selection of sample size and significance levels with relevance to textile applications - Acceptance sampling.

UNIT III ANALYSIS OF VARIANCE AND NON-PARAMETRIC TESTS 12
Analysis of variance for different models – Non-parametric tests - Sign test - Rank test - Concordance test.

UNIT IV PROCESS CONTROL AND CAPABILITY ANALYSIS 12
Control charts for variables and attributes - Basis, Development, Interpretation, Sensitizing rules, Average run length - Process capability analysis.

UNIT V DESIGN AND ANALYSIS OF EXPERIMENTS 12
2^k full-factorial designs - Composite designs - Robust designs - Development of regression Models - Regression coefficients - Adequacy test - Process optimizations.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of the course, students will be able to
- Analyze the performance in terms of probabilities, distributions and point estimation achieved by the determined solutions.
- Apply the basic principles underlying statistical inference (estimation and hypothesis testing).
- Demonstrate the knowledge of applicable large sample theory of estimators and tests.
- Identify the applicable sample theory of estimators and tests.
- Obtain a better understanding of the importance of the methods in modern industrial processes.

REFERENCES:
TX4101 THEOREY OF SHORT STAPLE SPINNING L T P C 4 0 0 4

COURSE OBJECTIVES:
- To enable the students to learn the theory of various operations carried out at different stages of yarn spinning, which would be helpful them in understanding the influence of various parameters on quality and productivity of short staple yarn.

UNIT I FIBRE DISPERSION AND CLEANING 12
Necessity of fibre-individualization; fibre opening and cleaning in blow-room machinery; forces acting on the fibre during carding operation; the mechanism of fibre dispersion, fibre transfer, short fibre removal and trash removal; entanglement and disentanglement of fibres; the new approaches to improve fibre-dispersion in carding operation; mechanism of removal of short fibre and trash in comber.

UNIT II FIBRE STRAIGHTENING, NEPS REMOVAL 12
Theory of hook formation; measurement of fibre extent, influence of fibre extent on yarn quality; improvement of fibre-extent by carding, drafting and combing actions; generation of neps, neps removal in carding and combing

UNIT III ATTENUATION 12
Principle of roller drafting and its application in yarn production; ideal drafting; factors affecting drafting force, fibre dynamics during drafting, drafting irregularities and their causes and remedies; amount of draft and draft distribution on strand irregularity; the function of aprons in roller drafting; limitation of apron-drafting and the scope for improvement; mechanism of wire-point drafting and its application in yarn production; merits and demerits of wire-point drafting; comparison of wire-point drafting with roller drafting

UNIT IV TWISTING 12
Twisted yarn geometry, forces acting on fibre and yarn during twisting, effect of fibre helix angle on strength, parameters affecting optimum twist level; balloon and spinning triangle formation and their effects on yarn quality and productivity; fundamental requirement to create real twist in a strand, mechanism of twisting principles in ring spinning, separation of twisting and winding actions of yarn; ply twisting, twist balance; modified twisting principles - open end twisting, false twisting, air-jet twisting, air-vortex twisting, up-twisting, two-for-one twisting, hollow-spindle twisting; merits and demerits of modern twisting system.

UNIT V FIBRE BLENDING AND LEVELLING 12
Importance of achieving homogeneous blending in fibre-mix; types of mixing during spinning preparatory process; lateral and longitudinal fibre blending; analysis of fibre blend index values; process parameters of spinning machinery for processing blended material; influence of intermediate product uniformity on yarn uniformity; different methods of levelling adopted during spinning processes.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student shall have the knowledge on
CO1: Theory of opening and cleaning in spinning preparatory machinery
CO2: Theory of generation of hooks, neeps and rectification
CO3: Wire and roller drafting, technology involved, their limitations and scope for improvement
CO4: Theory of twisting in different systems of yarn spinning
CO5: Fibre blending and leveling carried out at different stages of yarn production process
REFERENCES:
7. haw J., "Short-staple Ring Spinning", Textile Progress, The Textile Institute, Manchester, 1982

Course Articulation Matrix:

<table>
<thead>
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<td>CO3</td>
<td>Wire and roller drafting, technology involved, their limitations and scope for improvement</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>Theory of twisting in different systems of yarn spinning</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>Fibre blending and leveling carried out at different stages of yarn production process</td>
<td>2</td>
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<tr>
<td>Overall CO</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.

TX4102 ADVANCES IN FABRIC FORMATION LT PC

COURSE OBJECTIVES:
To enable the students to learn about
- Advances in fabric formation and their structural features, characteristics and application

UNIT I WOVEN FABRICS 12
UNIT II  KNITTED FABRICS
Advances in circular knitting – loop transfer, seamless knitting and sliver knitting techniques; 3-D knitted fabrics – circular and flat weft knit techniques, applications; spacer fabrics – weft and warp knit techniques, applications.

UNIT III  BRAIDED FABRICS
Principle and production of 3-D braided structures – Cartesian braiding, rotary braiding, and hexagonal; advances in track and column braiding – production of tubular and bifurcated structure; applications.

UNIT IV  NONWOVENs
Principle and Production of Complex nonwoven structures using various nonwoven production routes; Nonwovens with submicron fibres for technical applications

UNIT V  SMART FABRICS
Definition and classifications; production and development of smart fibre and yarn; smart fabric structure and preparation – weaving, knitting and braiding technique; applications; Auxetic fabrics – principles, production and applications

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student shall be able to understand
CO1: advancement in weaving and 3D weaving techniques
CO2: advanced knit structures and techniques
CO3: advancements in braiding techniques
CO4: advancements in Nonwoven Structures
CO5: smart fabric and their production methods

REFERENCES:

Course Articulation Matrix:

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<td></td>
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<td>PO1</td>
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<tr>
<td>CO1</td>
<td>Advancement in weaving and 3D</td>
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<tr>
<td></td>
<td>weaving techniques</td>
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<tr>
<td>CO2</td>
<td>Advanced knit structures and</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>techniques</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>Advancements in braiding</td>
<td>3</td>
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<tr>
<td></td>
<td>techniques</td>
<td></td>
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<tr>
<td>CO4</td>
<td>Auxetic structures and their</td>
<td>3</td>
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<tr>
<td></td>
<td>production methods</td>
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</tr>
<tr>
<td>CO5</td>
<td>Smart fabric and their production</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>methods</td>
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</table>
1. 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.

**TX4151 POLYMER AND FIBRE PHYSICS**

**COURSE OBJECTIVES:**
To enable the students to learn about
- Fibre forming polymer characteristics and their related models and models describing fibre structure.
- Conducting of experiments to characterize the polymers and fibres

**UNIT I BASIC CONCEPTS**
Synthetic fibre forming polymers, definition, terms and fundamental concepts of polymerization; molecular architecture in polymers-configuration and conformation, molecular weight and its influence on fibre formation

**UNIT II POLYMER PROPERTIES**
Glass transition temperature (Tg), factors affecting Tg, WLF equation; rubber elasticity; melting and crystallization, polymer solutions- solubility parameter and its significance to fibre spinning.

**UNIT III FLUID FLOW AND MASS TRANSFER**
Newton’s law of viscosity, velocity distribution in flow systems Newtonian and non-newtonian fluids; mass transfer operations: Fick’s law of diffusion, solid-liquid extraction and drying operations with application to polymer chips.

**UNIT IV VISCOELASTICITY**
Deformation of elastic solid, viscoelasticity and its measurement, non-linear viscoelasticity, yield behavior of solids and breaking phenomena

**UNIT V PROPERTIES OF FIBRES**
Mechanical properties of natural and synthetic fibres; moisture sorption behavior of natural and synthetic fibres; Thermal, Frictional and optical properties of fibres

**COURSE OUTCOMES:**
Upon completion of this course, the student shall
- CO1: Be able to understand the synthesis of polymers
- CO2: Be able to correlate the properties of polymers
- CO3: Be able to understand rheological characteristics
- CO4: Know about viscoelastic behavior of polymers
- CO5: Be able to correlate the properties of fibers

**REFERENCES:**
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<tbody>
<tr>
<td>CO1</td>
<td>Understand the synthesis of polymers</td>
<td>PO1</td>
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<tr>
<td>CO2</td>
<td>Correlate the properties of polymers</td>
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<tr>
<td>CO3</td>
<td>Understand rheological characteristics</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>Know about viscoelastic behaviour of polymer</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>Able to correlate the properties of fibre</td>
<td>3</td>
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<td><strong>Overall CO</strong></td>
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RM4151 RESEARCH METHODOLOGY AND IPR L T P C 2 0 0 2

UNIT I RESEARCH DESIGN 6
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II DATA COLLECTION AND SOURCES 6
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III DATA ANALYSIS AND REPORTING 6
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT IV INTELLECTUAL PROPERTY RIGHTS 6

UNIT V PATENTS 6

TOTAL : 30 PERIODS

REFERENCES:

TX4161  ADVANCED TEXTILE TESTING LABORATORY  L T P C  0 0 6 3

COURSE OBJECTIVES:
To enable the students to learn about
- Characteristics of textile materials and their related models to describe their properties.
- Conducting experiments to characterize the polymers and fibres

LIST OF EXPERIMENTS
1. Determination / Analysis of Molecular weight determination using GPC
2. Rheological studies using viscometer
3. Determination of MFI
4. Determination / Analysis of Birefringence measurement
5. Determination / Analysis of Creep and Stress relaxation of filament
6. Determination / Analysis of DSC Thermogram of different fibres
7. Determination / Analysis of Thermograms using TGA
8. Analysis - FTIR and NMR graphs
9. Determination / Analysis of crystallinity by XRD
10. Determination of residual formaldehyde in fabrics
11. Evaluation of Flame retardant finish
12. Evaluation of Water repellent finish
13. Evaluation of conductivity of fabrics
14. Determination of surface tension of liquids
15. Determination / Analysis of contact angle for porous substrates

TOTAL: 90 PERIODS

COURSE OUTCOMES:
Upon the completion of this course the student will be able to
CO1: Understand and analyze the characteristics of textile materials using advanced characterizing techniques
CO2: Analyze the graphs, charts of TGA, FTIR spectrometer and X-ray Diffractometer
CO3: Evaluate fabric finishes and nature of fabrics
CO4: Determine the property of liquids
CO5: Characterize the porous substrates

Course Articulation Matrix:

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<td></td>
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<td>PO1 PO2 PO3 PO4 PO5 PO6</td>
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<tr>
<td>CO1</td>
<td>Understand and analyze the characteristics of textile materials using advanced characterizing techniques</td>
<td>3 3 3 3 1 2</td>
</tr>
<tr>
<td>CO2</td>
<td>Analyze the graphs, charts of TGA, FTIR spectrometer and X-ray Diffractometer</td>
<td>3 3 3 3 1 2</td>
</tr>
<tr>
<td>CO3</td>
<td>Evaluate fabric finishes and nature of fabrics</td>
<td>3 3 3 3 1 2</td>
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SEMESTER II

TX4201 WETTING AND WICKING OF TEXTILE MATERIALS

OBJECTIVE
To enable the students to learn about the moisture distribution in textiles during dyeing and printing applications

UNIT I FUNDAMENTALS ON WETTING
Surface tension of liquids and theories on its measurements; equilibrium state of a liquid on a solid; solid-liquid interaction in immersion, penetration, adhesion and spreading

UNIT II CHARACTERIZATION OF WETTING
Determination of wetting force and work of adhesion; measurement of contact angle using Goniometry and tensiometry; critical assessment of the above techniques

UNIT III WETTING OF FIBRES AND FABRICS
Wettability assessment of fibres and filaments using goniometry and tensiometry; importance of wetting of fabrics and its assessment

UNIT IV WICKING IN YARNS AND FABRICS
Fundamentals of wicking; wicking in yarns and its measurement; wicking in fabrics from an infinite and finite reservoirs; studies on factors affecting wetting and wicking in fibres and fibrous assemblies; mathematical models of wetting and wicking

UNIT V APPLICATION
Areas of wetting and wicking of fibrous materials; role of wetting and wicking on comfort behavior of textiles; significance of wetting and wicking in medical and hygiene products; usefulness of wetting and wicking in industrial and domestic products

TOTAL: 45 PERIODS

OUTCOMES
On completion of this course, the students shall have the knowledge on the
CO1: Fundamentals of wetting and wicking
CO2: Characterization of wetting
CO3: Liquid-fibre interaction during of fiber and fabrics
CO4: Surface energy of the fabric
CO5: Application of wetting and wicking

REFERENCES


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<td>CO1</td>
<td>Fundamentals of Wetting and wicking</td>
<td>PO1</td>
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<tr>
<td>CO2</td>
<td>Characterization of wetting</td>
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</tr>
<tr>
<td>CO3</td>
<td>Liquid-fibre interaction during of fiber and fabrics</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>Surface energy of the fabric</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>Application of wetting and wicking</td>
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<td>Overall CO</td>
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TX4202   YARN QUALITY ANALYSIS   L T P C

OBJECTIVES
To make the students to
- Understand different characteristics of yarns
- Understand testing of yarn
- Analyze the various reports generated during quality evaluation of yarns and
- Interpret the results obtained through these reports for process and quality control.

UNIT I   MASS VARIATION OF TEXTILE STRANDS
Depiction of mass variation of textile strands in time and frequency domain; interpretation and significance of U% and CV% for textile strands; irregularity index.

UNIT II  VARIANCE LENGTH CURVE
Effect of specimen length and total length on mass variation measurements of textile strands; theory of construction of VL curve; analysis of variance length curves to understand and avoid the introduction of mass variation during the spinning operation

UNIT III  SPECTROGRAM
Determination of periodic mass variation in the form of spectrogram; determination of theoretical wave length from spectrum; comparison between normal and ideal spectrum; type of faults and their representation in spectrogram; interpretation of superimposed waves in spectrogram

UNIT IV   TENSILE PROPERTIES
Influence of testing factors on yarn tensile properties; measurement and application of yarn modulus; creep and stress relaxation of yarn; significance of estimating minimum yarn strength

UNIT V    YARN DEFECTS
Classification and analysis of yarn faults created by mass variation, their causes and remedies; yarn faults in fabrics - causes and remedies; Hairiness of yarns

TOTAL : 30 PERIODS

LABORATORY:
Measurement and analysis of
1. U% of sliver, roving and yarn
1. Imperfections and hairiness of yarn
2. Tensile properties
3. Creep and stress relaxation
4. Yarn fatigue
5. Variance-length curve
6. Spectrogram
7. Yarn faults

**OUTCOME:**
On completion of this course, the students can
CO1: Understand different methods of depicting mass variation of strand
CO2: Analyze and interpret VL curve
CO3: Analyze and interpret spectrogram in finding faulty machine elements
CO4: Analyze the tensile values of strand
CO5: Analyze classified faults and other faults present in the yarn and apply knowledge in reducing yarn faults

**REFERENCES**

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<tr>
<td>CO1</td>
<td>Understand different methods of depicting mass variation of strand</td>
<td>PO1</td>
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<td></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>Analyze and interpret VL curve</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>Analyze and interpret spectrogram in finding faulty machine elements</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>Analyze the tensile values of strand</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>Analyze classified faults and other faults present in the yarn and apply knowledge in reducing yarn faults</td>
<td>3</td>
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<tr>
<td><strong>Overall CO</strong></td>
<td>3</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES
To make the students understand
- Nature of fabric failure
- Analyzing low stress mechanical and comfort properties
- Fabric appearance and their properties

UNIT I  MECHANICS OF FABRIC FAILURE  6
Mode of fabric failure – tensile, tear, abrasion, slippage, bursting and fatigue; influence of fibre and
yarn characteristics, and fabric structure on fabric failure

UNIT II  LOW STRESS MECHANICAL PROPERTIES  6
Analysis and interpretation of low stress mechanical properties measured using Kawabata
Evaluation System - tensile, compression, bending, shear and buckling deformation; influence of
low stress mechanical properties of fabrics on fabric handle, tailorability and sewability

UNIT III  COMFORT PROPERTIES  6
Influence of fibre and yarn characteristics, and fabric structure on air permeability, water vapour
permeability, resistance to penetration of liquid water, resistance to flow of heat; static electricity
measurement and control; influence on comfort properties

UNIT IV  FABRIC APPEARANCE AND OTHER PROPERTIES  6
Role of drape, formability, crease recovery, wrinkle recovery, pilling resistance, dimensional
stability on fabric appearance, spirality; influence of fibre and yarn characteristics, and fabric
structure on the above fabric properties

UNIT V  PROTECTIVE PROPERTIES OF TECHNICAL TEXTILES  6
Influence of fibre and yarn characteristics, and fabric structure on flame resistance, impact
resistance, absorbency, water resistance, filtration efficiency, anti microbial properties, UV
Protection

TOTAL: 30 PERIODS

LABORATORY
1. Measurement/ Analysis of KES data
2. Measurement / Analysis of air permeability, filtration efficiency of fabrics
3. Measurement / Analysis of tensile and flexural properties of textile materials
4. Measurement / Analysis of water vapor permeability and thermal conductivity
characteristics
5. Analysis of UV Protection Data

TOTAL: 30 PERIODS

OUTCOMES
Upon completion of this course, the student shall have the knowledge on the
CO1: Mode of failure of fabrics and influencing parameters
CO2: Kawabata evaluation system
CO3: Fabric role on comfort
CO4: Fabric properties and appearance
CO5: Technical textile properties

REFERENCES:

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<td>PO1</td>
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<tr>
<td>CO1</td>
<td>Mode of failure of fabrics and influencing parameters</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>Kawabata evaluation system</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>Fabric role on comfort</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>Fabric properties and appearance</td>
<td>2</td>
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<tr>
<td>CO5</td>
<td>Technical textile properties</td>
<td>2</td>
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TX4211 TEXTILE PRODUCT ENGINEERING LABORATORY LT P C 0 0 8 4

OBJECTIVE:
To enable the students to test and analyze the given product that include identification of fibre, yarn and fabric specifications and method of production

LIST OF EXPERIMENTS
Reverse engineering of textile products with an emphasis on testing protocols – minimum six products each for a student

TOTAL: 120 PERIODS

OUTCOMES:
Upon the completion of this course the student will be able to
CO1: Identify the materials used in the product
CO2: Carryout confirmative tests to identify specifications of materials used
CO3: Suggest the production process required to make the product and carryout costing of product

Course Articulation Matrix:

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<tr>
<td>CO1</td>
<td>Identify the materials used in the product</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>Carryout confirmative tests to identify specifications of materials used</td>
<td>3</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.

### TX4311 PROJECT WORK I

#### OBJECTIVES
The course aims to enable the students to
- identify the problem/process relevant to their field of interest that can be carried out
- search databases and journals to collect and analyze relevant data
- plan, learn and perform experiments to find the solution
- prepare project report

**TOTAL : 180 PERIODS**

Individual students will identify a problem relevant to his/her field of study, collect and analyze literature, design, and carry out experiment, collect data, interpret the result and prepare the project report.

#### OUTCOMES:
At the end of the course the students will be able to
- **CO1** Identify the research/industrial problems
- **CO2** Collect and analyze the relevant literature
- **CO3** Design, conduct experiment and analyse the data
- **CO4** Prepare project report

### TX4411 PROJECT WORK II

#### OBJECTIVES
The course aims to
- train students to analyze the problem/ think innovatively to develop new methods/product/process
- make them understand how to find solutions/ create products economically and in an environmentally sustainable way
- enable them to acquire technical and experimental skills to conduct experiment, analyze the results and prepare project report
- enable them to effectively think about strategies to commercialize the product.

**TOTAL :360 PERIODS**

Individual students will identify a problem relevant to his/her field of study, collect and analyze literature, design, and carry out experiment, collect data, interpret the result and prepare the project report.

#### COURSE OUTCOMES
At the end of the project the student will be able to
- **CO1** Formulate and analyze problems for developing new methods/solutions/processes.
- **CO2** Plan and conduct experiments to find solutions in a logical manner
## TX4001 ALTERNATIVE SPINNING SYSTEMS

### COURSE OBJECTIVES:
To enable the students to learn the
- Theory of yarn formation by rotor, friction, air-jet, air vortex and other spinning systems
- Effect of process parameters used in the spinning system on yarn quality and production

### UNIT I ROTOR SPINNING I
Principle of open end spinning; description of the working of the rotor spinning; requirements of the raw materials; preparation of the sliver for rotor spinning; yarn formation and its structure; yarn withdrawal and winding

### UNIT II ROTOR SPINNING II
Design of rotor, opening roller, transport tube, navel and their implications on production and yarn quality; developments in rotor spinning machine; production limits; process control; techno economic comparison with ring spinning; structure property relationship

### UNIT III FRICTION SPINNING
Principle of yarn formation - DREF-2, DREF-3 spinning systems; developments in friction spinning systems, raw material requirement, theory of yarn formation, effect of process variables on yarn quality, application of these machines for different end products, economics; technological limitations; structure property relationship

### UNIT IV AIR-JET AND AIRVORTEX SPINNING
Description of yarn production in air-jet spinning machine; structure and quality of the air-jet spun yarn, raw materials requirement, process variables; theory of yarn formation by Air vortex system, raw material requirement and structure; structure property relationship

### UNIT V OTHER SPINNING TECHNOLOGIES
Production of yarn in PLYfil, self-twist, electrostatic, Bobtex spinning systems; working details of production of double-rove yarns, wrap yarns and core spun yarns; raw material requirement in these systems; economics of these methods of yarn production; yarn characteristics and their applications; structure property relationship

### COURSE OUTCOMES:
Upon completion of this course, the student shall be able to understand the
- CO1: Theory of yarn formation in open end spinning and production of yarn in rotor spinning system
- CO2: Design of important elements of rotor spinning machine
- CO3: Theory of yarn formation in friction spinning system and structure of yarn
- CO4: Theory of yarn formation in air-jet and Air vortex spinning system and structure of yarn
- CO5: Principle of yarn production by other spinning systems and double rove spinning

### TOTAL: 45 PERIODS

### REFERENCES:

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<tbody>
<tr>
<td>CO1</td>
<td>Theory of yarn formation in open end spinning and production of yarn in rotor spinning system</td>
<td>3 2 3 3 - 2</td>
</tr>
<tr>
<td>CO2</td>
<td>Design of important elements of rotor spinning machine</td>
<td>3 2 3 3 - 2</td>
</tr>
<tr>
<td>CO3</td>
<td>Theory of yarn formation in friction spinning system and structure of yarn</td>
<td>3 2 3 3 - 2</td>
</tr>
<tr>
<td>CO4</td>
<td>Theory of yarn formation in air-jet and Air vortex spinning system and structure of yarns</td>
<td>3 2 3 3 - 2</td>
</tr>
<tr>
<td>CO5</td>
<td>Yarn production by other spinning systems and double rove spinning</td>
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<td>Overall CO</td>
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TX4002 SHUTTLELESS WEAVING TECHNOLOGY L T P C

COURSE OBJECTIVES:
- To enable the students to understand different mechanisms of weft insertion, their advantages and limitations

UNIT I INTRODUCTION 9
Introduction to shuttleless weaving; advantages of shuttleless weaving, comparison with shuttle weaving; features of unconventional weaving; different selvedges: tucked-in, leno, fused, stitched, their mechanism of formation, their characteristics and uses; weft accumulator.

UNIT II PROJECTILE WEAVING MACHINE 9
Basic principle of projectile weaving; feeding of yarn to projectile; sequence of weft insertion; cam driven shedding; dwelling sley beat-up; torsion bar picking; energy utilization during picking.

UNIT III RAPIER WEAVING MACHINE 9
Classification based on type of rapier; system of weft insertion and number of rapiers; Sequence of weft insertion for Gabler and Dewas systems, their comparison; driving of flexible and rigid rapiers; asynchronized rapier timing; rapier buckling.
UNIT IV AIR-JET AND WATER-JET WEAVING MACHINES

Principle of weft insertion in air-jet weaving, air requirements; path of the yarn on loom; sequence of weft insertion; control of air stream by relay nozzle, confuser profile reed and suction; design of air jet nozzle, air drag force, factors affecting drag force; principle of weft insertion in water-jet weaving machine, path of the yarn on loom, quality of water required, sequence of weft insertion; design of water jet nozzle, merits and demerits of water jet weaving; fabric drying on loom

UNIT V MULTIPHASE WEAVING

Technological developments – models & features; functional description of multi-linear shed weaving – shed formation, filling insertion, beat-up, let-off, take-up and selvedge motion; characteristics of multi-linear shed weaving machine; circular and narrow fabric weaving

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to know

CO1: Overview of shuttless weaving technology
CO2: Principle, concepts and features of projectile weaving machine
CO3: Mechanisms of picking in rapier weaving machine
CO4: Mechanisms of picking and merits and demerits of air jet, water jet
CO5: Principle of fabric formation in multiphase weaving machine

REFERENCES:

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<td>Overview of shuttless weaving technology</td>
<td>PO1: 2 PO2: 2 PO3: 2 PO4: 2 PO5: - PO6: 2</td>
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<td>Principle, Concepts and features of projectile weaving machine</td>
<td>PO1: 2 PO2: 2 PO3: 2 PO4: - PO5: 2 PO6: 2</td>
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<td>CO3</td>
<td>Mechanisms of picking in rapier weaving machine</td>
<td>PO1: 2 PO2: 2 PO3: 2 PO4: - PO5: 2 PO6: 2</td>
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<td>CO4</td>
<td>Mechanisms of picking and merits and demerits of air jet, water jet</td>
<td>PO1: 2 PO2: 2 PO3: 2 PO4: - PO5: 2 PO6: 2</td>
</tr>
<tr>
<td>CO5</td>
<td>Principle of fabric formation in multiphase weaving machine</td>
<td>PO1: 2 PO2: 2 PO3: 2 PO4: - PO5: 2 PO6: 2</td>
</tr>
</tbody>
</table>

Overall CO

PO1: 2 PO2: 2 PO3: 2 PO4: - PO5: 2 PO6: 2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
TX4003 HIGH PERFORMANCE TEXTILES

COURSE OBJECTIVE:

- To enable the students to learn about advanced spinning technology for manufacturing high performance fibres, their properties and applications

UNIT I FUNDAMENTALS OF HIGH PERFORMANCE FIBRES

Fundamentals of high performance fibres; comparison of regular and high performance fibres; fibre forming process; manufacturing, properties and applications - aramide fibres, high performance polyethylene,

UNIT II INORGANIC AND CARBON FIBRES

Manufacturing, properties and applications - glass fibres, basalt fibres; carbon fibres, ceramic fibres

UNIT III BIODEGRADABLE FIBRES

Manufacturing, properties and applications - alginate fibres; chitosan fibres; regenerated protein fibres – silk, wool, casein, soy bean fibre; synthetic biodegradable fibres

UNIT IV CHEMICAL AND THERMAL RESISTANT FIBRES

Manufacturing, properties and applications of chemical resistance fibres – chlorinated fibres, fluorinated fibres, PPS, PEEK and PEI; thermal resistant fibres – semi carbon fibres, PBI, PBO

UNIT V SPECIALIZED FIBRES

Manufacturing, properties and applications - hollow fibres, profile fibres blended and bi-component fibres, film fibres; functionalization of fibres – methods and applications

COURSE OUTCOMES:

Upon completion of this course, the student shall be able to understand

CO1: Method of producing high performance fibres

CO2: High performance fibres for industrial applications

CO3: Manufacturing of biodegradable and protein fibres and their properties

CO4: Manufacturing of chemical resistant fibres and their properties

CO5: Manufacturing of specialty fibres and their properties

TOTAL: 45 PERIODS

REFERENCES:


Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
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</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Method of producing high performance fibres</td>
<td>PO1</td>
</tr>
<tr>
<td>CO2</td>
<td>High performance fibres for industrial applications</td>
<td>PO1</td>
</tr>
<tr>
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<td>Course Title</td>
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<tr>
<td>CO3</td>
<td>Manufacturing of biodegradable and protein fibres and their properties</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>Manufacturing of chemical resistant fibres and their properties</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>Manufacturing of specialty fibres and their properties</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.

**TX4004 FILTRATION TEXTILES**

<table>
<thead>
<tr>
<th>COURSE OBJECTIVES:</th>
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<tbody>
<tr>
<td>• To enable the students to learn about the principles of filtration and textile</td>
</tr>
<tr>
<td>materials used for filtration process</td>
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</tbody>
</table>

**UNIT I BASIC PRINCIPLES**
Filtration and separation, contaminants, surface and depth filtration; filter ratings and filter test, dust collection – theory and principles, practical implications, cleaning mechanisms; fabric design and selection considerations; filter media: introduction, absorbent, adsorbent and biological filter media, paper and fabrics, woven wire and screens, constructed filter cartridges, membranes, packed beds; types of filters.

**UNIT II TEXTILE FILTERS & FINISHING TREATMENTS**
Fabric construction -woven fabrics, needle felts, knitted fabrics; heat setting, singeing, raising, calendaring, chemical treatments, special surface treatments

**UNIT III LIQUID AND OIL FILTRATION**
Water filters, waste water treatments, surface treatment chemicals; oil and hydraulic systems; engine filters, oil-water separators, oil cleaning and hydraulic systems, oil cleaning, hydraulic systems

**UNIT IV TEXTILE FILTER IN SOLID-LIQUID SEPARATION**
Introduction, fabric design/selection consideration, filtration equipment, considerations; yarn types and fabric constructions - monofilaments, multi filaments, fibrillated tape (split film) yarns, staple-fibre yarns, yarn combinations; fabric constructions and properties - plain weave, twill weaves, satin weaves, duplex and semi duplex weaves, link fabrics, needle felts

**UNIT V GAS FILTRATION**
Introduction, indoor air quality, fume and vapour emissions, dust collectors, machine air intake filters, vehicle cabin filters, compressed air filtration, pneumatic systems, sterile air and gas filters, respiratory air filters, Engine filters.

**COURSE OUTCOMES:**
Upon completion of this course, the student shall be able to understand
CO1: Principles of filtration
CO2: Fabric construction and finishing treatments of filtration textiles
CO3: Concepts of liquid and oil filtration
CO4: Concepts of solid liquid separation

**TOTAL: 45 PERIODS**
CO5: Types of Gas filters

REFERENCES:

Course Articulation Matrix:

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<tr>
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<tr>
<td>CO1</td>
<td>Principles of filtration</td>
<td>2</td>
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<tr>
<td>CO2</td>
<td>Fabric construction and finishing treatments of filtration textiles</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>Concepts of liquid and oil filtration</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>Concepts of solid liquid separation</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>Types of Gas filters</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

TX4005 PROCESS CONTROL AND OPTIMIZATION IN YARN SPINNING L T P C

3 0 0 3

OBJECTIVE:
- To enable the students to understand and apply process and quality control measures during spinning of yarn to optimize the productivity and quality

UNIT I LEVELLING
9
Quality measures and control of intermediate products to achieve required yarn count with minimum dispersion; different levelling methods adopted in the pre-spinning machines; assessment and control of auto levelling; importance of fibre-mix homogeneity on yarn quality; types and levels of mixing in the preparatory processes; assessment of fibre-blend variations, effect of blend variation on fabric quality

UNIT II NEP AND HOOK REMOVAL
9
Causes of nep and hook formation, control measures; measurement of neps and hooks; factors influencing the removal of neps in the carding and combing machines; fibre hook straightening during the preparatory operations, factors
UNIT III  WASTE CONTROL
Waste determination and cleaning efficiency; control of waste in blowroom, card and combers; influence of machine and processing parameters on waste removal; controlling the lint content in waste; control of pneumatic waste, hard waste in ring frame; determination of yarn realization; centralized waste collection system

UNIT IV  PRODUCTION CONTROL
Balancing of machinery; factors affecting the production limits of the spinning machinery; new concepts in achieving higher production in the spinning machinery; computation of the productivity indices; automation, improving production and labour efficiency

UNIT V  HUMIDITY CONTROL AND MACHINERY MAINTENANCE
Effect of humidity, temperature and maintenance of machinery on production and quality of yarn, optimizing ambiance and humidity control; process conditions required for producing polyester, viscose and blended yarns; yarn defects – causes and remedies

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, the student shall be able to understand the
CO1: Quality control measures in terms of levelling of material
CO2: Control of nep and hooks
CO3: Factors influencing production rate and efficiency of spinning machines
CO4: Balancing of machinery, production and labour efficiency
CO5: Measures to be taken while processing manmade fibres, humidity control

REFERENCES

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<td>CO1</td>
<td>Quality control measures in terms of levelling of material</td>
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<td>CO2</td>
<td>Control of nep and hooks</td>
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<tr>
<td>CO3</td>
<td>Factors influencing production rate and efficiency of spinning machines</td>
<td>3</td>
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<tr>
<td>CO4</td>
<td>Balancing of machinery, production and labour efficiency</td>
<td>3</td>
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<tr>
<td>CO5</td>
<td>Measures to be taken while processing manmade fibres</td>
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Overall CO: 3 3 3 3 - 1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVE
To enable the students to learn about the manufacturing of nonwovens and their properties

UNIT I INTRODUCTION
Recapitulation of web preparation by dry and wet method and bonding by mechanical, thermal and chemical methods; brief outline of nonwoven manufacture by spun bonding and melt blown processes

UNIT II WEB QUALITY
Effect of web quality on nonwoven quality; mechanisms of web forming machines and processes to achieve uniformity in web; process control tools used for maintaining web quality

UNIT III NEEDLE PUNCHED NONWOVENS
Design of needles and its effect on needle punched fabric structure and quality; type of fibres and its characteristics which affect fabric quality; horizontal and vertical structure in needle punched fabrics, and their contribution to fabric properties; needle machine parameters that affect fabric structure and properties

UNIT IV HYDRO-ENTANGLED, THERMAL AND CHEMICAL BONDED NONWOVENS
Effect of water jets on fibres, effect of water pressure, number of manifolds and nozzles, and type of web support systems used in spun laced nonwoven production on fabric structure and properties; effect of type of heat transfer method on thermal bonded nonwoven structure and properties; effect of process and material variables on the structure and properties of thermal and chemical bonded nonwovens

UNIT V MELTBLOWN AND SPUN BONDED NONWOVENS
Effect of material and process variables like type of polymer, molecular weight, polymer and air temperature, collector distance, primary and secondary air pressure in melt-blown nonwoven production on fabric structure and quality; factors affecting the structure of spun bonded fabrics and properties

TOTAL: 45 PERIODS

OUTCOMES
Upon completion of the course the student will be able to
CO1: Know overview of nonwovens
CO2: Understand the optimization of process in web preparation
CO3: Process variables in needle punched nonwoven manufacture
CO4: Process control in hydro entangling, thermal and chemical bonding
CO5: Process control in melt blown and spun bonded fabrics

REFERENCES
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<td>CO1</td>
<td>Overview of nonwovens</td>
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<tr>
<td>CO2</td>
<td>Understand the optimization of process in web preparation</td>
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<tr>
<td>CO3</td>
<td>Process variables in needle punched nonwoven manufacture</td>
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</tr>
<tr>
<td>CO4</td>
<td>Process control in hydro entangling, thermal and chemical bonding</td>
<td>1</td>
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<tr>
<td>CO5</td>
<td>Process control in melt blown and spun bonded fabrics</td>
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<td><strong>Overall CO</strong></td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

TX4007 ENZYME TECHNOLOGY FOR TEXTILE PROCESSING

**OBJECTIVES**
- Enzymes, types and kinetics of enzyme reaction on textile fibres
- Application of enzymes on different fibres and

**UNIT I ENZYMES**
Nomenclature and classification of enzymes; characteristic features of enzymes; modifiers of enzyme activity - activators and inhibitors; specificity of enzyme action; extraction and purifications of enzymes

**UNIT II ENZYME KINETICS**
Kinetics of single-substrate enzyme-catalyzed reactions; basics of kinetics of multi-substrate enzyme-catalyzed reactions

**UNIT III ENZYMES FOR CELLULOSIC FIBRES**
Chemistry and structure of cotton fibre; enzymes in pretreatment of cotton substrates – desizing, scouring, bleaching and bio finishes

**UNIT IV ENZYMES FOR OTHER FIBERS**
Enzymes for processing and functionalizing protein fibres; enzymatic modification of polyester, polyamide, polyacrylonitrile and cellulose acetate fibres

**UNIT V ENZYMES IN EffluEnt TREATMENT**
Enzyme technology and biological remediation, enzyme decolourisation and decolouration by biosorption and enrichment cultures

TOTAL: 45 PERIODS
Upon completion of this course, the student shall be able to understand the
CO1: Classification, characteristics and activity of enzymes
CO2: Kinetics of single and multi-substrate enzyme
CO3: Activity of enzyme on cotton fibres
CO4: Activity of enzyme on protein and synthetic fibres
CO5: Application of enzymes for effluent treatment

REFERENCES

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<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
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<td>CO1</td>
<td>Classification, characteristics and activity of enzymes</td>
<td>PO1 2</td>
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<tr>
<td>CO2</td>
<td>Kinetics of single and multi-substrate enzyme</td>
<td>PO1 2</td>
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<tr>
<td>CO3</td>
<td>Activity of enzyme on cotton fibres</td>
<td>PO1 2</td>
</tr>
<tr>
<td>CO4</td>
<td>Activity of enzyme on protein and synthetic fibres</td>
<td>PO1 2</td>
</tr>
<tr>
<td>CO5</td>
<td>Application of enzymes for effluent treatment</td>
<td>PO1 2</td>
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</tbody>
</table>

Overall CO
| PO1 2 | PO2 1 | PO3 3 | PO4 - | PO5 3 | PO6 1 |

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and
Substantial (High) respectively

TX4074 PROTECTIVE CLOTHING LTPCS

OBJECTIVES:
To enable the students to learn about
- Functional requirements of protective clothing
- Selection of fibre, yarn and fabric for developing protective clothing
- Evaluation of protective clothing

UNIT I FIBRE REQUIREMENTS
Suitability and properties of high performance fibres for various protective clothing – chemical
composition and physical structure

UNIT II YARN AND FABRIC REQUIREMENTS
Types of yarns, woven, knitted and nonwoven fabric structures used for protective garments,
methods of production, effect of structure on their performance

UNIT III CLOTHING CONSTRUCTION
Method of construction of garments according to various protective end uses like protection
against cold, ballistic protection; use of different fabric type (knitted, woven, and nonwoven),
coated, laminated in different places; use of inter lining and composites; 3D structures; high tech
textiles–wearable electronics; protective garments for industrial and apparel end uses
UNIT IV  FINISHING OF PROTECTIVE CLOTHING
Types of finishes - fire retardant finishes, water repellent finishes, anti - microbial finishes; chemical finishes against radiation and chemicals; method of application of finishes; protective finishes for health care garments

UNIT V  QUALITY EVALUATION
Evaluation of protective fabrics - desirable properties of protective textiles, method of testing for thermal protective performance, abrasion and wear resistance, evaluation of resistance to mildew, ageing, sunlight, chemical, electrostatic and electrical resistivity, impact properties; ASTM standards for protective garments

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to understand

CO1: Properties of fibres required for protective clothing
CO2: Selection of fibre, yarn and fabric for developing protective clothing for different applications
CO3: Protective clothing construction
CO4: Different types of finishes given to develop protective clothing
CO5: Evaluation of protective clothing

REFERENCES

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<tr>
<td>CO1</td>
<td>Properties of fibres required for protective clothing</td>
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</tr>
<tr>
<td>CO2</td>
<td>Selection of fibre, yarn and fabric for developing protective clothing for different applications</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>Protective clothing construction</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>Different types of finishes given to develop protective clothing</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>Evaluation of protective clothing</td>
<td>3</td>
</tr>
</tbody>
</table>

| Overall CO | 3 | 3 | 3 | 3 | 1 |

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

TX4008 STRUCTURAL MECHANICS OF YARN

**OBJECTIVE**

To enable the students to learn about the structure of ideal and real yarn, migration of fibres in the yarn, breakage mechanism of yarn, mechanics of blended yarns and relationship between structure and property of yarns produced by different spinning systems.

**UNIT I YARN GEOMETRY**

Elements of yarn geometry; helix geometry of yarn; yarn diameter, twist relationship; ideal packing of fibres in yarn; packing coefficient, estimation of packing density and radial packing density of yarn

**UNIT II MIGRATION OF FIBRES IN YARN**

Twist contraction and retraction; geometry of folded yarns; migration characteristics in continuous filament and spun yarns; effect of various parameters on migration; measurement of fibre migration in yarn; effect of migration on tensile behavior and hairiness of the yarn

**UNIT III YARN MECHANICS**

Analysis of breakage of yarn; effect of twist on strength and elongation at break of filament yarn; relationship between elongation at break of filament and yarn; prediction of breakage - continuous filament yarn; model - breakage of spun yarn, effect of twist

**UNIT IV BLENDED YARN MECHANICS**

Blend irregularity; measurement of blending irregularity, effect on fabric properties; concept of elongation balance; effect of properties of constituent fibres and blend composition on behavior of blended yarns

**UNIT V STRUCTURE - PROPERTIES RELATIONSHIP**

Structure - property relationship of yarns produced from different spinning systems; effect of fibre properties and geometrical configuration of yarn on properties of ring yarn; comparison of ring and compact spun yarn based on structure

**OUTCOMES**

TOTAL: 45 PERIODS
On completion of this course, student would understand
CO1: Yarn geometry and packing density
CO2: Migration of fibres in yarn CO3: Breaking mechanics of yarn
CO4: Mechanics of blended yarn
CO5: Structure and properties relationship of yarn

REFERENCES

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<th>Statement</th>
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<td>CO1</td>
<td>Yarn geometry and its packing density</td>
<td>PO1 PO2 PO3 PO4 PO5 PO6</td>
</tr>
<tr>
<td>CO2</td>
<td>Migration of fibres in yarn</td>
<td>3    3    3   2   -   1</td>
</tr>
<tr>
<td>CO3</td>
<td>Breaking mechanics of yarn</td>
<td>3    3    3   2   -   1</td>
</tr>
<tr>
<td>CO4</td>
<td>Mechanics of blended yarn</td>
<td>3    3    3   2   -   1</td>
</tr>
<tr>
<td>CO5</td>
<td>Structure and properties relationship of yarn</td>
<td>3    3    3   2   -   1</td>
</tr>
<tr>
<td>Overall CO</td>
<td></td>
<td>3    3    3   2   -   1</td>
</tr>
</tbody>
</table>

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TX4009 STRUCTURAL MECHANICS OF FABRICS L T P C 3 0 0 3

OBJECTIVE
• To enable the students to learn about geometry of fabric, mechanics of fabric deformation fabrics

UNIT I GEOMETRY OF CLOTH STRUCTURE 13
Geometry of plain and non-plain weaves; Peirce and Olofsson models; crimp ratio and thread spacing; jamming of threads; crimp interchange, balance of crimp.

UNIT II FABRIC DEFORMATION 9
Fabric deformation under tensile stress; prediction of modulus; tensile properties in bias direction

UNIT III OTHER FABRIC DEFORMATION 9
Compression, shear, bending and buckling; fabric handle; spirality and skewness formation and control
UNIT IV  KNITTED FABRIC STRUCTURES  9
Geometry of weft and warp knitted structures, influence of friction on knit geometry; load extension of warp knit fabrics; biaxial stress behavior of plain-knit fabrics

UNIT V  NONWOVEN STRUCTURES  5
Structure of felts; mechanical behavior of needle felts; structure of stitch bonded fabrics, chemical and thermal bonded fabrics

OUTCOMES:
Upon completion of the course, the student will be able to
CO1: Understand the geometry of woven cloth
CO2: Know fabric deformation under tensile stress
CO3: Understand the mechanics of other fabric deformations
CO4: Know the mechanics of knitted fabric structure
CO5: Understand the structure of nonwovens

TOTAL: 45 PERIODS

REFERENCES

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<th>Statement</th>
<th>Program Outcome</th>
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<td>CO1</td>
<td>Understand the geometry of woven cloth</td>
<td>PO1 3 PO2 2 PO3 3 PO4 2 PO5 - PO6 1</td>
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<tr>
<td>CO2</td>
<td>Know fabric deformation under tensile stress</td>
<td>PO1 3 PO2 2 PO3 3 PO4 2 PO5 - PO6 1</td>
</tr>
<tr>
<td>CO3</td>
<td>Understand the mechanics of other fabric deformations</td>
<td>PO1 3 PO2 2 PO3 3 PO4 2 PO5 - PO6 1</td>
</tr>
<tr>
<td>CO4</td>
<td>Know the mechanics of knitted fabric structure</td>
<td>PO1 3 PO2 2 PO3 3 PO4 2 PO5 - PO6 1</td>
</tr>
<tr>
<td>CO5</td>
<td>Understand the structure of nonwovens</td>
<td>PO1 3 PO2 2 PO3 3 PO4 2 PO5 - PO6 1</td>
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</table>

Overall CO 3 2 3 2 - 1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

TX4073  COATED AND LAMINATED TEXTILES  L T P C 3 0 0 3

OBJECTIVE
- To enable the students to learn the production and applications of coated and laminated textile and their testing

UNIT I  POLYMERS USED IN COATING  9
Natural Latex & synthetic rubbers, synthetic polymers: polyurethanes, poly (vinyl chloride), polyacrylate elastomers, silicone elastomers, poly (Tetrafluoroethylene), polyethylene, chlorinated
and chlorosulphonated polyethylenes, foams for laminates; textile substrate for coating

UNIT II  METHODS OF COATING  9
Knife coating, roll coating, dip coating, transfer coating, gravure coating, rotary screen printing, calendaring, hot melt coating, foam coating, lamination by adhesives, welding.

UNIT III  END USES OF COATING I  9
Breathable textiles, microporous coatings and films, hydrophilic coatings, smart temperature responsive breathable coatings; synthetic leather, architectural textiles, fluid containers, tarpaulins, automotive applications, carpet backing, flocking, fusible interlinings.

UNIT IV  END USES OF COATING II  9
Thermochromic fabrics, temperature adaptable fabrics, fabrics for chemical protection, camouflage nets, high visibility garments, intumescent coating, metal and conducting polymer coated fabrics, coating with hydrogel and shape memory polymers

UNIT V  CHARACTERIZATION OF COATED TEXTILES  9
Tensile strength, elongation, adhesion, tear resistance, weathering behavior, microbiological degradation, yellowing, testing standards

TOTAL: 45 PERIODS

OUTCOMES
Upon completion of this course the student shall know
CO1: Different kinds of polymers used for coating and laminating
CO2: Different methods of coating and laminating
CO3: Application of coated and laminated textiles in weather proofing and upholstery
CO4: Application of coated and laminated textiles conductive and temperature applications
CO5: Characterization of coated textiles

REFERENCES

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<td>Different kinds of polymers used for coating and laminating</td>
<td>PO1 PO2 PO3 PO4 PO5 PO6</td>
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<tr>
<td>CO2</td>
<td>Different methods of coating and laminating</td>
<td>3 2 3 2 - 1</td>
</tr>
<tr>
<td>CO3</td>
<td>Application of coated and laminated textiles in different industry</td>
<td>3 2 3 2 - 1</td>
</tr>
<tr>
<td>CO4</td>
<td>Characterization of coated textiles</td>
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TX4010  COLOURURATION AND FUNCTIONAL FINISHES  L T P C  3 0 0 3

OBJECTIVE
To enable the students to learn various finishes applied on the textile fabrics for different applications.

UNIT I  THEORY OF DYING  9
Dyeing equilibrium; dye-fibre interaction; adsorption isotherm; dye affinity; heat of dyeing; half
UNIT II INK JET PRINTING
Concept and methods of inkjet printing; colour separation; selection of dyes and developments in inks; techno-economical features

UNIT III COATING
Coating polymers and auxiliaries, coating techniques and coated fabric assessment.

UNIT IV ENZYMES IN PROCESSING I
Enzymes – classifications of enzymes and nomenclature of enzymes, synthesis of enzymes, enzyme kinetics

UNIT V ENZYMES IN PROCESSING II
Substrates and their structure, scaling of enzyme production, textile processing enzymes

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, the student shall be able to know about
CO1: Theories and concepts of dyeing
CO2: Concepts of ink jet printing
CO3: Different coating techniques
CO4: Overview of enzymes and Nomenclature and synthesis of enzymes
CO5: Substrates and its relation with Textile Processing Enzymes

REFERENCES
Course Articulation Matrix:

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<td>Concepts of ink jet printing</td>
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<td>Different coating techniques</td>
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<td>Overview of enzymes and Nomenclature and synthesis of enzymes</td>
<td>3 2 3 2 - 1</td>
</tr>
<tr>
<td>CO5</td>
<td>Substrates and its relation with Textile Processing Enzymes</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.

TX4011 THEORY OF DRAFTING L T P C 3 0 0 3

OBJECTIVE
To enable the students to learn about the theory of drafting process and drafting irregularities

UNIT I DRAFTING 9
Definition of ideal drafting, model; conditions required to achieve ideal drafting in a roller drafting system; deviations from ideal drafting during actual drafting; definition of drafting wave; condition for drafting wave formation during roller drafting; estimation of the magnitude of the irregularity caused by the occurrence of drafting wave.

UNIT II DRAFTING FORCE 9
Roller drafting - forces acting on a fibre during drafting at different positions in drafting zone; measurement of drafting force; factors affecting drafting force; methods to avoid drafting wave formation; role of apron in controlling drafting wave formation; limitations of apron in roller drafting system.

UNIT III OTHER DRAFTING IRREGULARITIES 9
Definition of roller slip; conditions for the formation of forward and backward slips in the roller drafting systems; measures to avoid roller slip occurrence, causes for roller nip movement, model; roller speed variation during drafting and their effect on irregularity formation; control of the irregularity formed due to these sources.

UNIT IV COMPARISON 9
Comparison of roller drafting system with wire point drafting system; application of wire point drafting in card and rotor spinning machine; comparison of roller drafting in drawframe, comber preparatory, comber, speed frame, ring frame and air-jet spinning system.

UNIT V COMPACT SPINNING 9
Spinning triangle – formation, factors affecting dimensions, effect on yarn quality; condensed yarn spinning – principle, different methods

TOTAL 45 PERIODS
OUTCOMES:
On completion of this course, student would understand
CO1: Theory of ideal drafting and formation of drafting wave
CO2: Drafting force its measurement and influence
CO3: Different causes for irregularities in textile strand
CO4: Comparison of wire and roller drafting system and the drafting systems used in different
spinning machinery
CO5: Compact spinning, principle and different methods

REFERENCE:

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<td>Drafting force, its measurement and influence</td>
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<td>CO3</td>
<td>Different causes for irregularities in textile strand</td>
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<td>Comparison of wire and roller drafting system and the drafting systems used in different spinning machinery</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

TX4012   CLOTHING SCIENCE   L T P C   3 0 0 3

OBJECTIVES
To enable the students to learn about
- Important characteristics of fabric that are responsible for its comfort properties and
- Different phenomena which take place in the fabric related to the comfort properties of the fabric.

UNIT I   FABRIC HAND
**UNIT II CHARACTERISTICS OF POROUS MATERIALS**

Geometrical characterization of single fibres; structural analysis of fibrous materials with fibre orientations; determination of the fibre orientation; characterization of porous fibrous materials; pore distribution in a fibrous material

**UNIT III MOISTURE VAPOUR TRANSFER AND INTERACTIONS**

Mass transfer by diffusion; moisture vapour transfer – principle of moisture diffusion, methods of measurement of moisture vapour transfer; concept of moisture management tester; effect of fibre, yarn and fabric parameters on moisture vapour transfer.

**UNIT IV HEAT TRANSFER AND INTERACTIONS**

Thermal conduction in fibrous materials – thermal conduction analysis; Effective thermal conductivity (ETC) for fibrous materials; prediction of ETC by thermal resistance networks, volume averaging method and homogenization method; structure of plain weave woven fabric composites and the corresponding unit cell

**UNIT V PHYSIOLOGICAL COMFORT**


**OUTCOMES**

Upon completion of this course, the student shall be able to understand:

- CO1: Fabric hand and its comfort parameters
- CO2: Permeability and porous nature of fibrous assemblies
- CO3: Moisture vapour transfer phenomenon
- CO4: Heat transfer phenomenon
- CO5: Fabric properties with respect to comfort and correlate the property of the fabric with comfort to the wearer.

**REFERENCES**

2. Li Y., "The Science of Clothing Comfort", Textile Progress 31:1

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<td>Fabric properties with respect to comfort and correlate the property of the fabric with comfort to the wearer 2 2 3 3 - 1</td>
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| Overall CO      | 2 2 3 3 - 1 |

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES
To enable the students to learn about
- Different types of biomaterials and
- Biomedical application of textile products

UNIT I  BIOMATERIALS
Biomaterials–introduction, types; natural, polymeric and biological biomaterials

UNIT II  HYGIENE TEXTILES
Textile based healthcare and hygiene products; application of nano technology in medical hygiene
textiles; advanced textile materials in healthcare; infection control and barrier materials

UNIT III  BANDAGES AND PRESSURE GARMENTS
Bandages and pressure garments - elastic and non-elastic compression bandages, support and
retention bandages; evaluation of bandages; bandages for various end uses.

UNIT IV  WOUND DRESSING
Wound – types, healing process; requirements of wound dressing; wound care materials –
types, advantages and limitations; testing of wound dressings; advanced wound dressings

UNIT V  IMPLANTABLE MATERIALS AND REGULATIONS
Implantable products; sutures – requirements, classifications, specifications, materials and their
applications; vascular grafts, artificial ligaments, artificial tendons; scaffolds for tissue engineering;
intelligent textiles for medical applications; ethical issues, clearance; disposal of medical products

TOTAL: 45 PERIODS

OUTCOMES
Upon completion of this course, the student shall know the
CO1: Types of materials used for biomedical applications
CO2: Health care and hygiene products
CO3: Different types of bandages
CO4: Wound dressing construction, testing
CO5: Implantable products, scaffolds for tissue engineering, ethical issues

REFERENCES
1. Allison Mathews and Martin Hardingham., “Medical and Hygiene Textile Production - A
2. Anand S.C., Kennedy J.F. Miraftab M. and Rajendran S., “Medical Textiles and
Biomaterials for Health care”, Wood head Publishing Ltd. 2006.
185573317X.
6. Adanur S., “ Wellington Sears Handbook of Industrial Textiles” Technomic
ISBN 1 84569 2713.
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**Overall CO**: 3 2 3 3 - 1

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**TX4091  SUSTAINABILITY IN TEXTILE INDUSTRY**  
**L T P C**: 3 0 0 3  

**OBJECTIVE**  
To enable the students to learn the concepts of sustainability and its importance in textile industry.

**UNIT I  INTRODUCTION TO SUSTAINABILITY**  
Sustainability; Concepts and terminologies in sustainable approach; principles of sustainability; importance and application of sustainable approaches in textile industry.

**UNIT II  SUSTAINABILITY IN TEXTILE INDUSTRY**  
Supply chain in textile industry; sustainable cotton, wool, and synthetic fibre production and processing.

**UNIT III  SUSTAINABILITY IN PROCESSING**  
Enzyme biotechnology, plasma technology in textiles; waterless dyeing technologies, low liquor dyeing; sustainability in effluent treatment, water saving, zero hazardous chemicals.

**UNIT IV  RECYCLING**  
Textile recycling: polymer, fibre, yarn and fabric; consumer perception of recycled textile products.

**UNIT V  ECO DESIGNING AND ECOLABELLING**  
Eco-design, building eco-design through supply chain; sustainability for credit rating; environmental management systems; standards for labelling, textile labels and environmental labelling; life cycle analysis of textiles.

**TOTAL: 45 PERIODS**

**OUTCOMES**  
Upon completion of this course the student shall be able to understand the  
CO1: Concept of sustainability and importance  
CO2: Sustainability in textile fibre production  
CO3: Sustainability in dyeing of textiles  
CO4: Importance of recycling in textile industry  
CO5: Eco-labelling and eco-designing
REFERENCES

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<td>CO4</td>
<td>Importance of recycling in textile industry</td>
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<td>Eco-labelling and eco-designing</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

TX4014 THEORY OF TWISTING L T P C 3 0 0 3

OBJECTIVE
To enable the students to learn about the principle of twist insertion in different spinning systems

UNIT I FUNDAMENTALS OF TWISTING 9
Mechanics of imparting strength to a staple-fibre strand by twisting; meaning of twist multiplier and the basis of selection of required twist; principle of false twisting; fundamental requirements to create real twist in the strand.

UNIT II TWISTING IN RING SPINNING 9
Principle of twist insertion in ring spinning; limitations of ring twisting; mechanics of balloon formed during twisting, yarn tension; influence of twisting on spinning triangle size and the subsequent effect on yarn quality and spinning performance; design features of rings and travelers used for twisting different types of yams.
UNIT III TWISTING IN OPEN-END SPINNING
Principle of twist insertion in open-end spinning; application of this principle in rotor spinning and friction spinning machines; advantages of this method of twisting over ring twisting method; comparison of yarn tension developed during twisting in these two machines.

UNIT IV TWISTING IN AIR-JET AND AIR-VORTEX SPINNING
Principle of twist formation in air-jet, air vortex spinning; the merits and demerits of these methods of twisting; factors influencing twist insertion

UNIT V OTHER TWISTING PRINCIPLES
Principle of two-for-one twisting; twisting of yarns in double-rope fed spinning machines; operating principle involved in the twisting of core spun yarns, wrap-spun yarns; self-twist spinning; electrostatic spinning

TOTAL 45 PERIODS

OUTCOMES
Upon completion of this course, the student shall able to understand
CO1: Fundamentals of twisting
CO2: Theory of twisting at ring frame
CO3: Twisting principle of open end spinning and application in rotor and friction spinning systems
CO4: Twisting in air-jet and air-vortex spinning
CO5: Principle and method of twisting in two for one twisting system and other spinning systems

REFERENCE:

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<td>Twisting principle of open end spinning and application in rotor and friction spinning systems</td>
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<td>Twisting in air jet and air-vortex spinning</td>
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<td>Principle and method of twisting in two for one twisting system and other spinning systems</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.

**OBJECTIVES**
To enable the students to learn about
- Textiles used for civil construction and transportation applications and their functional requirements and
- Evaluation of textile materials used for civil construction and transportation applications.

**UNIT I GEO TEXTILES I**
Geo textile – definition, types, functions; types of fibers and fabrics used in geo textiles; applications of natural fibers in geo-textiles; joining of geo- textiles

**UNIT II GEO TEXTILES II**
Usage of geo-synthetics in civil engineering applications as filters, reinforcement, separation and drainage medium; material specifications and design criteria of geo-synthetics for specific applications

**UNIT III ARCHITECTURE TEXTILES**
Fiber and fabric property requirements for architecture textiles; coated textiles; Tents, Awnings and Canopies; Inflatable structures – high pressure and low pressure inflatable structures; textile for roofing applications; acoustic and heat insulation textiles; floor and wall covering, scaffolding nets

**UNIT IV TRANSPORTATION TEXTILES**
Quality and design of textile materials used in automobiles – tire cord, filter, air bag, belt, seat cover, noise insulation; design and development of textile reinforced composites in automobile, marine and aeronautic industry.

**UNIT V EVALUATION**
Evaluation of textile material used in civil construction and transportation industry in terms of performance, construction survivability and durability

**TOTAL: 45 PERIODS**

**OUTCOMES**
Upon completion of this course, the student shall be able to
CO1: Understand the requirements of textiles used for civil construction and transportation applications and
CO2: Understand geo synthetics in civil engineering applications
CO3: Design the textiles for the architectural applications
CO4: Design of textile materials for automobile industry
CO5: Evaluation of textiles to be used for civil construction and transportation industry

**REFERENCES**

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<td>Understand geo synthetics in civil engineering applications</td>
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<td>CO3</td>
<td>Design the textiles for the architectural applications</td>
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<td>CO4</td>
<td>Design of textile materials for automobile industry</td>
<td>3   2   3   3   -   1</td>
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<tr>
<td>CO5</td>
<td>Evaluation of textiles to be used for civil construction and transportation industry</td>
<td>3   2   3   3   -   1</td>
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**TX4072 FUNCTIONAL DYES**

**OBJECTIVES**

To enable the students to
- recall the basics of dyes and their use in textile industry
- define functional dyes and recognize their use
- understand the application of functional dyes
- know the importance of toxicity and health aspects of dyes

**UNIT I BASICOS DYES**

General survey of dyes; chemical structure of dyes, general properties of dyes, chromophores and dye classes for textile application

**UNIT II DYSES USED IN TEXTILES**

Dyeing technology; standardization of textile dyes: dyes for cellulosic fibres, polyamides, polyesters and acrylic fibres; optical brightening agents: chemistry and evaluation of OBA

**UNIT III FUNCTIONAL DYES**

Functional dyes: dyes for leather; fur; paper; hair; food and inks – introduction, chemical structure and requirements

**UNIT IV APPLICATION OF FUNCTIONAL DYSES**

Dyes used for imaging, invisible imaging, displays, electronic materials and biomedical applications; solar cells

**UNIT V TOXICOLOGY AND HEALTH ASPECTS**

Toxicity and environmental assessment; regulatory and legislative aspects

**TOTAL: 45 PERIODS**
OUTCOMES
Upon completion of this course the student shall be able to understand
CO1: Chemical structure and properties of dyes
CO2: Dyes used in textiles
CO3: Functional dyes, their chemical structure and requirements
CO4: Applications of the functional dyes in different industries
CO5: Toxicity and health issues

REFERENCES:
8. Non-Textile Dyes, Freeman H. S.

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<td>Applications of the functional dyes in different industries</td>
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TX4016 POLLUTION ABATEMENT IN TEXTILE INDUSTRY

OBJECTIVE
- To enable the students to learn about pollutants from textile chemical processing industry, treatment and Government regulations

UNIT I ENVIRONMENTAL POLLUTION
Industrial policy of India; pollution monitoring and control; functions and activities of Ministry of Environment; Central and State pollution control boards; environmental clearance and guidelines
for industries; environment impact assessment; fiscal incentives for environmental protection; environmental auditing; Introduction to water, air and Noise pollution Control

UNIT II   WASTEWATER TREATMENT
Wastewater characteristics; wastewater treatment - objectives, methods and implementation considerations; recycling of effluents

UNIT III   TEXTILE EFFLUENTS
Identification and reduction of pollution sources in textile wet processing; pollution control in man-made fibre industry; analysis of textile processing effluents – colour, odour, pH, total solids, suspended solids, total dissolved solids, BOD, COD, total alkalinity, chloride, sulphates, calcium and chromium; tolerance limits for effluents; bio - degradability of textile chemicals and auxiliaries.

UNIT IV   SAFETY AND HEALTH ASPECTS
Technical regulations on safety and health aspects of textile materials – banned dyes and chemicals; eco labeling, eco friendly textile processes - machines and specialty chemicals; natural dyes and environmental considerations.

UNIT V   WASTE MANAGEMENT
Need for solid and hazardous waste management in textile industry, types and sources of solid and hazardous wastes, storage, collection and transport of wastes, waste processing technologies, waste disposal

OUTCOMES
Upon completion of this course, the student shall know about
CO1: Pollution control policies and Government regulations
CO2: Method of treatment of waste water from processing industry
CO3: Managing pollutants as per Government regulations
CO4: Eco labeling, eco friendly textile processes
CO5: Solid and hazardous waste management in textile industry

TOTAL: 45 PERIODS

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<td>Method of treatment of waste water from processing industry</td>
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<tr>
<td>CO3</td>
<td>Managing pollutants as per Government regulations</td>
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**TX4071 CHARACTERIZATION OF TEXTILE POLYMERS**

**OBJECTIVE**
To enable the students to learn about characterization of polymers used in the production of textile fibres

**UNIT I MOLECULAR WEIGHT**
9
Polymer solution thermo dynamics; molecular weight and molecular dimensions by end group analysis, osmometry, light scattering, viscometry, gel permeation chromatography, high performance liquid chromatography

**UNIT II MOLECULAR STRUCTURE CHARACTERISATION**
9
Infrared, NMR, UV–visible, Raman spectroscopy, mass spectroscopy

**UNIT III THERMAL PROPERTIES**
9
Thermal properties by differential scanning calorimetry, differential thermal analysis, thermo gravimetry, thermo-mechanical analyzer, dynamic mechanical and dielectric analysis

**UNIT IV MICROSCOPY**
9
Optical and electron microscopy; TEM, SEM, AFM, X-ray scattering from polymers, birefringence

**UNIT V OTHER PROPERTIES**
9
Crystallinity by density measurements, surface area, pore volume measurements by B.E.T. method, porosimetry, surface energy measurements and particle size measurement.

**TOTAL: 45 PERIODS**

**OUTCOMES:**
Upon completion of this course, the student shall be able to
CO1: Determine the molecular weight using various techniques
CO2: Interpret molecular structure obtained from various analytical instruments
CO3: Determine the thermal properties using various instruments
CO4: Understand microscopy
CO5: Understand the properties of textile polymers

**REFERENCES**

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<td>Interpret molecular structure obtained from various analytical instruments</td>
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<td>Understand microscopy</td>
<td>PO1 3  PO2 2  PO3 3  PO4 3  PO5  -  PO6 1</td>
</tr>
<tr>
<td>CO5</td>
<td>Understand the properties of textile polymers</td>
<td>PO1 3  PO2 2  PO3 3  PO4 3  PO5  -  PO6 1</td>
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<td>3  PO1 2  PO2 3  PO3 3  PO4 3  PO5  -  PO6 1</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

TX4092

TEXTILE REINFORCED COMPOSITES

L T P C

3 0 0 3

OBJECTIVES

To enable the students to learn about

- Reinforcements, matrices used for the composites
- Manufacture and testing of composites and
- Mechanics of failure of composites

UNIT I   REINFORCEMENTS

Introduction – composites –classification and application; reinforcements- fibres and its properties; preparation of reinforced materials and quality evaluation; preforms for various composites

UNIT II   MATRICES

Preparation, chemistry, properties and applications of thermoplastic and thermoset resins; mechanism of interaction of matrices and reinforcements; optimization of matrices

UNIT III  COMPOSITE MANUFACTURING

Classification; methods of composites manufacturing for both thermoplastics and thermosets- Hand layup, Filament Winding, Resin transfer moulding, prepregs and autoclave moulding, pultrusion, vacuum impregnation methods, compression moulding; post processing of composites and composite design requirements

UNIT IV   TESTING

Fibre volume and weight fraction, specific gravity of composites, tensile, flexural, impact, compression, inter laminar shear stress and fatigue properties of thermoset and thermoplastic composites.
UNIT V MECHANICS
Micro mechanics, macro mechanics of single layer, macro mechanics of laminate, classical lamination theory, failure theories and prediction of inter laminar stresses using at ware

TOTAL: 45 PERIODS

OUTCOMES
Upon completion of this course, the student shall be able to
CO1: Understand different types of textile reinforcements
CO2: Understand different types of matrices
CO3: Understand manufacturing of composites
CO4: Evaluate the properties of thermoset and thermoplastic composite
CO5: Mechanics of composites failure

REFERENCES

Course Articulation Matrix:

<table>
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<tr>
<td>CO3</td>
<td>Understand manufacturing of composites</td>
<td>3</td>
</tr>
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<td></td>
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<tr>
<td>CO4</td>
<td>Evaluate the properties of thermoset and</td>
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<td>thermoplastic composite</td>
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<td>Mechanics of composites failure</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

TX4017 COLOUR SCIENCE AND ITS APPLICATION L T P C 3 0 0 3

OBJECTIVE:
- To enable the students to understand the theory of colour and measurement of colour

UNIT I LIGHT-MATTER INTERACTION
Electromagnetic spectrum – the optical region, interaction of light with matter a) Transparent case— Beer’s Law and Lambert’s Law b) Opaque case – reflection absorption and scattering, the concept of “Radiative Transfer Theory” and its simplification into the Kubelka – Munk model
UNIT II  HUMAN COLOUR VISION
Colour sensation – physiological and psychological mechanism of colour vision; colour vision theories; defects in colour vision; colour vision tests; additive and subtractive colour mixing and confusion in colour perception

UNIT III  COLOUR ORDER SYSTEMS
Description of colour, various colour order systems, CIE numerical system for colour definition and its components – illuminants, the versions of the standard observer, the colour scales, chromaticity diagram.

UNIT IV  METAMERISM AND COLOUR DIFFERENCE ASSESSMENT
Metamerism – types and its assessment, metamerism in textile materials; colour differences – visual assessment, standard conditions, methods and problems, assessment of colour difference, non-linearity of subjective perception of colour, need for specific colour difference systems, setting up of objective pass/fail standards.

UNIT V  NUMERICAL COLOUR MATCHING
Reflectance and K/S value, relationship between dye concentrations and a) reflectance values and b) K/S values, reflectance and K/S curves of dyed samples; CIE model for computer colour matching and the calculation of colour recipes; non CIE models for colour matching, limitations of computer colour matching, shade sorting

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, the students shall be able to know about
CO1: Light matter interaction using various theories and laws
CO2: Colour vision theories, tests and colour mixing
CO3: Concepts of colour and colour order system
CO4: Concepts of Metamerism, colour difference assessment
CO5: Numerical colour matching

REFERENCES
Course Articulation Matrix:

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<td>Colour vision theories, tests and colour mixing</td>
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<td>CO3</td>
<td>Concepts of colour and colour order system</td>
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<tr>
<td>CO4</td>
<td>Concepts of Metamerism, colour difference assessment</td>
<td>2</td>
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<tr>
<td>CO5</td>
<td>Numerical colour matching</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

TX4018 DESIGN AND ANALYSIS OF TEXTILE EXPERIMENTS

OBJECTIVES
To make the students to learn about the
• Fundamentals of experimental design and
• Selection of suitable design and analysis of the results..

UNIT I EXPERIMENTAL DESIGN FUNDAMENTALS
Importance of experiments, experimental strategies, basic principles of design, terminology, ANOVA, steps in experimentation, sample size, normal probability plot, linear regression model.

UNIT II SINGLE FACTOR EXPERIMENTS
Completely randomized design, Randomized block design, Latin square design. Statistical analysis, estimation of model parameters, model adequacy checking, pair wise comparison tests, in respect of textile process, machine and quality parameters.

UNIT III MULTIFACTOR EXPERIMENTS
Two and three factor full factorial experiments, \(2^k\) factorial Experiments, Confounding and Blocking designs; application in textile experiments.

UNIT IV SPECIAL EXPERIMENTAL DESIGNS
Fractional factorial design, nested designs, Split plot design, Introduction to Response Surface Methodology, Experiments with random factors, rules for expected mean squares, approximate F-tests for textile applications.

UNIT V TAGUCHI METHODS
Steps in experimentation, design using Orthogonal Arrays, data analysis, Robust design- control and noise factors, S/N ratios, parameter design, case studies related to textile engineering.

OUTCOME
Upon completion of this course, the student shall be able to
CO1: Understand the fundamentals of experimental design
CO2: Carryout statistical analysis and understand the single factor experiments
CO3: Design the experiment, conduct statistical tests and analyse the results to arrive at the
conclusion
CO4: Understand the response surface methodology and other experimental design
CO5: Analyse the design parameters and case studies related to textile engineering

REFERENCES

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<td>Understand the fundamentals of experimental design</td>
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<tr>
<td>CO2</td>
<td>Carry out statistical analysis and understand the single factor experiments</td>
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<tr>
<td>CO3</td>
<td>Design the experiment, conduct statistical tests and analyse the results to arrive at the conclusion</td>
<td>3     3     2     2     -     1</td>
</tr>
<tr>
<td>CO4</td>
<td>Understand the response surface methodology and other experimental design</td>
<td>3     3     2     2     -     1</td>
</tr>
<tr>
<td>CO5</td>
<td>Analyse the design parameters and case studies related to textile engineering</td>
<td>3     3     2     2     -     1</td>
</tr>
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<td>Overall CO</td>
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<td>3     3     2     2     -     1</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
AUDIT COURSES

AX4091 ENGLISH FOR RESEARCH PAPER WRITING  LTPC 2000

COURSE OBJECTIVES:

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I  INTRODUCTION TO RESEARCH PAPER WRITING  6
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II  PRESENTATION SKILLS  6

UNIT III  TITLE WRITING SKILLS  6
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, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV  RESULT WRITING SKILLS  6
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 V  VERIFICATION SKILLS  6
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS

COURSE OUTCOMES:

CO1 – Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

REFERENCES
COURSE OBJECTIVES:
- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I  INTRODUCTION
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II  REPERCUSSIONS OF DISASTERS AND HAZARDS

UNIT III  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 IV  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 V  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

TOTAL : 30 PERIODS

COURSE OUTCOMES:
CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

REFERENCES:
COURSE OBJECTIVES
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- 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 nationhood in the early years of Indian nationalism.
- 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.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION
History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION
Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

UNIT IV 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 V LOCAL ADMINISTRATION

UNIT VI ELECTION COMMISSION
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

COURSE OUTCOMES
Students will be able to:
- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- 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.
- Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING
1. The Constitution of India, 1950 (Bare Act), Government Publication.
UNIT I
1. நற்றிகணத்தைக் குறிப்பிட்டுக் குறிப்பிட்டு - சதுரக், தர்க், பார்வை
2. மேம்பாடு (82)
   - தமிழக் குறிப்பிட்டு அரசியல்
3. நற்றிகணப் பாபுரொன் மாற்றகாலம்
4. புனிதவதர் (95,195)
   - பாப்பா சிங்கியம் தலைப்பக்கிய

UNIT II
1. அறநூறு குறிக் குறிப்பிட்டு - அம்ம, அவிற்றவர், அபரப்பாண, புருஷாவை, சதுரக், பார்வை
2. பிற அறநூறுகள் - தூரின் மத்தியா
   - தூரின், சின்னகாணம், சிற்றிகக்கள், புரூப்பாக்கத்திற்கு (அபரப்பாண அமினுடைய தலை)

UNIT III
1. கற்றம்பிவிப்பு புரட்சி
   - சின்னகாணம் முற்றகால காலக
2. முழக்கவை துறைநிமிடம் முறுகோக்குக
   - சின்னகாணம் அதுக்காலமிடம் காலக

UNIT IV
1. கற்றம்பிவிப்புப்படற
   - பார்வை பல்காதைசு குறிப்பிட்டு காலக, புரூப்பாக்கப் புரூப்பாக்கக காலக்குத்துக் காலக்குத்துக், அவிற்றவர் வெளிக்கோள் சிற்றிகக்களிக் காலக்குத்துக், அம்ம பெற்றுக
2. பொருளாட்சி
   - அறநூறுகளைப் பதிவு சிற்றிக
3. குறிமரிடு (617, 618)
   - பெயர் பெயர் சிற்றிக
4. சூரியகாலசொறு துரியம் வணிமங்கரா
5. புரட்சிக
   - சின்னகாணம் முறுகோக்குக
6. அன்பாட்சி (4) - மாண்ஜி
   குறிப்பிட்டு (11) - மாண்ஜி
   குறிமரிடு (11) - பாப்பா, புரூ
   குறிமரிடு 50 (27) - பாப்பா
   சின்னகாணம் புரட்சியைச் சிற்றிக
UNIT V  நவீன தமிழ் இலக்கியம்

1. உகரநகடத் தமிழ்,
   - நொடகம்
   - பயண இலக்கியம்
   - கட்டுகர இலக்கியம்
   - முதல் சிறுககத
2. முதல் விடுதகல பபொரொட்டமும் தமிழ் இலக்கியமும்
3. முதல் விடுதகலயும் தமிழ் இலக்கியமும்
4. விடுதகலயும் விளிம்பு நிகலயினரின் பமப்பொட்டில் தமிழ் இலக்கியமும்
5. அறிவியல் தமிழ்
6. நொடகத்தில் தமிழ்
7. சுற்றுசூழல் பபொரொட்டில் தமிழ் இலக்கியம்

TOTAL : 30 PERIODS

தமிழ் இலக்கிய வன்முகாக்க புத்தகங்கள்

1. தமிழ் விளக்கம் கல்லூரிகள் (Tamil Virtual University)
   - www.tamilvu.org
2. தமிழ் விக்கிப்பீடியொ (Tamil Wikipedia)
   - https://ta.wikipedia.org
3. ராம்பவார் அண்டர் விண்ணிப்பு
4. மாத்திரம் கல்கித்இயற்க
   - தமிழ் பல்கலைக் கழகம்
5. தமிழ் வலர்க்கிக் தருவார் (thamilvalarchithurai.com)
6. அறிவியல் கல்கித் தமிழ்
   - தமிழ் பல்கலைக் கழகம்
OBJECTIVE

- Students will be introduced to the concepts and principles of IWRM, which is inclusive of the economics, public-private partnership, water & health, water & food security and legal & regulatory settings.

UNIT I CONTEXT FOR IWRM

Water as a global issue: key challenges – Definition of IWRM within the broader context of development – Key elements of IWRM - Principles – Paradigm shift in water management - Complexity of the IWRM process – UN World Water Assessment - SDGs.

UNIT II WATER ECONOMICS

Economic view of water issues: economic characteristics of water good and services – Non-market monetary valuation methods – Water economic instruments – Private sector involvement in water resources management: PPP objectives, PPP models, PPP processes, PPP experiences through case studies.

UNIT III LEGAL AND REGULATORY SETTINGS

Basic notion of law and governance: principles of international and national law in the area of water management - Understanding UN law on non-navigable uses of international water courses – International law for groundwater management – World Water Forums – Global Water Partnerships - Development of IWRM in line with legal and regulatory framework.

UNIT IV WATER AND HEALTH WITHIN THE IWRM CONTEXT

Links between water and health: options to include water management interventions for health – Health protection and promotion in the context of IWRM – Global burden of Diseases - Health impact assessment of water resources development projects – Case studies.

UNIT V AGRICULTURE IN THE CONCEPT OF IWRM

Water for food production: ‘blue’ versus ‘green’ water debate – Water foot print - Virtual water trade for achieving global water and food security — Irrigation efficiencies, irrigation methods - current water pricing policy– scope to relook pricing.

OUTCOMES

- On completion of the course, the student is expected to be able to

| CO1 | Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management. |
| CO2 | Select the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies. |
| CO3 | Apply law and governance in the context of IWRM. |
| CO4 | Discuss the linkages between water-health; develop a HIA framework. |
| CO5 | Analyse how the virtual water concept pave way to alternate policy options. |

REFERENCES:

4. Technical Advisory Committee, Dublin principles for water as reflected in comparative assessment of institutional and legal arrangements for Integrated Water Resources
OBJECTIVES:
• Understand the accelerating health impacts due to the present managerial aspects and initiatives in water and sanitation and health sectors in the developing scenario

UNIT I FUNDAMENTALS WASH
Meanings and Definition: Safe Water- Health, Nexus: Water- Sanitation - Health and Hygiene – Equity issues-Water security - Food Security. Sanitation And Hygiene (WASH) and Integrated Water Resources Management (IWRM) - Need and Importance of WASH

UNIT II MANAGERIAL IMPLICATIONS AND IMPACT

UNIT III CHALLENGES IN MANAGEMENT AND DEVELOPMENT

UNIT IV GOVERNANCE
Public health -Community Health Assessment and Improvement Planning (CHA/CHIP)- Infrastructure and Investments on Water, (WASH) - Cost Benefit Analysis – Institutional Intervention-Public Private Partnership - Policy Directives - Social Insurance -Political Will vs Participatory Governance -

UNIT V INITIATIVES
Management vs Development -Accelerating Development- Development Indicators -Inclusive Development-Global and Local- Millennium Development Goal (MDG) and Targets - Five Year Plans - Implementation - Capacity Building - Case studies on WASH.

OUTCOMES:
| CO1 | Capture to fundamental concepts and terms which are to be applied and understood all through the study. |
| CO2 | Comprehend the various factors affecting water sanitation and health through the lens of third world scenario. |
| CO3 | Critically analyse and articulate the underlying common challenges in water, sanitation and health. |
| CO4 | Acquire knowledge on the attributes of governance and its say on water sanitation and health. |
| CO5 | Gain an overarching insight in to the aspects of sustainable resource management in the absence of a clear level playing field in the developmental aspects. |

REFERENCES


<table>
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<td>OCE433</td>
<td>PRINCIPLES OF SUSTAINABLE DEVELOPMENT</td>
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**OBJECTIVES:**

- To impart knowledge on environmental, social and economic dimensions of sustainability and the principles evolved through landmark events so as to develop an action mindset for sustainable development.

**UNIT I SUSTAINABILITY AND DEVELOPMENT CHALLENGES**


**UNIT II PRINCIPLES AND FRAME WORK**


**UNIT III SUSTAINABLE DEVELOPMENT AND WELLBEING**


**UNIT IV SUSTAINABLE SOCIO-ECONOMIC SYSTEMS**


**UNIT V ASSESSING PROGRESS AND WAY FORWARD**

- Nature of sustainable development strategies and current practice- Sustainability in global, regional and national context –Approaches to measuring and analysing sustainability– limitations of GDP-

TOTAL: 45 PERIODS

OUTCOMES:
• On completion of the course, the student is expected to be able to

<table>
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<tr>
<td>CO1</td>
<td>Explain and evaluate current challenges to sustainability, including modern world social, environmental, and economic structures and crises.</td>
</tr>
<tr>
<td>CO2</td>
<td>Identify and critically analyze the social environmental, and economic dimensions of sustainability in terms of UN Sustainable development goals.</td>
</tr>
<tr>
<td>CO3</td>
<td>Develop a fair understanding of the social, economic and ecological linkage of Human well being, production and consumption.</td>
</tr>
<tr>
<td>CO4</td>
<td>Evaluate sustainability issues and solutions using a holistic approach that focuses on connections between complex human and natural systems.</td>
</tr>
<tr>
<td>CO5</td>
<td>Integrate knowledge from multiple sources and perspectives to understand environmental limits governing human societies and economies and social justice dimensions of sustainability.</td>
</tr>
</tbody>
</table>

REFERENCES:

OCE434 ENVIRONMENTAL IMPACT ASSESSMENT

OBJECTIVES:
• To make the students to understand environmental clearance, its legal requirements and to provide knowledge on overall methodology of EIA, prediction tools and models, environmental management plan and case studies.

UNIT I INTRODUCTION

UNIT II IMPACT IDENTIFICATION AND PREDICTION
UNIT III  SOCIO-ECONOMIC IMPACT ASSESSMENT  
Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts. communities in transition-rehabilitation

UNIT IV  EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN  
Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact assessment

UNIT V  CASE STUDIES  
Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects

OUTCOMES:  
• On completion of the course, the student is expected to be able to

| CO1 | Understand need for environmental clearance, its legal procedure, need of EIA, its types, stakeholders and their roles |
| CO2 | Understand various impact identification methodologies, prediction techniques and model of impacts on various environments |
| CO3 | Understand relationship between social impacts and change in community due to development activities and rehabilitation methods |
| CO4 | Document the EIA findings and prepare environmental management and monitoring plan |
| CO5 | Identify, predict and assess impacts of similar projects based on case studies |

REFERENCES:
1. EIA Notification 2006 including recent amendments, by Ministry of Environment, Forest and Climate Change, Government of India
2. Sectoral Guidelines under EIA Notification by Ministry of Environment, Forest and Climate Change, Government of India

OIC431  BLOCKCHAIN TECHNOLOGIES  
L T P C  3 0 0 3

COURSE OBJECTIVES:
• This course is intended to study the basics of Blockchain technology.
• During this course the learner will explore various aspects of Blockchain technology like application in various domains.
• By implementing, learners will have idea about private and public Blockchain, and smart contract.
UNIT I  INTRODUCTION OF CRYPTOGRAPHY AND BLOCKCHAIN  
Introduction to Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions and Blocks, P2P Systems, Keys as Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.

UNIT II  BITCOIN AND CRYPTOCURRENCY  

UNIT III  INTRODUCTION TO ETHEREUM  
Introduction to Ethereum, Consensus Mechanisms, Metamask Setup, Ethereum Accounts, Transactions, Receiving Ethers, Smart Contracts.

UNIT-IV  INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING  

UNIT V  BLOCKCHAIN APPLICATIONS  
Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.

COURSE OUTCOMES:
After the completion of this course, student will be able to
CO1: Understand and explore the working of Blockchain technology
CO2: Analyze the working of Smart Contracts
CO3: Understand and analyze the working of Hyperledger
CO4: Apply the learning of solidity to build de-centralized apps on Ethereum
CO5: Develop applications on Blockchain

REFERENCES:

OIC432  DEEP LEARNING  
COURSE OBJECTIVES:
- Develop and Train Deep Neural Networks.
- Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
- Build and train RNNs, work with NLP and Word Embeddings
- The internal structure of LSTM and GRU and the differences between them
The Auto Encoders for Image Processing

UNIT I DEEP LEARNING CONCEPTS

UNIT II NEURAL NETWORKS

UNIT III CONVOLUTIONAL NEURAL NETWORK

UNIT IV NATURAL LANGUAGE PROCESSING USING RNN

UNIT V DEEP REINFORCEMENT & UNSUPERVISED LEARNING

COURSE OUTCOMES:
CO1: Feature Extraction from Image and Video Data
CO2: Implement Image Segmentation and Instance Segmentation in Images
CO3: Implement image recognition and image classification using a pretrained network (Transfer Learning)
CO4: Traffic Information analysis using Twitter Data
CO5: Autoencoder for Classification & Feature Extraction

TOTAL : 45 PERIODS

REFERENCES
1. Deep Learning A Practitioner’s Approach Josh Patterson and Adam Gibson O’Reilly Media, Inc.2017
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017
OBJECTIVES
- To appreciate the basic concepts of vibration in damped and undamped systems
- To appreciate the basic concepts of noise, its effect on hearing and related terminology
- To use the instruments for measuring and analyzing the vibration levels in a body
- To use the instruments for measuring and analyzing the noise levels in a system
- To learn the standards of vibration and noise levels and their control techniques

UNIT- I BASICS OF VIBRATION

UNIT- II BASICS OF NOISE
Introduction - Anatomy of human ear - Mechanism of hearing - Amplitude, frequency, wavelength and sound pressure level - Relationship between sound power, sound intensity and sound pressure level - Addition, subtraction and averaging decibel levels - sound spectra -Types of sound fields - Octave band analysis - Loudness.

UNIT- III INSTRUMENTATION FOR VIBRATION MEASUREMENT

UNIT- IV INSTRUMENTATION FOR NOISE MEASUREMENT AND ANALYSIS
Microphones - Weighting networks - Sound Level meters, its classes and calibration - Noise measurements using sound level meters - Data Loggers - Sound exposure meters - Recording of noise - Spectrum analyser - Intensity meters - Energy density sensors - Sound source localization.

UNIT- V METHODS OF VIBRATION CONTROL, SOURCES OF NOISE AND ITS CONTROL

TOTAL: 45 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
1. apply the basic concepts of vibration in damped and undamped systems
2. apply the basic concepts of noise and to understand its effects on systems
3. select the instruments required for vibration measurement and its analysis
4. select the instruments required for noise measurement and its analysis.
5. recognize the noise sources and to control the vibration levels in a body and to control noise under different strategies.

REFERENCES:
OMETE432

ENERGY CONSERVATION AND MANAGEMENT IN DOMESTIC SECTORS

T P C

3 0 0 3

COURSE OBJECTIVES:
1. To learn the present energy scenario and the need for energy conservation.
2. To understand the different measures for energy conservation in utilities.
3. To acquaint students with principle theories, materials, and construction techniques to create energy efficient buildings.
4. To identify the energy demand and bridge the gap with suitable technology for sustainable habitat.
5. To get familiar with the energy technology, current status of research and find the ways to optimize a system as per the user requirement.

UNIT I

ENERGY SCENARIO


UNIT II

HEATING, VENTILATION & AIR CONDITIONING


UNIT III

LIGHTING, COMPUTER, TV


UNIT IV

ENERGY EFFICIENT BUILDINGS


UNIT V

ENERGY STORAGE TECHNOLOGIES

Necessity & types of energy storage – Thermal energy storage – Battery energy storage, charging and discharging– Hydrogen energy storage & Super capacitors – energy density and safety issues – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Understand technical aspects of energy conservation scenario.
2. Energy audit in any type for domestic buildings and suggest the conservation measures.
3. Perform building load estimates and design the energy efficient landscape system.
4. Gain knowledge to utilize an appliance/device sustainably.
5. Understand the status and current technological advancement in energy storage field.
REFERENCES:
   (Could be downloaded from www.energymanagertraining.com)

OME433 ADDITIVE MANUFACTURING

UNIT I INTRODUCTION

UNIT II DESIGN FOR ADDITIVE MANUFACTURING

UNIT III VAT POLYMERIZATION

UNIT IV MATERIAL EXTRUSION AND SHEET LAMINATION

POWDER BASED PROCESS
UNIT V CASE STUDIES AND OPPORTUNITIES ADDITIVE MANUFACTURING PROCESSES 9

REFERENCES:

OME434 ELECTRIC VEHICLE TECHNOLOGY

UNIT I NEED FOR ELECTRIC VEHICLES
History and need for electric and hybrid vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies, comparison of diesel, petrol, electric and hybrid vehicles, limitations, technical challenges

UNIT II ELECTRIC VEHICLE ARCHITECTURE
Electric vehicle types, layout and power delivery, performance – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, Concepts of hybrid electric drive train, architecture of series and parallel hybrid electric drive train, merits and demerits, mild and full hybrids, plug-in hybrid electric vehicles and range extended hybrid electric vehicles, Fuel cell vehicles.

UNIT III ENERGY STORAGE
Batteries – types – lead acid batteries, nickel based batteries, and lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, Battery modeling and equivalent circuit, battery charging and types, battery cooling, Ultra-capacitors, Flywheel technology, Hydrogen fuel cell, Thermal Management of the PEM fuel cell

UNIT IV ELECTRIC DRIVES AND CONTROL
Types of electric motors – working principle of AC and DC motors, advantages and limitations, DC motor drives and control, Induction motor drives and control, PMSM and brushless DC motor - drives and control , AC and Switch reluctance motor drives and control – Drive system efficiency – Inverters – DC and AC motor speed controllers

UNIT V DESIGN OF ELECTRIC VEHICLES
Materials and types of production, Chassis skate board design, motor sizing, power pack sizing, component matching, Ideal gear box – Gear ratio, torque–speed characteristics, Dynamic equation of vehicle motion, Maximum tractive effort – Power train tractive effort Acceleration performance, rated vehicle velocity – maximum gradability, Brake performance, Electronic control system, safety
and challenges in electric vehicles. Case study of Nissan Leaf, Toyota Prius, Tesla Model 3, and Renault Zoe cars.

TOTAL: 45 PERIODS

REFERENCES:

OME435 NEW PRODUCT DEVELOPMENT

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Applying the principles of generic development process; and understanding the organization structure for new product design and development.
2. Identifying opportunity and planning for new product design and development.
3. Conducting customer need analysis; and setting product specification for new product design and development.
4. Generating, selecting, and testing the concepts for new product design and development.
5. Applying the principles of industrial design and prototype for new product design and development.

UNIT I INTRODUCTION TO PRODUCT DESIGN & DEVELOPMENT

UNIT II OPPORTUNITY IDENTIFICATION & PRODUCT PLANNING

UNIT III IDENTIFYING CUSTOMER NEEDS & PRODUCT SPECIFICATIONS

UNIT IV CONCEPT GENERATION, SELECTION & TESTING

UNIT V INDUSTRIAL DESIGN & PROTOTYPING

TOTAL: 45 PERIODS

72
COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Apply the principles of generic development process; and understand the organization structure for new product design and development.
2. Identify opportunity and plan for new product design and development.
3. Conduct customer need analysis; and set product specification for new product design and development.
4. Generate, select, and test the concepts for new product design and development.
5. Apply the principles of Industrial design and prototype for design and develop new products.

TEXT BOOK:

REFERENCES:

OBA431 SUSTAINABLE MANAGEMENT LT P C
COURSE OBJECTIVES:
- To provide students with fundamental knowledge of the notion of corporate sustainability.
- To determine how organizations impacts on the environment and socio-technical systems, the relationship between social and environmental performance and competitiveness, the approaches and methods.

UNIT I MANAGEMENT OF SUSTAINABILITY
Management of sustainability - rationale and political trends: An introduction to sustainability management, International and European policies on sustainable development, theoretical pillars in sustainability management studies.

UNIT II CORPORATE SUSTAINABILITY AND RESPONSIBILITY
Corporate sustainability parameter, corporate sustainability institutional framework, integration of sustainability into strategic planning and regular business practices, fundamentals of stakeholder engagement.

UNIT III SUSTAINABILITY MANAGEMENT: STRATEGIES AND APPROACHES
Corporate sustainability management and competitiveness: Sustainability-oriented corporate strategies, markets and competitiveness, Green Management between theory and practice, Sustainable Consumption and Green Marketing strategies, Environmental regulation and strategic postures; Green Management approaches and tools; Green engineering: clean technologies and innovation processes; Sustainable Supply Chain Management and Procurement.

UNIT IV SUSTAINABILITY AND INNOVATION
Socio-technical transitions and sustainability, Sustainable entrepreneurship, Sustainable pioneers in green market niches, Smart communities and smart specializations.

UNIT V SUSTAINABLE MANAGEMENT OF RESOURCES, COMMODITIES AND COMMONS
COURSE OUTCOMES:
CO1: An understanding of sustainability management as an approach to aid in evaluating and minimizing environmental impacts while achieving the expected social impact.
CO2: An understanding of corporate sustainability and responsible Business Practices
CO3: Knowledge and skills to understand, to measure and interpret sustainability performance.
CO4: Knowledge of innovative practices in sustainable business and community management
CO5: Deep understanding of sustainable management of resources and commodities

REFERENCES:
4. Margaret Robertson, Sustainability Principles and Practice, 2014
5. Peter Rogers, An Introduction to Sustainable Development, 2006

OBA432 MICRO AND SMALL BUSINESS MANAGEMENT

COURSE OBJECTIVES
- To familiarize students with the theory and practice of small business management.
- To learn the legal issues faced by small business and how they impact operations.

UNIT I INTRODUCTION TO SMALL BUSINESS

UNIT II SCREENING THE BUSINESS OPPORTUNITY AND FORMULATING THE BUSINESS PLAN
Concepts of opportunity recognition; Key factors leading to new venture failure; New venture screening process; Applying new venture screening process to the early stage small firm Role planning in small business – importance of strategy formulation – management skills for small business creation and development.

UNIT III BUILDING THE RIGHT TEAM AND MARKETING STRATEGY
Management and Leadership – employee assessments – Tuckman's stages of group development - The entrepreneurial process model - Delegation and team building - Comparison of HR management in small and large firms - Importance of coaching and how to apply a coaching model.
Marketing within the small business - success strategies for small business marketing - customer delight and business generating systems, - market research, - assessing market performance - sales management and strategy - the marketing mix and marketing strategy.

UNIT IV FINANCING SMALL BUSINESS
Main sources of entrepreneurial capital; Nature of 'bootstrap' financing - Difference between cash and profit - Nature of bank financing and equity financing - Funding-equity gap for small firms. Importance of working capital cycle - Calculation of break-even point - Power of gross profit
UNIT V VALUING SMALL BUSINESS AND CRISIS MANAGEMENT
Causes of small business failure - Danger signals of impending trouble - Characteristics of poorly performing firms - Turnaround strategies - Concept of business valuation - Different valuation measurements - Nature of goodwill and how to measure it - Advantages and disadvantages of buying an established small firm - Process of preparing a business for sale.

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1. Familiarise the students with the concept of small business
CO2. In depth knowledge on small business opportunities and challenges
CO3. Ability to devise plans for small business by building the right skills and marketing strategies
CO4. Identify the funding source for small start ups
CO5. Business evaluation for buying and selling of small firms

REFERENCES
3. Journal articles on SME’s.

OBA433 INTELLECTUAL PROPERTY RIGHTS

COURSE OBJECTIVE
➢ To understand intellectual property rights and its valuation.

UNIT I INTRODUCTION
Intellectual property rights - Introduction, Basic concepts, Patents, Copyrights, Trademarks, Trade Secrets, Geographic Indicators; Nature of Intellectual Property, Technological Research, Inventions and Innovations, History - the way from WTO to WIPO, TRIPS.

UNIT II PROCESS
New Developments in IPR, Procedure for grant of Patents, TM, GIs, Patenting under Patent Cooperation Treaty, Administration of Patent system in India, Patenting in foreign countries.

UNIT III STATUTES

UNIT IV STRATEGIES IN INTELLECTUAL PROPERTY
Strategies for investing in R&D, Patent Information and databases, IPR strength in India, Traditional Knowledge, Case studies.
UNIT V MODELS
The technologies Know-how, concept of ownership, Significance of IP in Value Creation, IP Valuation and IP Valuation Models, Application of Real Option Model in Strategic Decision Making, Transfer and Licensing.

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1: Understanding of intellectual property and appreciation of the need to protect it
CO2: Awareness about the process of patenting
CO3: Understanding of the statutes related to IPR
CO4: Ability to apply strategies to protect intellectual property
CO5: Ability to apply models for making strategic decisions related to IPR

REFERENCES
2. Intellectual Property rights and copyrights, EssEss Publications.

OBA434 ETHICAL MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVE
➢ To help students develop knowledge and competence in ethical management and decision making in organizational contexts.

UNIT I ETHICS AND SOCIETY
Ethical Management- Definition, Motivation, Advantages-Practical implications of ethical management. Managerial ethics, professional ethics, and social Responsibility-Role of culture and society’s expectations- Individual and organizational responsibility to society and the community.

UNIT II ETHICAL DECISION MAKING AND MANAGEMENT IN A CRISIS
Managing in an ethical crisis, the nature of a crisis, ethics in crisis management, discuss case studies, analyze real-world scenarios, develop ethical management skills, knowledge, and competencies. Proactive crisis management.

UNIT III STAKEHOLDERS IN ETHICAL MANAGEMENT
Stakeholders in ethical management, identifying internal and external stakeholders, nature of stakeholders, ethical management of various kinds of stakeholders: customers (product and service issues), employees (leadership, fairness, justice, diversity) suppliers, collaborators, business, community, the natural environment (the sustainability imperative, green management, Contemporary issues).

UNIT IV INDIVIDUAL VARIABLES IN ETHICAL MANAGEMENT
Understanding individual variables in ethics, managerial ethics, concepts in ethical psychology-ethical awareness, ethical courage, ethical judgment, ethical foundations, ethical emotions/intuitions/intensity. Utilization of these concepts and competencies for ethical decision-making and management.
UNIT V  PRACTICAL FIELD-GUIDE, TECHNIQUES AND SKILLS  9
Ethical management in practice, development of techniques and skills, navigating challenges and dilemmas, resolving issues and preventing unethical management proactively. Role modelling and creating a culture of ethical management and human flourishing.

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1: Role modelling and influencing the ethical and cultural context.
CO2: Respond to ethical crises and proactively address potential crises situations.
CO3: Understand and implement stakeholder management decisions.
CO4: Develop the ability, knowledge, and skills for ethical management.
CO5: Develop practical skills to navigate, resolve and thrive in management situations

REFERENCES

ET4251  IoT FOR SMART SYSTEMS  LT P C  3 0 0 3

COURSE OBJECTIVES:
1. To study about Internet of Things technologies and its role in real time applications.
2. To introduce the infrastructure required for IoT
3. To familiarize the accessories and communication techniques for IoT.
4. To provide insight about the embedded processor and sensors required for IoT
5. To familiarize the different platforms and Attributes for IoT

UNIT I  INTRODUCTION TO INTERNET OF THINGS  9
Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.

UNIT II  IOT ARCHITECTURE  9

UNIT III  PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT  9
PROTOCOLS:
NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCCe GSM, CDMA, LTE, GPRS, small cell.

Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems-Recent trends.

UNIT IV  IOT PROCESSORS  9
Services/Attributes: Big-Data Analytics for IOT, Dependability,Interoperability, Security, Maintainability.
Embedded processors for IOT :Introduction to Python programming -Building IOT with RASPERRY PI and Arduino.
UNIT V  CASE STUDIES
Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will have the ability to
CO1: Analyze the concepts of IoT and its present developments.
CO2: Compare and contrast different platforms and infrastructures available for IoT
CO3: Explain different protocols and communication technologies used in IoT
CO4: Analyze the big data analytic and programming of IoT
CO5: Implement IoT solutions for smart applications

REFERENCES:

ET4072  MACHINE LEARNING AND DEEP LEARNING

COURSE OBJECTIVES:
The course is aimed at
1. Understanding about the learning problem and algorithms
2. Providing insight about neural networks
3. Introducing the machine learning fundamentals and significance
4. Enabling the students to acquire knowledge about pattern recognition.
5. Motivating the students to apply deep learning algorithms for solving real life problems.

UNIT I  LEARNING PROBLEMS AND ALGORITHMS
Various paradigms of learning problems, Supervised, Semi-supervised and Unsupervised algorithms
UNIT II    NEURAL NETWORKS

UNIT III    MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS
Classifying Samples: The confusion matrix, Accuracy, Precision, Recall, F1-Score, the curse of dimensionality, training, testing, validation, cross validation, overfitting, under-fitting the data, early stopping, regularization, bias and variance. Feature Selection, normalization, dimensionality reduction, Classifiers: KNN, SVM, Decision trees, Naïve Bayes, Binary classification, multi class classification, clustering.

UNIT IV    DEEP LEARNING: CONVOLUTIONAL NEURAL NETWORKS
Feed forward networks, Activation functions, back propagation in CNN, optimizers, batch normalization, convolution layers, pooling layers, fully connected layers, dropout, Examples of CNNs.

UNIT V    DEEP LEARNING: RNNS, AUTOENCODERS AND GANS
State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text, Autoencoders: Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders, GANs: The discriminator, generator, DCGANs

TOTAL: 45 PERIODS

COURSE OUTCOMES (CO):
At the end of the course the student will be able to
CO1: Illustrate the categorization of machine learning algorithms.
CO2: Compare and contrast the types of neural network architectures, activation functions
CO3: Acquaint with the pattern association using neural networks
CO4: Elaborate various terminologies related with pattern recognition and architectures of convolutional neural networks
CO5: Construct different feature selection and classification techniques and advanced neural network architectures such as RNN, Autoencoders, and GANs.

REFERENCES:
OBJECTIVES:
To impart knowledge on
- Different types of renewable energy technologies
- Standalone operation, grid connected operation of renewable energy systems

UNIT I  INTRODUCTION
Classification of energy sources – Co2 Emission - Features of Renewable energy - Renewable energy scenario in India - Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment Per Capital Consumption - CO$_2$ Emission - importance of renewable energy sources, Potentials – Achievements– Applications.

UNIT II  SOLAR PHOTOVOLTAICS

UNIT III  PHOTOVOLTAIC SYSTEM DESIGN
Block diagram of solar photo voltaic system : Line commutated converters (inversion mode) - Boost and buck-boost converters - selection of inverter, battery sizing, array sizing - PV systems classification- standalone PV systems - Grid tied and grid interactive inverters- grid connection issues.

UNIT IV  WIND ENERGY CONVERSION SYSTEMS

UNIT V  OTHER RENEWABLE ENERGY SOURCES
Qualitative study of different renewable energy resources: ocean, Biomass, Hydrogen energy systems, Fuel cells, Ocean Thermal Energy Conversion (OTEC), Tidal and wave energy, Geothermal Energy Resources.

TOTAL : 45 PERIODS

OUTCOMES:
After completion of this course, the student will be able to:
- CO1: Demonstrate the need for renewable energy sources.
- CO2: Develop a stand-alone photo voltaic system and implement a maximum power point tracking in the PV system.
- CO3: Design a stand-alone and Grid connected PV system.
- CO4: Analyze the different configurations of the wind energy conversion systems.
- CO5: Realize the basic of various available renewable energy sources

REFERENCES:

PS4093 SMART GRID L T P C 3 0 0 3

COURSE OBJECTIVES
• To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
• To know about the function of smart grid.
• To familiarize the power quality management issues in Smart Grid.
• To familiarize the high performance computing for Smart Grid applications
• To get familiarized with the communication networks for Smart Grid applications

UNIT I INTRODUCTION TO SMART GRID
Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Comparison of Micro grid and Smart grid, Present development & International policies in Smart Grid, Smart Grid Initiative for Power Distribution Utility in India – Case Study.

UNIT II SMART GRID TECHNOLOGIES
Technology Drivers, Smart Integration of energy resources, Smart substations, Substation Automation, Feeder Automation ,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV) – Grid to Vehicle and Vehicle to Grid charging concepts.

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE
Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU) & their application for monitoring & protection. Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing, Peak Time Pricing.

UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID

UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS
Architecture and Standards -Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), PLC, Zigbee, GSM, IP based Protocols, Basics of Web Service and CLOUD Computing, Cyber Security for Smart Grid.

COURSE OUTCOME:
Students able to
CO1: Relate with the smart resources, smart meters and other smart devices.
CO2: Explain the function of Smart Grid.
CO3: Experiment the issues of Power Quality in Smart Grid.
CO4: Analyze the performance of Smart Grid.
CO5: Recommend suitable communication networks for smart grid applications

REFERENCES

CP4391 SECURITY PRACTICES L T P C

3 0 0 3

COURSE OBJECTIVES:
- To learn the core fundamentals of system and web security concepts
- To have through understanding in the security concepts related to networks
- To deploy the security essentials in IT Sector
- To be exposed to the concepts of Cyber Security and cloud security
- To perform a detailed study of Privacy and Storage security and related Issues

UNIT I SYSTEM SECURITY 9
Model of network security – Security attacks, services and mechanisms – OSI security architecture

UNIT II NETWORK SECURITY 9

UNIT III SECURITY MANAGEMENT 9

UNIT IV CYBER SECURITY AND CLOUD SECURITY 9

UNIT V PRIVACY AND STORAGE SECURITY 9

TOTAL: 45 PERIODS
COURSE OUTCOMES:
CO1: Understand the core fundamentals of system security
CO2: Apply the security concepts to wired and wireless networks
CO3: Implement and Manage the security essentials in IT Sector
CO4: Explain the concepts of Cyber Security and Cyber forensics
CO5: Be aware of Privacy and Storage security Issues.

REFERENCES

MP4251 CLOUD COMPUTING TECHNOLOGIES L T P C
3 0 0 3

COURSE OBJECTIVES:
- To gain expertise in Virtualization, Virtual Machines and deploy practical virtualization solution
- To understand the architecture, infrastructure and delivery models of cloud computing.
- To explore the roster of AWS services and illustrate the way to make applications in AWS
- To gain knowledge in the working of Windows Azure and Storage services offered by Windows Azure
- To develop the cloud application using various programming model of Hadoop and Aneka

UNIT I VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE 6

UNIT II CLOUD PLATFORM ARCHITECTURE 12

UNIT III AWS CLOUD PLATFORM - IAAS 9
AWS Code Pipeline, AWS code Star - AWS Management Tools: Cloud Watch, AWS Auto Scaling, AWS control Tower, Cloud Formation, Cloud Trail, AWS License Manager

UNIT IV  PAAS CLOUD PLATFORM  9

UNIT V  PROGRAMMING MODEL  9
Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster- Aneka: Cloud Application Platform, Thread Programming, Task Programming and Map-Reduce Programming in Aneka

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Employ the concepts of virtualization in the cloud computing
CO2: Identify the architecture, infrastructure and delivery models of cloud computing
CO3: Develop the Cloud Application in AWS platform
CO4: Apply the concepts of Windows Azure to design Cloud Application
CO5: Develop services using various Cloud computing programming models.

REFERENCES

IF4072  DESIGN THINKING  L T P C 3 0 0 3

COURSE OBJECTIVES:
• To provide a sound knowledge in UI & UX
• To understand the need for UI and UX
• Research Methods used in Design
• Tools used in UI & UX
• Creating a wireframe and prototype

UNIT I  UX LIFECYCLE TEMPLATE  8

84
UNIT II  CONTEXTUAL INQUIRY  10

UNIT III  DESIGN THINKING, IDEATION, AND SKETCHING  9

UNIT IV  UX GOALS, METRICS, AND TARGETS  8

UNIT V  ANALYSING USER EXPERIENCE  10

SUGGESTED ACTIVITIES:
1: Hands on Design Thinking process for a product
2: Defining the Look and Feel of any new Project
3: Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)
4: Identify a customer problem to solve.
5: Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: Build UI for user Applications
CO2: Use the UI Interaction behaviors and principles
CO3: Evaluate UX design of any product or application
CO4: Demonstrate UX Skills in product development
CO5: Implement Sketching principles

REFERENCES
4. Lean UX: Designing Great Products with Agile Teams, Gothelf, Jeff, Seiden, and Josh.
PRINCIPLES OF MULTIMEDIA

COURSE OBJECTIVES:
• To get familiarity with gamut of multimedia and its significance
• To acquire knowledge in multimedia components.
• To acquire knowledge about multimedia tools and authoring.
• To acquire knowledge in the development of multimedia applications.
• To explore the latest trends and technologies in multimedia

UNIT I INTRODUCTION

Suggested Activities:
1. Flipped classroom on media Components.
2. External learning – Interactive presentation.

Suggested Evaluation Methods:
1. Tutorial – Handling media components
2. Quizzes on different types of data presentation.

UNIT II ELEMENTS OF MULTIMEDIA
Text-Types, Font, Unicode Standard, File Formats, Graphics and Image data representations – data types, file formats, color models; video – color models in video, analog video, digital video, file formats, video display interfaces, 3D video and TV; Audio – Digitization, SNR, SQNR, quantization, audio quality, file formats, MIDI; Animation- Key Frames and Tweening, other Techniques, 2D and 3D Animation.

Suggested Activities:
1. Flipped classroom on different file formats of various media elements.

Suggested Evaluation Methods:
1. Demonstration on after effects animations.
2. Quizzes on file formats and color models.

UNIT III MULTIMEDIA TOOLS

Suggested Activities:
1. Flipped classroom on multimedia tools.
2. External learning – Comparison of various authoring tools.
Suggested Evaluation Methods:
1. Tutorial – Audio editing tool.
2. Quizzes on animation tools.

UNIT IV  MULTIMEDIA SYSTEMS

Suggested Activities:
1. Flipped classroom on concepts of multimedia hardware architectures.
2. External learning – Digital repositories and hypermedia design.

Suggested Evaluation Methods:
1. Quizzes on multimedia hardware and compression techniques.
2. Tutorial – Hypermedia design.

UNIT V  MULTIMEDIA APPLICATIONS FOR THE WEB AND MOBILE PLATFORMS

Suggested Activities:
1. External learning – Game consoles.
2. External learning – VRML scripting languages.

Suggested Evaluation Methods:
1. Demonstration of simple interactive games.
2. Tutorial – Simple VRML program.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: Handle the multimedia elements effectively.
CO2: Articulate the concepts and techniques used in multimedia applications.
CO3: Develop effective strategies to deliver Quality of Experience in multimedia applications.
CO4: Design and implement algorithms and techniques applied to multimedia objects.
CO5: Design and develop multimedia applications following software engineering models.

REFERENCES:
COURSE OBJECTIVES:
- To understand the basics of big data analytics
- To understand the search methods and visualization
- To learn mining data streams
- To learn frameworks
- To gain knowledge on R language

UNIT I  INTRODUCTION TO BIG DATA

UNIT II  SEARCH METHODS AND VISUALIZATION

UNIT III  MINING DATA STREAMS

UNIT IV  FRAMEWORKS
MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Case Study- Preventing Private Information Inference Attacks on Social Networks- Grand Challenge: Applying Regulatory Science and Big Data to Improve Medical Device Innovation

UNIT V  R LANGUAGE

COURSE OUTCOMES:
CO1: understand the basics of big data analytics
CO2: Ability to use Hadoop, Map Reduce Framework.
CO3: Ability to identify the areas for applying big data analytics for increasing the business outcome.
CO4: gain knowledge on R language
CO5: Contextually integrate and correlate large amounts of information to gain faster insights.
TOTAL: 45 PERIODS
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NC4201 INETRNET OF THINGS AND CLOUD

COURSE OBJECTIVES:
- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

UNIT I FUNDAMENTALS OF IoT

UNIT II PROTOCOLS FOR IoT

UNIT III CASE STUDIES/INDUSTRIAL APPLICATIONS
Case studies with architectural analysis: IoT applications – Smart City – Smart Water – Smart Agriculture – Smart Energy – Smart Healthcare – Smart Transportation – Smart Retail – Smart waste management.

UNIT IV CLOUD COMPUTING INTRODUCTION
UNIT V  IoT AND CLOUD

COURSE OUTCOMES:
At the end of the course, the student will be able to:
CO1: Understand the various concept of the IoT and their technologies.
CO2: Develop IoT application using different hardware platforms
CO3: Implement the various IoT Protocols
CO4: Understand the basic principles of cloud computing.
CO5: Develop and deploy the IoT application into cloud environment

REFERENCES

MX4073  MEDICAL ROBOTICS

COURSE OBJECTIVES:
- To explain the basic concepts of robots and types of robots
- To discuss the designing procedure of manipulators, actuators and grippers
- To impart knowledge on various types of sensors and power sources
- To explore various applications of Robots in Medicine
- To impart knowledge on wearable robots

UNIT I  INTRODUCTION TO ROBOTICS
Introduction to Robotics, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Dynamic Stabilization

Sensors and Actuators
Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of Grippers, PD and PID feedback actuator models

UNIT II  MANIPULATORS & BASIC KINEMATICS
Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and pneumatic manipulator, Forward Kinematic Problems, Inverse Kinematic Problems, Solutions of Inverse Kinematic problems

Navigation and Treatment Planning
Variable speed arrangements, Path determination – Machinery vision, Ranging – Laser – Acoustic, Magnetic, fiber optic and Tactile sensor

UNIT III  SURGICAL ROBOTS
Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump, CABG surgery,
Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric and General Surgery, Gynecologic Surgery, General Surgery and Nanorobotics. Case Study

UNIT IV REHABILITATION AND ASSISTIVE ROBOTS
Pediatric Rehabilitation, Robotic Therapy for the Upper Extremity and Walking, Clinical-Based Gait Rehabilitation Robots, Motion Correlation and Tracking, Motion Prediction, Motion Replication. Portable Robot for Tele rehabilitation, Robotic Exoskeletons – Design considerations, Hybrid assistive limb. Case Study

UNIT V WEARABLE ROBOTS
Augmented Reality, Kinematics and Dynamics for Wearable Robots, Wearable Robot technology, Sensors, Actuators, Portable Energy Storage, Human–robot cognitive interaction (cHRI), Human–robot physical interaction (pHRI), Wearable Robotic Communication - case study

COURSE OUTCOMES:
CO1: Describe the configuration, applications of robots and the concept of grippers and actuators
CO2: Explain the functions of manipulators and basic kinematics
CO3: Describe the application of robots in various surgeries
CO4: Design and analyze the robotic systems for rehabilitation
CO5: Design the wearable robots

REFERENCES

VE4202 EMBEDDED AUTOMATION

COURSE OBJECTIVES:
• To learn about the process involved in the design and development of real-time embedded system
• To develop the embedded C programming skills on 8-bit microcontroller
• To study about the interfacing mechanism of peripheral devices with 8-bit microcontrollers
• To learn about the tools, firmware related to microcontroller programming
• To build a home automation system
UNIT - I  INTRODUCTION TO EMBEDDED C PROGRAMMING
C Overview and Program Structure - C Types, Operators and Expressions - C Control Flow - C Functions and Program Structures - C Pointers And Arrays - FIFO and LIFO - C Structures - Development Tools

UNIT - II  AVR MICROCONTROLLER
ATMEGA 16 Architecture - Nonvolatile and Data Memories - Port System - Peripheral Features : Time Base, Timing Subsystem, Pulse Width Modulation, USART, SPI, Two Wire Serial Interface, ADC, Interrupts - Physical and Operating Parameters

UNIT – III  HARDWARE AND SOFTWARE INTERFACING WITH 8-BIT SERIES CONTROLLERS
Lights and Switches - Stack Operation - Implementing Combinational Logic - Expanding I/O - Interfacing Analog To Digital Convertors - Interfacing Digital To Analog Convertors - LED Displays : Seven Segment Displays, Dot Matrix Displays - LCD Displays - Driving Relays - Stepper Motor Interface - Serial EEPROM - Real Time Clock - Accessing Constants Table - Arbitrary Waveform Generation - Communication Links - System Development Tools

UNIT – IV  VISION SYSTEM

UNIT – V  HOME AUTOMATION
Home Automation - Requirements - Water Level Notifier - Electric Guard Dog - Tweeting Bird Feeder - Package Delivery Detector - Web Enabled Light Switch - Curtain Automation - Android Door Lock - Voice Controlled Home Automation - Smart Lighting - Smart Mailbox - Electricity Usage Monitor -Proximity Garage Door Opener - Vision Based Authentic Entry System

COURSE OUTCOMES:
On successful completion of this course, students will be able to
CO1: analyze the 8-bit series microcontroller architecture, features and pin details
CO2: write embedded C programs for embedded system application
CO3: design and develop real time systems using AVR microcontrollers
CO4: design and develop the systems based on vision mechanism
CO5: design and develop a real time home automation system

REFERENCES: