

**SU/BOS/Sci & Tech/470**

**Date : 26/06/2023**

**To,**

**1) The Director,**  
Departments of Technology,  
Shivaji University, Kolhapur

**2) The Principal/ Director,**  
All affiliated Engineering Colleges/ Institute,  
Shivaji University, Kolhapur.

**Subject:** Regarding revised syllabus of **Ph. D. Coursework** under the Faculty of Science and Technology.

**Sir/Madam,**

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the syllabus of **Ph. D. Coursework** under the Faculty of Science and Technology.

1.	Civil Engineering & Technology
2.	Mechanical Engineering & Technology
3.	Electrical Engineering & Technology
4.	Electronics Engineering & Technology
5.	Electronics and Telecommunication Engineering & Technology
6.	Textile Engineering & Technology
7.	Computer Science Engineering & Technology
8.	Environmental Engineering & Technology
9.	Pharmacy

This syllabus will be implemented from the academic year 2023-24 i.e. from June 2023 onwards.

You are therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

**Yours faithfully,**

  
**Dr. S. M. Kubal**  
**Dy. Registrar**

**Copy to:**

1	The Dean, Faculty of Science & Technology	7	Computer Centre (IT)
2	The Chairman, Respective Board of Studies	8	Affiliation Section (T.1)
3	Director, Examination and Evaluation	9	Affiliation Section (T.2)
4	Eligibility Section	10	P.G.Admission Section
5	O.E. – 4	11	P.G Seminar Section
6	Appointment Section	12	Meeting Section

# **SHIVAJI UNIVERSITY, KOLHAPUR**

## **Doctor of Philosophy [Ph. D.]**

### **Ph.D. Coursework**

## **TEXTILE ENGINEERING**

### **Course Structure**

**(To be implemented from Academic Year 2022-23 Onwards)**

## Course Structure

### TEXTILE ENGINEERING

#### **Total number of papers:**

S. No.	Subject	Marks
1	Research Methodology, Quantitative Techniques and Computer Application.	100
2	Advances in Textile Engineering	100
3	Elective Subjects (Based on Specialization). The student has to select one elective from the followings. 1. Surface Treatment of Textiles or 2. Fibre Reinforced Composite or 3. Theory of Clothing Comfort or 4. Mechanics of Textile Machines	100
	<b>Total</b>	<b>300</b>

**For each Paper there will be 60 hours of work load (Lectures -40 hours, Discussion/Seminars - 10 hours and Library work -10 hours).**

#### **Scheme of Examination:**

##### **Paper I:– Research Methodology, Quantitative Techniques and Computer Application.**

This is a common subject for the Faculty of Engineering and its scheme of examination is also common.

##### **Paper II & III:-**

Paper No	Paper Title	Theory Marks	Internal Marks	Total Marks
Paper II	Advances in Textile Engineering	80	20	100
Paper III	Elective Subjects (Based on Specialization).	80	20	100
			Total	300

For Paper II the internal evaluation will include 2 Seminars of 10 Marks each

For Paper III the internal evaluation will be as follows:

- a) Seminars (Submission and Presentation)- 10 marks
- b) Review of Literature: Submission and Presentation- 10 marks

## **PAPER-III**

Elective Subject

### **SURFACE TREATMENT OF TEXTILES**

#### **COATING CHEMISTRY:**

Advantages & Disadvantages of conventional finishing, Concept of Coating & Lamination, Merits & Demerits of Coating & Lamination, Production, Structure & Properties of Rubbers like- Natural Rubber, Styrene- Butadiene rubber, Isoprene-Isobutylene Rubber, Butyl Rubber, EPM & EPDM, Polychloroprene Rubber, Nitrile Butadiene Rubber & Silicone Rubber, Polymeric materials like Polyvinyl Chloride, Polyurethane, Acrylic Polymers, Foams For Laminates, Radiation-Cured Coating, Adhesion.

#### **COATING TECHNIQUES:**

Knife Coating- Different types of Knives, Knife coating with pre-metering and post-metering, Roll Coating- Mayer rod coating, Direct-roll coating, Kiss roll coating, Gravure coating, Reverse roll coating, Dip Coating, Transfer Coating, Rotary screen Printing, Calendering- Zimmer coating, Hot-Melt Coating, Scatter Coating, Foam Coating, Lamination by Adhesives, Flame Lamination, Hot melt Lamination Merits & Demerits of each coating methods. Test methods for coated, laminated materials

#### **NANO TECHNOLOGY:**

Concept of nano-scale and historical background of nanotechnology, Fundamental concepts of nanotechnology - Bottom-up approaches, Top- down approaches, Functional approaches.

**Synthesis and Properties of Nanoparticles:** Synthesis of Fullerenes and various forms of carbon. Synthesis of nano metal particles by various chemical, physical and biological methods. Properties of nano particles like organic and inorganic materials in various chemical forms. **Characterization of Nanoparticles:** Principles of various techniques

#### **NANO TEXTILES:**

Development of functional textile using nano material: Conductive textiles, Antimicrobial textiles, Self-cleaning textiles, Moisture absorbing textiles, Improved hydrophilicity, colourability and wear resistance, UV- blocking textiles, Controlled release of active agents.

### **PLASMA TECHNOLOGY:**

Introduction, gases used, plasmas generation, plasma chemistry and plasma surface collisions. Low pressure, Atmospheric pressure and DBD plasma generation, its equipment for textile processing

### **TEXTILE APPLICATIONS OF PLASMA TECHNOLOGY**

Action of plasma on various textile substrates. Plasma treatment of Textiles for water and soil repellency, Interfacial engineering of functional textiles for biomedical applications, plasma modification of wool, plasma modification of natural cellulosic fibres, plasma treatments of fibres and textiles. Characterization of Plasma Treated Textiles, principles of various techniques.

### **REFERENCE BOOKS**

1. Principles of Nanotechnology by Phani Kumar
2. Nanofibres & Nanotechnology in Textiles by P.J. Brown & K. Stevens
3. Plasma Technology for Textiles by Roshan Shishoo, CRC Publication
4. Plasma Surface Modification and Plasma Polymerization – Norihiro Inagaki: CRC Press
5. Coated Textiles Principles and Applications by Dr. A. K. Sen
6. The Nanoscope, Encyclopedia of Nano Science & nanotechnology Vol.-I to VI, Dr.
7. Parag Diwan & Ashish Bharadwaj
8. Analytical Electrochemistry in Textiles by P. Westbroek, G. Priniotakis & P. Kiekens

## PAPER-III

Elective Subject

### FIBRE REINFORCED COMPOSITES

**General Introduction** - Meaning and types of composite materials, design of composite materials, the concept of load transfer.

#### Fibers and Matrices

**Reinforcements** - carbon fibers, glass fibers, organic fibers, silicon carbide, Strength of reinforcements: thermal stability, compressive strength, fiber fracture and flexibility, A statistical treatment of fiber strength.

**Matrices** - polymer matrices, metal matrices, ceramic matrices.

**Fiber architecture** - Volume fraction and weight fraction, fiber packing arrangements, clustering of fibers and particles.

**Long fibers** - laminates, woven, braided and knitted fabric arrays, characterization of fiber orientations in a plane.

**Short fibers** - fiber orientation distributions in three dimensions, fiber length distributions.

**Fabrication:** Liquid resin impregnation routes, pressurized consolidation of resin pre-pregs, injection mouldings of thermoplastics, hot press mouldings of thermoplastics, powder blending and consolidation, physical vapour deposition diffusion bonding of foils, Layered ceramic composites, reactive processing, carbon/carbon composites, powder based routes.

**The interface region:** Bonding mechanisms: absorption and wetting, inter diffusion and chemical reaction, electrostatic attraction, mechanical keying, residual stresses. Bond strength: Measurements of bond strength: single fiber pull out strength, single fiber push out and push down strength. Control of bond strength: coupling agents and environmental effects, toughness reducing coatings, interfacial chemical reaction and diffusion barrier coatings.

**Strength of composites:** Failure mode of long fibers like axial tensile failure, transverse tensile failure, shear failure, failure in compression. Failure of laminae under off-axis loads. Strength of laminates like tensile cracking, interlaminar stresses and edge effects. Basic concepts of fracture mechanics, interfacial fracture and crack deflection. Contributions to work of fracture like Matrix deformation, fiber fracture, interfacial debonding and frictional sliding. Subcritical crack growth like fatigue and stress corrosion cracking.

**Thermal behavior of composites:** Thermal stresses and strains, thermal expansivities, thermal cycling of unidirectional composites, thermal cycling of laminates, basics of matrix and fiber in relation to creep, axial creep of long fiber composites, transverse creep and discontinuously reinforced composites. Thermal conduction mechanism like heat transfer, conductivity of composites and interfacial thermal resistance.

**Applications:** minesweeper hull, sheet processing rolls, helicopter rotor blade, and golf driving club, racing bicycle, diesel engine piston, microelectronics housing, aircraft brakes and gas turbine combustor can.

### REFERENCE BOOKS

- 1 Introduction to Composite Materials, Clyne and Hull
- 2 Fabre reinforced composites by P. K. Mallick
- 3 Composite materials: Engineering & science by F. L. Mathew & R. D. Rawlings.
- 4 Micro structural Characterization of fibre reinforced composites by John Summer scales
- 5 3-D Textile reinforcements in composite materials by Prof. A. Miravete
- 6 Mechanics of Textile & Laminated composites by A. E. Bogdanovich & C. M. Pastore.

## **PAPER-III**

Elective Subject

### **THEORY OF CLOTHING COMFORT**

#### **HUMAN PHYSIOLOGY AND ROLE OF CLOTHING:**

Definition of Comfort. Human physiological aspect of comfort. Perception of Comfort. Various aspects of clothing comfort. Comfort variables. Comfort properties of fibres, yarns and fabric structures.

#### **THERMAL COMFORT:**

Thermal balance of human body. Mechanism of heat transfer through clothing. Parameters influencing heat transfer. Mathematical modeling of heat transfer through clothing. Moisture transmission: Liquid water transfer- wicking, water absorption and principles of moisture vapour transfer. Dynamic heat and mass transmission characteristics of clothing. Factors influencing heat and mass transfer through fabrics.

#### **TACTILE COMFORT:**

Tactile comfort sensations. Fabric characteristics and tactile attributes. Fabric parameters influencing tactile sensation.

#### **CLOTHING FIT AND COMFORT:**

Body dimensions and pattern. Tight-fit and loose-fit clothing. Clothing fit and pressure. Factors related to clothing fit. Clothing fit and body movement.

#### **AESTHETIC COMFORT:**

Psychological aspects of aesthetic comfort. Analysis of clothing aesthetics. Aesthetic concepts of clothing.

#### **IMPROVING COMFORT IN CLOTHING:**

Different approaches for improving thermal comfort of clothing. Improving moisture transport and developments in moisture management. Improving textile surface properties for tactile sensation. Materials and design strategies for improved fit and movement.



**REFERENCE BOOKS**

- 1 Guowen Song, “Improving Comfort in Clothing”, Woodhead Publishing Limited, Cambridge, 2011
- 2 Apurba Das and Alagirusamy R, “Science in Clothing Comfort”, Wood head Publishing India Limited, New Delhi, 2010
- 3 Li Y, “The Science of Clothing Comfort”, Textile Progress, Vol.31, No.1/2, The Textile Institute, Manchester, 2001
- 4 Fan J and Hunter L, “Engineering Apparel Fabrics and Garments”, Woodhead Publishing Limited, Cambridge, 2009

## **PAPER-III**

Elective Subject

### **MECHANICS OF TEXTILE MACHINES**

**Fundamentals of mechanics** - Equations of forces, motion and energy; energy stored in rotating masses, simple harmonic motion its application to sley motion & heald shaft movement.

**Design of machine elements** – forces acting on components, stress strain curve, factor of safety, design steps, combined stresses, design of drafting rollers & shaft.

**Friction & Lubrication** – Machine degradation, factors & impact, meaning of lubrication, types of lubricants, selection criteria, lubricant monitoring.

**Vibration monitoring** – types of machine vibrations, impact of vibration, natural frequency of vibration, important vibration characteristics, vibration monitoring programme, materials & methods to control vibrations.

**Mechanics in yarn manufacturing processes** – elimination of trash & dust, carding theories, transfer of fibres, doubling & drafting, drafting force, design of cone drums, tension variation in roving, spinning geometry, balloon tension, cop winding, friction & open end spinning

**Mechanics in fabric manufacturing processes** - Study of mechanisms in winding, Build of various packages. Screw traversing mechanism. Design of grooved drums for various packages. Design changes in Beam warping drive for high speed. Sectional warping drum design. Mechanism of squeezing, sow box design. Review of design changes of shedding mechanism. Picking mechanism theories for different shuttle less weaving techniques.

#### **REFERENCE BOOKS**

- 1 Textile Mathematics, Vol-I, II and III By J.E. Booth, The Textile Institute Publication.
- 2 Control Methodology in Textile Engineering and Economics By John W.s. Hearle, Journal of the Textile Inst. Vol.83, No.3, 1992, The Textile Institute Publication

- 3 Textile Mechanics Vol.I, II By K. Slater, The Textile Institute Publication.
- 4 Mechanics of Spinning Machines By R.S. Rengasamy, NCUTE Publication
- 5 An Introduction to Textile Mechanisms By P. Grosberg, The General Publishing Company.
- 6 Theory of Machines by Sharma Agarwal
- 7 Mechanics of Textile Machinery By W.A.Hanton, The Textile Institute, Publication.
- 8 Principles of Weaving By R.Marks & Robinson