ANNA UNIVERSITY, CHENNAI: 600 025
NON AUTONOMOUS AFFILIATED COLLEGES
M.TECH. TEXTILE TECHNOLOGY
REGULATIONS – 2021
CHOICE BASED CREDIT SYSTEM

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

PEO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1.	✓	✓	✓	✓	✓	✓
2.		✓	✓	✓	✓	
3.		✓	✓	✓		
4.		✓	✓	✓	✓	✓

MAPPING OF COURSE OUTCOMES AND PROGRAMME OUTCOMES

		COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6
YEAR I	SEMESTER I	Theory of short staple spinning	2	1	1	3	-	1
		Advances in fabric formation	3	2	2	3	-	1
		Polymer and fibre physics	3	1	2	3	-	2
		Statistical Applications in Textile Engineering	3	3	-	-	-	3
		Advanced textile testing	3	3	3	3	1	2
		Research Methodology and	3	3	-	2	-	3
		Audit Course I						
	SEMESTER II	Wetting and wicking of textile Materials	3	1	2	3	-	2
		Yarn quality analysis	3	3	3	3	-	2
		Fabric quality analysis	2	3	3	3	-	2
		Textile product engineering Laboratory	3	3	3	3	2	2
		Audit Course II						
YEAR II	SEMESTER III	Project Work I	3	3	3	3	1	1
	SEMESTER IV	Project Work II	3	3	3	3	1	1

	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6
PROFESSIONAL ELECTIVES	Alternative Spinning System	3	2	3	3	-	2
	Shuttleless Weaving Technology	2	2	2	2	-	2
	High Performance Textiles	3	2	2	2	-	2
	Filtration textiles	2	2	2	2	-	2
	Process control and optimization in yarn spinning	3	3	3	3	-	1
	Structure and properties of nonwovens	1	2	3	3	-	1
	Enzyme technology for textile processing	2	1	3	3	-	1
	Protective clothing	3	3	3	3	-	1
	Structural mechanics of yarn	3	3	3	2	-	1
	Structural mechanics of fabrics	3	2	3	2	-	1
	Coated and laminated textiles	3	2	3	2	-	1
	Colouration and functional finishes	3	2	3	2	-	1
	Theory of drafting	3	2	3	3	-	1
	Clothing science	2	2	3	3	-	1
	Medical textiles	3	2	3	3	-	1
	Sustainability in textile industry	3	2	3	2	2	1
	Theory of twisting	2	2	3	3	-	1
	Textiles in civil construction and transportation	3	2	3	3	-	1
	Functional dyes	3	2	3	3	1	1
	Pollution abatement in textile industry	2	1	3	3	2	2
	Characterization of textile polymers	3	2	3	3	-	1
	Textile reinforced composites	3	2	3	2	-	1
	Colour science and its application	2	1	2	3	-	-
	Design and analysis of textile experiments	3	3	2	2	-	1

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

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIOD PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA4158	Statistical Applications in Textile Engineering	FC	4	0	0	4	4
2.	TX4101	Theory of Short Staple Spinning	PCC	4	0	0	4	4
3.	TX4102	Advances in Fabric Formation	PCC	4	0	0	4	4
4.	TX4151	Polymer and Fibre Physics	PCC	3	0	0	3	3
5.	RM4151	Research Methodology and IPR	RMC	2	0	0	2	2
6.		Professional Elective I	PEC	3	0	0	3	3
7.		Audit Course – I *	AC	2	0	0	2	0
PRACTICALS								
8.	TX4161	Advanced Textile Testing Laboratory	PCC	0	0	6	6	3
			TOTAL	**22**	**0**	**6**	**28**	**23**

***Audit Course is Optional**

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIOD PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	TX4201	Wetting and Wicking of Textile Materials	PCC	3	0	0	3	3
2.	TX4202	Yarn Quality Analysis	PCC	2	0	2	4	3
3.	TX4203	Fabric Quality Analysis	PCC	2	0	2	4	3
4.		Professional Elective II	PEC	3	0	0	3	3
5.		Professional Elective III	PEC	3	0	0	3	3
6.		Professional Elective IV	PEC	3	0	0	3	3
7.		Audit Course – II*	AC	2	0	0	2	0
PRACTICALS								
8.	TX4211	Textile Product Engineering Laboratory	PCC	0	0	8	8	4
			TOTAL	**18**	**0**	**12**	**30**	**22**

***Audit Course is Optional**

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIOD PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Professional Elective V	PEC	3	0	0	3	3
2.		Professional Elective VI	PEC	3	0	0	3	3
3.		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
4.	TX4311	Project Work I	EEC	0	0	12	12	6
			TOTAL	**18**	**0**	**12**	**30**	**22**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIOD PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	TX4411	Project Work II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL NO. OF CREDITS: 72

FOUNDATION COURSES (FC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	MA4158	Statistical Applications in Textile Engineering	4	0	0	4	1

PROFESSIONAL CORE COURSES (PCC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	TX4101	Theory of Short Staple Spinning	4	0	0	4	1
2.	TX4102	Advances in Fabric Formation	4	0	0	4	1
3.	TX4151	Polymer and Fibre Physics	3	0	0	3	1
4.	TX4161	Advanced Textile Testing Laboratory	0	0	6	3	1
5.	TX4201	Wetting and Wicking of Textile Materials	3	0	0	3	2
6.	TX4202	Yarn Quality Analysis	2	0	2	3	2
7.	TX4203	Fabric Quality Analysis	2	0	2	3	2
8.	TX4211	Textile Product Engineering Laboratory	0	0	8	4	2
				TOTAL CREDITS		**27**	

LIST OF PROFESSIONAL ELECTIVE COURSES

SEMESTER - I, ELECTIVE I

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	TX4001	Alternative Spinning Systems	PEC	3	0	0	3	3
2.	TX4002	Shuttleless Weaving Technology	PEC	3	0	0	3	3
3.	TX4003	High Performance Textiles	PEC	3	0	0	3	3
4.	TX4004	Filtration Textiles	PEC	3	0	0	3	3

SEMESTER- II, ELECTIVE II

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	TX4005	Process Control and Optimization in Yarn Spinning	PEC	3	0	0	3	3
2.	TX4006	Structure and Properties of Nonwovens	PEC	3	0	0	3	3
3.	TX4007	Enzyme Technology for Textile Processing	PEC	3	0	0	3	3
4.	TX4074	Protective Clothing	PEC	3	0	0	3	3

SEMESTER - II, ELECTIVE III

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	TX4008	Structural Mechanics of Yarn	PEC	3	0	0	3	3
2.	TX4009	Structural Mechanics of Fabrics	PEC	3	0	0	3	3
3.	TX4073	Coated and Laminated Textiles	PEC	3	0	0	3	3
4.	TX4010	Colouration and Functional Finishes	PEC	3	0	0	3	3

SEMESTER - II, ELECTIVE IV

Sl. No.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	TX4011	Theory of Drafting	PEC	3	0	0	3	3

2.	TX4012	Clothing Science	PEC	3	0	0	3	3
3.	TX4013	Medical Textiles	PEC	3	0	0	3	3
4.	TX4091	Sustainability in Textile Industry	PEC	3	0	0	3	3

SEMESTER- III, ELECTIVE V

Sl. No.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	TX4014	Theory of Twisting	PEC	3	0	0	3	3
2.	TX4015	Textiles in Civil Construction and Transportation	PEC	3	0	0	3	3
3.	TX4072	Functional Dyes	PEC	3	0	0	3	3
4.	TX4016	Pollution Abatement in Textile Industry	PEC	3	0	0	3	3

SEMESTER- III, ELECTIVE VI

Sl. No.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	TX4071	Characterization of Textile Polymers	PEC	3	0	0	3	3
2.	TX4092	Textile Reinforced Composites	PEC	3	0	0	3	3
3.	TX4017	Colour Science and its Applications	PEC	3	0	0	3	3
4.	TX4018	Design and Analysis of Textile Experiments	PEC	3	0	0	3	3

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	RM4151	Research Methodology and IPR	2	0	0	2	1
TOTAL CREDITS						**2**	

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	TX4311	Project Work I	0	0	12	6	
2.	TX4411	Project Work II	0	0	24	12	
TOTAL CREDITS						**18**	

AUDIT COURSES - I (AC)
REGISTRATION FOR ANY OF THESE COURSES IS OPTIONAL TO STUDENTS

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1.	AX4091	English for Research Paper Writing	2	0	0	0
2.	AX4092	Disaster Management	2	0	0	0
3.	AX4093	Constitution of India	2	0	0	0
4.	AX4094	நற்றமிழ் இலக்கியம்	2	0	0	0

LIST OF OPEN ELECTIVES FOR PG PROGRAMMES

SL. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1.	OCE431	Integrated Water Resources Management	3	0	0	3
2.	OCE432	Water, Sanitation and Health	3	0	0	3
3.	OCE433	Principles of Sustainable Development	3	0	0	3
4.	OCE434	Environmental Impact Assessment	3	0	0	3
5.	OIC431	Blockchain Technologies	3	0	0	3
6.	OIC432	Deep Learning	3	0	0	3
7.	OME431	Vibration and Noise Control Strategies	3	0	0	3
8.	OME432	Energy Conservation and Management in Domestic Sectors	3	0	0	3
9.	OME433	Additive Manufacturing	3	0	0	3
10.	OME434	Electric Vehicle Technology	3	0	0	3
11.	OME435	New Product Development	3	0	0	3
12.	OBA431	Sustainable Management	3	0	0	3
13.	OBA432	Micro and Small Business Management	3	0	0	3
14.	OBA433	Intellectual Property Rights	3	0	0	3
15.	OBA434	Ethical Management	3	0	0	3
16.	ET4251	IoT for Smart Systems	3	0	0	3
17.	ET4072	Machine Learning and Deep Learning	3	0	0	3
18.	PX4012	Renewable Energy Technology	3	0	0	3
19.	PS4093	Smart Grid	3	0	0	3
20.	CP4391	Security Practices	3	0	0	3
21.	MP4251	Cloud Computing Technologies	3	0	0	3
22.	IF4072	Design Thinking	3	0	0	3
23.	MU4153	Principles of Multimedia	3	0	0	3
24.	DS4015	Big Data Analytics	3	0	0	3
25.	NC4201	Internet of Things and Cloud	3	0	0	3
26.	MX4073	Medical Robotics	3	0	0	3
27.	VE4202	Embedded Automation	3	0	0	3

SUMMARY

Sl. No.	Name of the Programme: M.TECH. TEXTILE TECHNOLOGY					
	SUBJECT AREA	CREDITS PER SEMESTER				CREDITS TOTAL
		I	II	III	IV	
1.	FC	04	00	00	00	04
2.	PCC	14	13	00	00	27
3.	PEC	03	09	06	00	18
4.	RMC	02	00	00	00	02
5.	OEC	00	00	03	00	03
6.	EEC	00	00	06	12	18
7.	Non Credit/Audit Course	✓	✓	00	00	
8.	**TOTAL CREDIT**	**23**	**22**	**15**	**12**	**72**

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:

1. Douglas C. Montgomery, “Design and analysis of experiments”, 8th Edition, John Wiley & Sons, Singapore, 2013.
2. Leaf G.A.V., “Practical Statistics for the Textile Industry, Part I and II”, the Textile Institute, Manchester, 1984.
3. Montgomery D.C., “Introduction to Statistical Quality Control”, 6th Edition, John Wiley and Sons, Singapore, 2009.
4. Ronald D. Moen, Thomas W. Nolan, Lloyd P. Provost, “Quality improvement through planned experimentation’, 3rd Edition, McGraw-Hill, 2012.

TX4101 THEORY 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, neps 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:

1. Klein W., “The Rieter Manual of Spinning, Vol.1”, Rieter Machine Works Ltd., Winterthur, 2014, ISBN 10 3-9523173-1-4 / ISBN 13 978-3-9523173-1-0.
2. Klein W., “The Rieter Manual of Spinning, Vol.2”, Rieter Machine Works Ltd., Winterthur, 2014, ISBN 10 3-9523173-2-2 / ISBN 13 978-3-9523173-2-7.
3. Klein W., “The Rieter Manual of Spinning, Vol.1-3”, Rieter Machine Works Ltd., Winterthur, 2014, ISBN 10 3-9523173-3-0 / ISBN 13 978-3-9523173-3-4.
4. Lord P.R., “Yarn Production: Science, Technology and Economics”, The Textile Institute, Manchester, 1999.
5. Iredale John A., “Yarn Preparation: A Handbook”, Intermediate Technology, London, 1992, ISBN:1853390429.
6. Salhotra K.R. and Chattopadhyay R., "Book of papers on Blow room, Card", Indian Institute of Technology, Delhi, 1998.
7. haw J., "Short-staple Ring Spinning", Textile Progress, The Textile Institute, Manchester, 1982
8. Grosberg P. and Iype C, "Yarn Production: Theoretical Aspects", Textile Institute, 1999, ISBN: 1870372034.
9. Carl A. Lawrence., “Fundamentals of Spun Yarn Technology”, CRC press, 2003, ISBN 1-56676-821-7
10. Eric Oxtoby, “Spun Yarn Technology “, Butterworth, Boston, London, 1987, ISBN: 0408014644/9780408014649

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Theory of opening and cleaning in spinning preparatory machinery	2	1	2	3	-	1
CO2	Theory of generation of hooks, neps and rectification	2	1	2	3	-	1
CO3	Wire and roller drafting, technology involved, their limitations and scope for improvement	2	1	2	3	-	1
CO4	Theory of twisting in different systems of yarn spinning	2	1	2	3	-	1
CO5	Fibre blending and leveling carried out at different stages of yarn production process	2	1	2	3	-	1
	Overall CO	**2**	**1**	**2**	**3**	**-**	**1**

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

TX4102 ADVANCES IN FABRIC FORMATION L T P C 4 0 0 4

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

Principle of fabric formation and fabric structure - circular woven fabrics, narrow fabric; advances in 3-D woven fabrics – principle of hollow, shell and nodal fabric formations; Noobing – principle and fabric structure; applications.

UNIT II KNITTED FABRICS 12

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 12

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 12

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

UNIT V SMART FABRICS 12

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:

1. John McLoughlin and TasneemSabir, “High-Performance Apparel” Woodhead Publishing Limited, 2018
2. Xiaogang Chen, “ Advances in 3 D Textiles” Woodhead Publishing Limited, 2015
3. K. F. Au, “Advances in knitting technology” Woodhead Publishing Limited, 2011
4. George Kellie, Advances in Technical Nonwovens, Woodhead Publishing Limited, 2016
5. SavvasVassiliadis, Advances in Modern Woven Fabrics Technology, InTech publications, 2011,
6. YordanKyosev, Recent Developments in Braiding and Narrow Weaving, Springer, 2016

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Advancement in weaving and 3D weaving techniques	3	2	2	3	-	1
CO2	Advanced knit structures and techniques	3	2	2	3	-	1
CO3	Advancements in braiding techniques	3	2	2	3	-	1
CO4	Auxetic structures and their production methods	3	2	2	3	-	1
CO5	Smart fabric and their production methods	3	2	2	3	-	1
	Overall CO	**3**	**2**	**2**	**3**	**-**	**1**

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

TX4151 POLYMER AND FIBRE PHYSICS L T P C
3 0 0 3

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 9

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 9

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 9

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 9

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

UNIT V PROPERTIES OF FIBRES 9

Mechanical properties of natural and synthetic fibres; moisture sorption behavior of natural and synthetic fibres; Thermal, Frictional and optical properties of fibres

TOTAL: 45 PERIODS

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 fiber

REFERENCES:

1. Billmeyer, "Textbooks of Polymer Science", 3rd ed., Wiley, 1984.
2. Sperling, "Introduction to Physical Polymer Science", Wiley, 1986.
3. Odian, "Principle of Polymerization", 3rd ed., Wiley, 1991
4. Gordon, "High Polymers", Addision-Wesley, 1963.
5. Gupta.V.B. and Kothari V.K., "Man Made Fibre Production", Chapman and Hall, 1985
6. Kothari V.K., "Textile Fibres: Developments and innovations", IAFL Publication, 2000
7. Hongu T. and Philips G., "New Fibres", Wood Head Publishing Ltd,1997
8. Xiangwu Zhang, **"**Fundamentals of Fiber Science**",** DEStech Publications, Inc, 2014
9. Donald G. Baird, Dimitris I. Collias, "Polymer Processing: Principles and Design", Wiley Edition, 2014.
10. Walczak Z.K., "Processes of Fiber formation", Elsevier Science,2002.

11. V R Gowariker., NV Viswanathan.,Jayadev Sreedhar.,“Polymer science”., New age International Publishers, 2020

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Understand the synthesis of polymers	3	1	2	3	-	2
CO2	Correlate the properties of polymers	3	1	2	3	-	2
CO3	Understand rheological characteristics	3	1	2	3	-	2
CO4	Know about viscoelastic behaviour of polymer	3	1	2	3	-	2
CO5	Able to correlate the properties of fibre	3	1	2	3	-	2
	Overall CO	3	1	2	3	-	2

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

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

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT V PATENTS 6

Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.

TOTAL : 30 PERIODS

REFERENCES:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012).

2. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013.

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 repellant 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:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Understand and analyze the characteristics of textile materials using advanced characterizing techniques	3	3	3	3	1	2
CO2	Analyze the graphs, charts of TGA, FTIR spectrometer and X-ray Diffractometer	3	3	3	3	1	2
CO3	Evaluate fabric finishes and nature of fabrics	3	3	3	3	1	2

CO4	Determine the property of liquids	3	3	3	3	1	2
CO5	Characterize the porous substrates	3	3	3	3	1	2
	Overall CO	3	3	3	3	1	2

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

SEMESTER II

TX4201 WETTING AND WICKING OF TEXTILE MATERIALS L T P C
3 0 0 3

OBJECTIVE

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

UNIT I FUNDAMENTALS ON WETTING 9

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 9

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 9

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 9

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 9

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

1. Pan N. and Gibson P., “Thermal and moisture transport in fibrous materials”, Woodhead Publishing Limited, 2006, ISBN-13: 978-1-84569-057-1.
2. Ningtao, “Liquid transport and wicking in nonwoven materials”, VDM Verlag Dr. Müller, 2009, ISBN 3639114213/978-3639114218.
3. Patnaik A , R. S. Rengasamy , V. K. Kothari & A. Ghosh, “Wetting and Wicking in Fibrous Materials”, Journal of Textile Progress, 2006, Volume 38, Issue 1.
4. Pan N. and Zhong W., “Fluid Transport phenomenon in fibrous materials”, Journal of Textile

Progress, 2006, Volume 38, Issue 1.
5. Huaxiong Huang, Changhua Ye, Weiwei Sun, “Moisture Transport in fibrous clothing assemblies”, Journal of engineering mathematics, 2008.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Fundamentals of Wetting and wicking	3	1	2	3	-	2
CO2	Characterization of wetting	3	1	2	3	-	2
CO3	Liquid-fibre interaction during of fiber and fabrics	3	1	2	3	-	2
CO4	Surface energy of the fabric	3	1	2	3	-	2
CO5	Application of wetting and wicking	3	1	2	3	-	2
	Overall CO	3	1	2	3	-	2

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

TX4202 YARN QUALITY ANALYSIS L T P C
2 0 2 3

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 6

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 6

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 6

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 6

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 6

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

2. Imperfections and hairiness of yarn
3. Tensile properties
4. Creep and stress relaxation
5. Yarn fatigue
6. Variance-length curve
7. Spectrogram
8. Yarn faults

TOTAL : 30 PERIODS

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

1. Kothari V.K., "Progress in Textiles: Science & Technology Vol. 1, Testing and Quality Management", IAFL Publications, New Delhi, 1999, ISBN: 81-s901033-0-X.
2. Furter R.,"Strength and elongation testing of single and ply yarns", The Textile Institute, Manchester, 1985.
3. Furter R., "Evenness testing in yarn production: Part I", The Textile Institute, Manchester, 1982.
4. Furter R., "Evenness testing in yarn production: Part II", The Textile Institute, Manchester, 1982.
5. Steadman R.G.,"Cotton testing", Textile Progress, Vol. 27, No.1.Text.Inst., 1997, ISBN:1870812859.
6. "Instrumentation in the textile industry", Vol. 1; 1996, Instrument Society of America,1997, ISBN:1556175973.
7. Lord P.R. and Grover G., "Roller drafting", Textile Progress, Vol. 23 No.4, Textile Institute, 1993, ISBN:1870812468.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	Understand different methods of depicting mass variation of strand	3	3	3	3	-	2
CO2	Analyze and interpret VL curve	3	3	3	3	-	2
CO3	Analyze and interpret spectrogram in finding faulty machine elements	3	3	3	3	-	2
CO4	Analyze the tensile values of strand	3	3	3	3	-	2
CO5	Analyze classified faults and other faults present in the yarn and apply knowledge in reducing yarn faults	3	3	3	3	-	2
	Overall CO	**3**	**3**	**3**	**3**	**-**	**2**

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

TX4203 FABRIC QUALITY ANALYSIS L T P C
2 0 2 3

OBJECTIVES

To make the students understand

- Nature of fabric failure
- Aanalyzing 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:

1. Ukponmwan J., Mukhopadhuau A. and Chatterjee K., “Pilling”, Textile Progress, Vol.8/3, 1996. ISBN: 1870372153.
2. Li, “The Science of Clothing Comfort”, Textile Progress, Vol., 29/3, 1997, ISBN:1870372247.
3. Slater K., Charles C., Thomas Springfield I.L., “Human Comfort”, 1985.

4. Bishop D.L., “Fabrics: Sensory and Mechanical Properties”, Textile Progress Vol. 26/3, 1994.ISBN: 1870812751.
5. Seyam, “Structural Design of Woven Fabric: Theory and Practice”, Textile Progress, Vol., 31/3, 1999.
6. Laing and Sleivert, “Clothing Textiles and Human Performance”, Textile Progress, Vol. 32/4, 2000.
7. Ponmwan, J.O, “The Thermal Insulation Properties on fabrics”, Textile Progress, Vol. 24, No.4, Textile Institute, 1993, ISBN: 1870812654.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Mode of failure of fabrics and influencing parameters	2	3	3	3	-	2
CO2	Kawabata evaluation system	2	3	3	3	-	2
CO3	Fabric role on comfort	2	3	3	3	-	2
CO4	Fabric properties and appearance	2	3	3	3	-	2
CO5	Technical textile properties	2	3	3	3	-	2
	Overall CO	2	3	3	3	-	2

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

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:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Identify the materials used in the product	3	3	3	3	-	2
CO2	Carryout confirmative tests to identify specifications of materials used	3	3	3	3	-	2

CO3	Suggest the production process required to make the product	3	3	3	3	2	2
	Overall CO	**3**	**3**	**3**	**3**	**-**	**2**

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

TX4311 **PROJECT WORK I** **L T P C**
0 0 12 6

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 carryout 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** **L T P C**
0 0 24 12

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 carryout 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

CO3 Analyze the results, interpret and prepare project report/know the strategies for commercialization

TX4001 ALTERNATIVE SPINNING SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:

To enable the students to learn the

- Theory of yarn formation by rotor, friction, air-jet, air vortex and other spinning systems and Effect of process parameters used in the spinning system on yarn quality and production

UNIT I ROTOR SPINNING I 9

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 9

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 9

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 9

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 9

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

TOTAL: 45 PERIODS

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 yarns

CO5: Principle of yarn production by other spinning systems and double rove spinning

REFERENCES:

1. Oxtoby E., “Spun Yarn Technology”, Butter worths London,1987.
2. Klein W., "New Spinning Methods ", The Textile Institute, Manchester, 1993.
3. Dyson E., "Rotor Spinning, Technical and Economics Aspects ", Textile Trade Press, New Mills, Stock Port, 1975.
4. Salhotra K.R. and Ishtiaque S.M., "Rotor Spinning; its advantages ", Limitations and Prospects in India, ATIRA, Ahmedabad, 1995.

5. Lord P.R, " Yarn Production; Science, Technology and Economics ", The Textile Institute, Manchester, 1999.
6. Trommer G., "Rotor Spinning", Meliand Textile benchte GmbH, Rohrbacher, 1995.
7. Lawerence C.A and Chen K.Z., "Rotor Spinning ", Textile Progress, The Textile Institute, Manchester, 1984.
8. Lawrence C. A., "Advances in yarn spinning technology" Wood head publishing, 2010,ISBN-13: 978 1 84569 444 9.
9. Klein W., "Rieter Manual of spinning", Vol.5&6, Rieter Machine Works, Winterthur,2014.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Theory of yarn formation in open end spinning and production of yarn in rotor spinning system	3	2	3	3	-	2
CO2	Design of important elements of rotor spinning machine	3	2	3	3	-	2
CO3	Theory of yarn formation in friction spinning system and structure of yarn	3	2	3	3	-	2
CO4	Theory of yarn formation in air- jet and Air vortex spinning system and structure of yarns	3	2	3	3	-	2
CO5	Yarn production by other spinning systems and double rove spinning	3	2	3	3	-	2
	Overall CO	3	2	3	3	-	2

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

TX4002 SHUTTLELESS WEAVING TECHNOLOGY L T P C
3 0 0 3

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 9

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 9

Technological developments – models & features; functional description of multi-linear shedweaving – 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:

1. Weaving Technology and Operations, Allaan Ormerod and Walter S. Sondhelm, The Textile Institute, 1995, ISBN 1 870812 76 X
2. Adanur.S, “Handbook of Weaving”, Textile Institute, 2000.
3. Ormerod A, “Modern Preparation and Weaving Machinery”, Butterworth’s & Co., London, 1983.
4. Adanur.S, “Handbook of Weaving”, Textile Institute, 2000.
5. Ormerod A, “Modern Preparation and Weaving Machinery”, Butterworth’s & Co., London, 1983.
6. Talukdar M K, Sriramulu P K, Ajgaonkar D B, “Weaving Machines, Mechanisms, Management” ISBN: 8185401160, Mahajan Publishers Pvt. Ltd., 2004.
7. Ormerod .A and Sondhelm.W.S, “Weaving Technology & Operations”, Textile Institute Publication, 1995.
8. Khatwani P A, "Weaving II: Shuttleless looms", NCUTE Publication, 1999.
9. Marks and Robinson, "Principles of Weaving", Textile Institute, Manchester, 1976.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Overview of shuttless weaving technology	2	2	2	2	-	2
CO2	Principle, Concepts and features of projectile weaving machine	2	2	2	2	-	2
CO3	mechanisms of picking in rapier weaving machine	2	2	2	2	-	2
CO4	mechanisms of picking and merits and demerits of air jet, water jet	2	2	2	2	-	2
CO5	Principle of fabric formation in multiphase weaving machine	2	2	2	2	-	2
	Overall CO	2	2	2	2	-	2

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

TX4003 HIGH PERFORMANCE TEXTILES L T P C
3 0 0 3

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 9

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

UNIT II INORGANIC AND CARBON FIBRES 9

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

UNIT III BIODEGRADABLE FIBRES 9

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 9

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 9

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

TOTAL: 45 PERIODS

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

REFERENCES:

1. Kothari V. K., “Textile Fibres: Development and Innovations”, Vol. 2, Progress in Textiles, IAFL Publications, 2000.
2. Peebles L.H., “Carbon Fibres”, CRC Press, London, 1995.
3. Hearle J. W. S., “High Performance Fibres”, Woodhead Publishing Ltd., Cambridge, England, 2001.
4. Hongu T. and Phillips G.O., “New Fibres”, Woodhead Publishing Ltd., England, 1997
5. Carl. A Lawrence., “High performance textiles and its applications”, Woodhead Publishing Ltd., ISBN: 978-1-84569-180-6., 2014.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Method of producing high performance fibres	3	2	2	2	-	2
CO2	High performance fibres for industrial applications	3	2	2	2	-	2

CO3	Manufacturing of biodegradable and protein fibres and their properties	3	2	2	2	-	2
CO4	Manufacturing of chemical resistant fibres and their properties	3	2	2	2	-	2
CO5	Manufacturing of specialty fibres and their properties	3	2	2	2	-	2
	Overall CO	3	2	2	2	-	2

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

TX4004 FILTRATION TEXTILES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To enable the students to learn about the principles of filtration and textile materials used for filtration process

UNIT I BASIC PRINCIPLES 9

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 9

Fabric construction -woven fabrics, needle felts, knitted fabrics; heat setting, singeing, raising, calendaring, chemical treatments, special surface treatments

UNIT III LIQUID AND OIL FILTRATION 9

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 9

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 9

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.

TOTAL: 45 PERIODS

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

CO5: Types of Gas filters

REFERENCES:

1. Alagirusamy R and Das A, “Technical Textile Yarns”, Wood head Publishers, Cambridge, England, 2010
2. Horrocks A R and Anand S C, “Handbook of Technical Textiles”, Wood head publication and Textile Institute, England, 2000.
3. Ken Sutherland, “Filters and Filtration Handbook”, Butterworth-Heinemann Elsevier, Burlington, 2008.
4. Senthil kumar, “ Textiles in Filtration”, Create space Independent Publications.,2014

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Principles of filtration	2	2	2	2	-	2
CO2	Fabric construction and finishing treatments of filtration textiles	2	2	2	2	-	2
CO3	Concepts of liquid and oil filtration	2	2	2	2	-	2
CO4	Concepts of solid liquid separation	2	2	2	2	-	2
CO5	Types of Gas filters	2	2	2	2	-	2
	Overall CO	2	2	2	2	-	2

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 9

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 pneumafil waste, hard waste in ring frame; determination of yarn realization; centralized waste collection system

UNIT IV PRODUCTION CONTROL 9

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 9

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 neps 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

1. Lord P.R., “Handbook of Yarn Production; Science, Technology and Economics”, WoodheadPublishing, 2003, ISBN: 1855736969 | ISBN-13: 9781855736962
2. MajumdarA., Das A., Alagirusamy. R., and Kothari V.K., “Process Control in Text ileManufacturing”, Wood Head publishing, 2012, ISBN: 0857090275 | ISBN-13: 9780857090270
3. Thomas Weide., “The Rieter Manual of Spinning, Vol.7”, Rieter Machine Works Ltd.,Winterthur, 2014, ISBN: 10 3-9523173-7-3 / ISBN: 13 978-3-9523173-0-3
4. Garde A.R., and Subramaniam T.A., “Process Control in Spinning”, ATIRA Publications, Ahmedabad, 1989.
5. Van der Sluijs M., and Hunter L., “Neps in Cotton Lint, Textile Progress”,The Textile Institute, Manchester, 1999, ISBN: 1870372239 / ISBN: 978-1870372237
6. Slater K., “Yarn Evenness”, Textile Progress, The Textile Institute, Manchester, 1986.
7. Townend P.P., “Nep Formation in Carding”, Wira, U.K., 1986, ISBN: 0900739851 / ISBN: 978- 0900739859.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Quality control measures in terms of levelling of material	3	3	3	3	-	1
CO2	Control of neps and hooks	3	3	3	3	-	1
CO3	Factors influencing production rate and efficiency of spinning machines	3	3	3	3	-	1
CO4	Balancing of machinery, production and labour efficiency	3	3	3	3	-	1
CO5	Measures to be taken while processing manmade fibres	3	3	3	3	-	1
	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

TX4006 STRUCTURE AND PROPERTIES OF NONWOVENS L T P C
3 0 0 3

OBJECTIVE

To enable the students to learn about the manufacturing of nonwovens and their properties

UNIT I INTRODUCTION 9

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 9

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 9

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 9

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 9

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 inhydro entangling, thermal and chemical bonding
CO5: Process control inmelt blown and spun bonded fabrics

REFERENCES

1. Lunenschloss J., Albrecht W. and David Sharp., “Nonwoven Bonded Fabrics”, Ellis Horwood Ltd., New York, 1985, ISBN: 0-85312-636-4.
2. Mrstina V. and Feigl F., “Needle Punching Textile Technology”, Elsevier, New York, 1990, ISBN: 0444988041 | ISBN-13: 9780444988041
3. Dharmadhikary R. K., Gilmore T. F., Davis H. A. and Batra S. K., “Thermal Bonding of Nonwoven Fabrics”, Textile Progress, Vol.26, No.2, Textile Institute Manchester,1995, ISBN: 1870812786.
4. Jirsak O. and Wadsworth L. C., “Nonwoven Textiles”, Textile Institute, Manchester,1999, ISBN: 0 89089 9788.
5. Russell S., “Hand Book of Nonwovens”, Textile Institute, Manchester, 2004, ISBN:1855736039.
6. Chapman R., “Applications of Nonwovens in Technical Textiles”, Textile Institute, Manchester, 2010, ISBN: 1845694376

7. AbhijitMajumdar, Apurba Das, R.Alagirusamy and V.K.Kothari., “Process Control in Textile Manufacturing”, Wood Head Publishing Limited, Oxford, 2013, ISBN: 978-0-85709-027-0

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Overview of nonwovens	1	2	3	3	-	1
CO2	Understand the optimization of process in web preparation	1	2	3	3	-	1
CO3	Process variables in needle punched nonwoven manufacture	1	2	3	3	-	1
CO4	Process control in hydro entangling, thermal and chemical bonding	1	2	3	3	-	1
CO5	Process control in melt blown and spun bonded fabrics	1	2	3	3	-	1
	Overall CO	1	2	3	3	-	1

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

TX4007 ENZYME TECHNOLOGY FOR TEXTILE PROCESSING L T P C
3 0 0 3

OBJECTIVES

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

UNIT I ENZYMES 9

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 9

Kinetics of single-substrate enzyme-catalyzed reactions; basics of kinetics of multi-substrate enzyme-catalyzed reactions

UNIT III ENZYMES FOR CELLULOSIC FIBRES 9

Chemistry and structure of cotton fibre; enzymes in pretreatment of cotton substrates – desizing, scouring, bleaching and bio finishes

UNIT IV ENZYMES FOR OTHER FIBERS 9

Enzymes for processing and functionalizing protein fibres; enzymatic modification of polyester, polyamide, polyacrylonitrile and cellulose acetate fibres

UNIT V ENZYMES IN EFFLUENT TREATMENT 9

Enzyme technology and biological remediation, enzyme decolourisation and decolouration by bio sorption and enrichment cultures

TOTAL: 45 PERIODS

OUTCOMES

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

1. Freifelder D., "Molecular Biology ", Jones and Bartlett Publishers Inc. 1987.
2. Nierstrasz V. and Cavaco-Paulo A., “Advances in textile biotechnology”, Woodhead Publishing Ltd, Cambridge, UK, 2010.
3. Cavaco-Paulo A. and Gubitz G., “Textile processing with enzymes”, Woodhead Publishing Ltd, Cambridge, UK, 2003.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Classification, characteristics and activity of enzymes	2	1	3	3	-	1
CO2	Kinetics of single and multi-substrate enzyme	2	1	3	3	-	1
CO3	Activity of enzyme on cotton fibres	2	1	3	3	-	1
CO4	Activity of enzyme on protein and synthetic fibres	2	1	3	3	-	1
CO5	Application of enzymes for effluent treatment	2	1	3	3	-	1
	Overall CO	2	1	3	3	-	1

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

TX4074 PROTECTIVE CLOTHING L T P C
3 0 0 3

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 9

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

UNIT II YARN AND FABRIC REQUIREMENTS 9

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 9

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 9

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 9

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

1. Adanur S., "Wellington sears handbook of Industrial textiles" Technomic publishing co. inc., 1995, ISBN : 1 – 56676 – 340 – 1
2. Pushpa Bajaj and Sengupta A.K, "Protective clothing", the Textile Institute, 1992, ISBN 1-870812 – 44-1
3. Chellamani K.P. and Chattopadhyyay D., "Yarns and Technical Textiles", SITRA, 1999.
4. Mukhopadhyay S.K. and Partridge J.F., "Automotive Textiles", Textile Progress, Vol29, No1/2, 1999, ISBN:1870372212
5. Horrocks A.R. and Anand S.C., "Handbook of Technical Textiles", The Textile Institute, anchester, 2000, ISBN: 1855733854.
6. Anand S.C., "Medical Textiles", Textile Institute, Manchester, 2001, ISBN:185573494X.
7. Scott R.A., "Textiles for protection", Woodhead Publishing Ltd., Cambridge, UK, 2005, ISBN 1-85573-921-6.
8. Saville B.P., "Physical testing of textiles", Woodhead Publishing Ltd., Cambridge, UK, 1999, ISBN 1-85573-367-6.
9. Long A.C., "Design and manufacture of Textile Composities", Woodhead Publishing Ltd., Cambridge, UK, 2005, ISBN 1-85573-744-2.
10. Fung W, "Coated and laminated textiles", Woodhead Publishing Ltd, Cambridge, UK, 2002, ISBN 1-85573-576-8.
11. Anand S.C., Kennedy J.F., Miraftab.M and Rajendran.S., "Medical textiles and biomaterials for health care", Woodhead Publishing Ltd, Cambridge, UK,2006, ISBN 1-85573-683-7.
12. Fung W. and Hardcastle, "Textiles in automotive engineering", Woodhead Publishing Ltd, Cambridge, UK, 2001, ISBN 1-85573-493-1.
13. John N.W.M., "Geo Textile", Blackie and Sons Ltd, London, U.K. , 1987, ISBN 0-412-01351-7.
14. Allison Mathews. and Martin Hardingham, "Medical and Hygiene Textile Production – A hand book" Intermediate Technology Publications, 1994.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6

CO1	Properties of fibres required for protective clothing	3	3	3	3	-	1
CO2	Selection of fibre, yarn and fabric for developing protective clothing for different applications	3	3	3	3	-	1
CO3	Protective clothing construction	3	3	3	3	-	1
CO4	Different types of finishes given to develop protective clothing	3	3	3	3	-	1
CO5	Evaluation of protective clothing	3	3	3	3	-	1
	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 L T P C
3 0 0 3

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 9

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 9

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 9

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 9

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 9

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

TOTAL: 45 PERIODS

OUTCOMES

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

1. Hearle J.W.S., Grosberg P. and Baker S., "Structural Mechanics of fibres, yarns and fabrics", Wiley Interscience, New York, 1969.
2. Goswami B.C., Martindale J.G. and Scardino F.L., "Textile Yarns: Technology, Structure and Applications", Wiley Interscience, New York, 1985
3. Hearle J.W.S., Thwaitesand J.J. and Amikrbayhat A., "Mechanics of Flexible Fibre Assemblies", Maryland, 1980.
4. Postle P., DejongS.andCarnaby G.A., "The Mechanics of Wool Structure", Ellis Horwood, London, 1988.
5. 3. Grosberg P. and Iype C., "Yarn production: Theoretical aspects", Textile Institute publication, 1999, ISBN-13: 978 1 87037 203 9.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Yarn geometry and its packing density	3	3	3	2	-	1
CO2	Migration of fibres in yarn	3	3	3	2	-	1
CO3	Breaking mechanics of yarn	3	3	3	2	-	1
CO4	Mechanics of blended yarn	3	3	3	2	-	1
CO5	Structure and properties relationship of yarn	3	3	3	2	-	1
	Overall CO	3	3	3	2	-	1

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

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

TOTAL: 45 PERIODS

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

REFERENCES

1. Hearle J. W. S., "Structural Mechanics of Fibers, Yarns and Fabrics", Wiley-Interscience, New York, 1969, ISBN: 0471366692
2. Hearle J. W. S., John J., Thwaites. andJafargholiAmirbayat., "Mechanics of Flexible Fibre Assemblies", Sijthoff and Noordhoff, 1980, ISBN : 902860720X
3. Jinlian Hu., "Structure and Mechanics of Woven Fabrics", Woodhead Publishing Ltd.,2004, ISBN: 1855739046
4. Hassan M. Berery., "Effect of Mechanical and Physical Properties on Fabrics Hand",Wood head publishing Ltd., 2005, ISBN : 13: 978 – 1- 85573 -9185

Course Articulation Matrix:

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

OBJETIVE

- 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 chlorosulponated 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

1. Walter Fung, “Coated and Laminated Textiles”, Woodhead Publishing Ltd, UK, 2002, ISBN 978-1-85573-576-7.
2. Carr C M, “Chemistry of the Textile Industry”, Blackie Academic & Professional, UK, 1995.
3. Smith W C, “Smart textile Coatings and Laminates”, Woodhead Publishing Ltd, UK, 2010, ISBN 978-1-84569-379-4.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Different kinds of polymers used for coating and laminating	3	2	3	2	-	1
CO2	Different methods of coating and laminating	3	2	3	2	-	1
CO3	Application of coated and laminated textiles in different industry	3	2	3	2	-	1
CO4	Characterization of coated textiles	3	2	3	2	-	1
	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

TX4010 COLOURATION 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 DYEING 9

Dyeing equilibrium; dye-fibre interaction; adsorption isotherm; dye affinity; heat of dyeing; half

dyeing time

UNIT II INK JET PRINTING **9**

Concept and methods of inkjet printing; colour separation; selection of dyes and developments in inks; techno-economical features

UNIT III COATING **9**

Coating polymers and auxiliaries, coating techniques and coated fabric assessment.

UNIT IV ENZYMES IN PROCESSING I **9**

Enzymes – classifications of enzymes and nomenclature of enzymes, synthesis of enzymes, enzyme kinetics

UNIT V ENZYMES IN PROCESSING II **9**

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

1. Park J., “Instrumental Colour formulation: A Practical guide”, Woodhead Publishing, 1993, ISBN 0 901956 54 6.
2. Choudhury A. K. R., “Modern concepts of colour and appearance”, Oxford and IBH Publishing Ltd, 2000.
3. Sule A. D., “Computer colour analysis”, New Age International Publishers, 2002.
4. McLaren K., “The color science of Dyes & Pigments”, Adam Hilger Ltd., 1983, ISBN 0 85274-4269.
5. Freifelder D., "Molecular Biology ", Jones and Bartlett Publishers Inc. 1987.
6. Nierstrasz V. and Cavaco- Paulo A., “Advances in textile biotechnology”, Woodhead Publishing Ltd, Cambridge, UK, 2010.
7. Cavaco -Paulo A. and Gubitz G., “Textile processing with enzymes”, Woodhead Publishing Ltd, Cambridge, UK, 2003.
8. UjiieH.,”Digital Printing of Textiles”, Woodhead Publishing Ltd, Cambridge, UK, 2006

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Theories and concepts of dyeing	3	2	3	2	-	1
CO2	Concepts of ink jet printing	3	2	3	2	-	1
CO3	Different coating techniques	3	2	3	2	-	1
CO4	Overview of enzymes and Nomenclature and synthesis of enzymes	3	2	3	2	-	1
CO5	Substrates and its relation with Textile Processing Enzymes	3	2	3	2	-	1
	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

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 draftingduring 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 yam 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:

1. Foster G.A.R. The Principles of Roller Drafting and the Irregularity of Drafted Materials, The Textile Institute, Manchester, 1958.
2. Klein W. A Practical Guide to Combing, Drawing and the Roving Frame, The Textile Institute, Manchester, 1999.
3. Lord P.R. Roller Drafting, Textile Progress, The Textile Institute, Manchester, 1993.
4. Grosberg P and lype C. Yarn Production: Theoretical Aspects, The Textile Institute, Manchester, 1999.
5. Lord P.R., Yam Production: Science, Technology and Economics, The Textile Institute, Manchester, 1999.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Theory of ideal drafting and formation of drafting wave	3	2	3	3	-	1
CO2	Drafting force, its measurement and influence	3	2	3	3	-	1
CO3	Different causes for irregularities in textile strand	3	2	3	3	-	1
CO4	Comparison of wire and roller drafting system and the drafting systems used in different spinning machinery	3	2	3	3	-	1
CO5	Compact spinning, principle and different methods	3	2	3	3	-	1
	Overall CO	3	2	3	3	-	1

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 9

Definition and concept of fabric hand; elements relating to fabric hand; development of fabric hand evaluation - subjective evaluation of fabric hand; objective evaluation of fabric hand - The El Mogahzy–Kilinc hand method. effects of fibre and yarn properties on fabric hand.

UNIT II CHARACTERISTICS OF POROUS MATERIALS 9

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 9

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 9

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 9

Neurophysiological comfort – basis of sensory perceptions, measurement techniques – mechanical stimuli and thermal stimuli; fabric tactile and mechanical properties – fabric prickliness, itchiness, stiffness, softness, smoothness, roughness, and scratchiness; predictability of clothing comfort performance.

TOTAL: 45 PERIODS

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

1. Hassan M. Behery, “Effect of Mechanical and Physical Properties on Fabric Hand”, Wood head Publishing Ltd., ISBN 0-8493-3479-9.
2. Li Y., “The Science of Clothing Comfort”, Textile Progress 31:1
3. Laing, R.M. and Sleivert G.G., “Clothing, Textile and Human Performance, Textile Progress, 32:2
4. Pan N. and Gibson P., Thermal and moisture transport in fibrous materials Wood head Publishing Limited ISBN-10: 1-84569-226-8.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Fabric hand and its comfort parameters	2	2	3	3	-	1
CO2	Permeabilityand porous nature of fibrous assemblies	2	2	3	3	-	1
CO3	Moisture vapour transfer phenomenon	2	2	3	3	-	1
CO4	Heat transfer phenomenon	2	2	3	3	-	1
CO5	Fabric properties with respect to comfort and correlate the property of the fabric with comfort to the wearer.	2	2	3	3	-	1
	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

TX4013 **MEDICAL TEXTILES** **L T P C**
3 0 0 3

OBJECTIVES

To enable the students to learn about

- Different types of biomaterials and
- Biomedical application of textile products

UNIT I BIOMATERIALS **9**

Biomaterials–introduction, types; natural, polymeric and biological biomaterials

UNIT II HYGIENE TEXTILES **9**

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 **9**

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 **9**

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 **9**

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 hand book”, Intermediate Technology Publications, 1994.
2. Anand S.C., Kennedy J.F. Miraftab M. and Rajendran S., “Medical Textiles and Biomaterials for Health care”, Wood head Publishing Ltd. 2006.
3. Joon B. Park. and Joseph D. Bronzino., “Biomaterials – Principles and Applications”,CRC Press Boca Raton London, NewYork, Washington , D.C. 2002
4. Anand S., “ Medical Textiles”, Textile Institute, 1996, ISBN: 185573317X
5. Horrocks A.R. and Anand S.C, “Technical Textiles”, Textile Institute,1999, ISBN: 185573317X.
6. Adanur S., “ Wellington Sears Handbook of Industrial Textiles”’ Technomic Publishing Co., Inc., Lancaster Pennylvania 1995, ISBN 1-56676-340-1.
7. Michael Szycher and Steven James Lee, “Modern Wound Dressing: A Systematic Approach to Wound Healing”, Journal of Biomaterials Applications, 1992
8. Rajendran S., “Advanced Textiles for Wound Care”, Woodhead Publishing Ltd., 2009, ISBN 1 84569 2713.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Types of materials used for biomedical applications	3	2	3	3	-	1
CO2	Health care and hygiene products	3	2	3	3	-	1
CO3	Different types of bandages	3	2	3	3	-	1
CO4	Wound dressing construction, testing	3	2	3	3	-	1
CO5	Implantable products, scaffolds for tissue engineering, ethical issues	3	2	3	3	-	1
	Overall CO	3	2	3	3	-	1

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 9

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 9

Supply chain in textile industry; sustainable cotton, wool, and synthetic fibre production and processing

UNIT III SUSTAINABILITY IN PROCESSING 9

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

UNIT IV RECYCLING 9

Textile recycling: polymer, fibre, yarn and fabric; consumer perception of recycled textile products

UNIT V ECO DESIGNING AND ECOLABELLING 9

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 in dyeing of textiles
CO4: Importance of recycling in textile industry
CO5: Eco-labelling and eco-designing

REFERENCES

1. Peter P Rogers., "An Introduction to Sustainable Development", Glen Educational Foundation, Inc, 2008, ISBN 978-1-84407-520-1.
2. Blackburn R S., "Sustainable Textiles", Woodhead Publishing Limited, 2009, ISBN 978-1-84569-453-1.
3. Marim I. Tobler. Rohr., "Handbook of Sustainable Textile Production", Woodhead Publishing Limited, Cambridge, 2011, ISBN 0-85274-426-9.
4. Miraftab M and Horrocks R, "Eco-Textiles", Woodhead Publishing Limited, Cambridge 2007, ISBN 978-1-42004-444-7.
5. Youjiang Wang, "Recycling in Textiles", Woodhead Publishing Limited, Cambridge, 2006, ISBN 1-85573-952-6.
6. Chavan R B and Radhakrishnan J, "Environmental Issues - Technology Options for Textile Industry", IIT Delhi Publication, 1998.
7. Cavaco-Paulo and Gübitz G M, "Textile Processing with Enzymes", Woodhead Publishing Ltd., UK, 2003, ISBN 978-1-85573-610-8.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Concept of sustainability and importance	3	2	3	2	2	1
CO2	Sustainability in textile fibre production	3	2	3	2	2	1
CO3	Sustainability in in dyeing of textiles	3	2	3	2	2	1
CO4	Importance of recycling in textile industry	3	2	3	2	2	1
CO5	Eco-labelling and eco-designing	3	2	3	2	2	1
	Overall CO	3	2	3	2	2	1

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 9

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 yam tension developed during twisting in these two machines.

UNIT IV TWISTING IN AIR-JET AND AIR-VORTEX SPINNING 9

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 9

Principle of two-for-one twisting; twisting of yarns in double-rove 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:

1. Klein W., “The Rieter Manual of Spinning, Vol.1”, Rieter Machine Works Ltd., Winterthur, 2014, ISBN 10 3-9523173-1-4 / ISBN 13 978-3-9523173-1-0.
2. Stalder H., “The Rieter Manual of Spinning, Vol.6”, Rieter Machine Works Ltd., Winterthur, 2014, ISBN: 10 3-9523173-6-5 / ISBN: 13 978-3-9523173-6-5
3. De Barr A.E. and Catling H., The Principle and Theory of Ring Spinning, The Textile Institute, Manchester, 1965.
4. Usenko V., Processing of Man-made Fibres, Mir Publishers, Moscow, 1979.
5. Grosbe,G . andlype C. Yarn Production: Theoretical Aspects, The Textile Institute, Manchester, 1999.
6. Lord P.R., Yarn Production: Science, Technology and Economics, The Textile Institute, Manchester, 1999

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Fundamentals of twisting	2	2	3	3	-	1
CO2	Theory frame of twisting At ring	2	2	3	3	-	1
CO3	Twisting principle of open end spinning and application in rotor and friction spinning systems	2	2	3	3	-	1
CO4	Twisting in air jet and air-vortex spinning	2	2	3	3	-	1
CO5	Principle and method of twisting in two for one twisting system and other spinning systems	2	2	3	3	-	1
	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

TX4015 TEXTILES IN CIVIL CONSTRUCTION AND TRANSPORTATION L T P C
3 0 0 3

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 9

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 9

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 9

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 9

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 9

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

1. Horrocks A.R. and Anand S.C., “Handbook of Technical Textiles”, The Textile Institute, Manchester, 2000, ISBN: 1855733854.
2. R. W. Sarsby, “Geo Synthetics in Civil Engineering”, Woodhead Publishing, ISBN-13 978-1-85573-607-8
3. Mukhopadhyay S.K. and Partridge J.F., “Automotive Textiles”, Textile Progress, Vol.29, No1/2, 1999, ISBN:1870372212.
4. Adanur S., “Wellington sears handbook of Industrial textiles”, Technomic publishing co

inc., 1995, ISBN : 1–56676–340–1.
5. Eugeniooñate and Bern kröplin “Textile Composites and Inflatable Structures”, Springer Dordrecht, Berlin, Heidelberg, New York, ISBN-10 1-4020-3316-8

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Understand the requirements of textiles used for civil construction and transportation applications	3	2	3	3	-	1
CO2	Understand geo synthetics in civil engineering applications	3	2	3	3	-	1
CO3	Design the textiles for the architectural applications	3	2	3	3	-	1
CO4	Design of textile materials for automobile industry	3	2	3	3	-	1
CO5	Evaluation of textiles to be used for civil construction and transportation industry	3	2	3	3	-	1
	Overall CO	**3**	**2**	**3**	**3**	**-**	**1**

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

TX4072 FUNCTIONAL DYES L T P C
3 0 0 3

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 BASICS OF DYES 9

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

UNIT II DYES USED IN TEXTILES 9

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 9

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

UNIT IV APPLICATION OF FUNCTIONAL DYES 9

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

UNIT V TOXICOLOGY AND HEALTH ASPECTS 9

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: Dyesused 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:

1. McLaren K., "The Color Science of Dyes & Pigments", Adam Hilger Ltd., 1983, ISBN 0-85274-426-9.
2. Venkataraman K., "The Chemistry of Synthetic Dyes", Elsevier., 2012, ISBN 97801-271-70084
3. Choudhury A. K. R., "Modern Concepts of Colour and Appearance", Oxford and IBH Publishing Ltd, 2000.
4. G. Buxbaum (Ed.) Industrial Inorganic Pigments, Second, Completely Revised Edition, 1998 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim.
5. Willy Herbst, Klaus Hunger, Industrial Organic Pigments- Production, Properties, Applications Third, Completely Revised Edition (With Contributions by Gerhard Wilker, HeinfredOhleier and Rainer Winter) 2004 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim
6. Advances in Color Chemistry – Vol I, Peters A. T.
7. Advances in Color Chemistry – Vol II, Peters A. T.
8. Non-Textile Dyes, Freeman H. S.
9. Robert A. Charvat ., "Coloring of Plastics: Fundamentals", John Wiley & Sons, 2005

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO 6
CO1	Chemical structure and properties of dyes	3	2	3	3	1	1
CO2	Dyes used in textiles	3	2	3	3	1	1
CO3	Functional dyes, their chemical structure and requirements	3	2	3	3	1	1
CO4	Applications of the functional dyes in different industries	3	2	3	3	1	1
CO5	Toxicity and health issues	3	2	3	3	1	1
	Overall CO	3	2	3	3	1	1

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

TX4016 POLLUTION ABATEMENT IN TEXTILE INDUSTRY L T P C

3 0 0 3

OBJECTIVE

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

UNIT I ENVIRONMENTAL POLLUTION 9

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 9

Wastewater characteristics; wastewater treatment - objectives, methods and implementation considerations; recycling of effluents

UNIT III TEXTILE EFFLUENTS 9

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 9

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 9

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

TOTAL: 45 PERIODS

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

REFERENCES

1. Trivedi R.K., “Handbook of Environmental laws, Acts, Guidelines, Compliances and Standards”, Vol. 1, Enviro Media, India, 1996.
2. George Thobanoglous and Franklin L. Burton., “Waste Water Engineering and Treatment, Disposal, Reuse (Metcalf & Eddy Inc., California)”, Tata McGraw-Hill Publishing co Ltd, New Delhi, 1995.
3. Manivasakam N., “Treatment of Textile Processing Effluents (including analysis)”, Sakhi Publications, Coimbatore, 1995.
4. “Eco-Textiles: Regulations, Labels, Processing and Testing, A Special Report”, The Bombay Textile Research Association, Mumbai, 1996.
5. “Symposium Proceedings on Eco - Friendly Textile Processing”, Department of textile Technology, Indian Institute of Textile Technology, New Delhi, 1995.
6. Skelly J. K., “Water Recycling in Textile wet Processing”, Woodhead Publishing Ltd, 2003.
7. Cooper P., “ Colour in Dyehouse Effluent”, Woodhead Publishing Ltd, 1995.
8. 6. Slater K., “Environmental impact of textiles: Production Processes and Protection”, Woodhead Publishing Ltd, 2003.
9. Chritie R., “Environmental aspects of textile dyeing”, Woodhead Publishing Ltd, 2007.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Pollution control policies and Government regulations	2	1	3	3	2	2

CO2	Method of treatment of waste water from processing industry	2	1	3	3	2	2
CO3	Managing pollutants as per Government regulations	2	1	3	3	2	2
CO4	Eco labeling, eco friendly textile processes	2	1	3	3	2	2
CO5	Solid and hazardous waste management in textile industry	2	1	3	3	2	2
	Overall CO	2	1	3	3	2	2

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

TX4071 CHARACTERIZATION OF TEXTILE POLYMERS L T P C
3 0 0 3

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

1. Gupta V.B. and Kothari V.K., “Man Made Fibre production,” Chapman and Hall, 1985.
2. Billmayer, “Textbooks of Polymer Science,” 3rd ed., Wiley, 1984

3. Sperling, “Introduction to Physical Polymer Science,” Wiley, 1986.
4. Campell D. and White J.R, “Polymer characterization, Physical Techniques”, McGraw – Hill, New York, 1969.
5. Stamm M., “Polymer surfaces and Interfaces”, Springer1st ed., 2008.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Determine weight techniques the using molecular various	3	2	3	3	-	1
CO2	Interpret molecular structure obtained from various analytical instruments	3	2	3	3	-	1
CO3	Determine properties instruments	3	2	3	3	-	1
CO4	Understand microscopy	3	2	3	3	-	1
CO5	Understand the properties of textile polymers	3	2	3	3	-	1
Overall CO		3	2	3	3	-	1

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 9

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

UNIT II MATRICES 9

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

UNIT III COMPOSITE MANUFACTURING 9

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 9

Fibre volume and weight fraction, specif ic gravity of composites, tensile, f lexural, impact, compression, inter laminar shear stress and fatigue properties of thermoset and thermoplastic composites.

UNIT V MECHANICS **9**

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 ofmatrices
CO3: Understand manufacturing of composites
CO4: Evaluate the properties of thermoset and thermoplastic composite
CO5: Mechanics of composites failure

REFERENCES

1. BorZ.Jang,"Advanced Polymer composites",ASM International,USA,1994.
2. Carlsson L.A. and Pipes R.B., "Experimental Characterization of advanced composite Materials",SecondEdition,CRCPress,NewJersey,1996.
3. George LubinandStanley T.Peters, "Handbook of Composites", Springer Publications,1998.
4. Mel. M. Schwartz, "Composite Materials", Vol. 1 &2, Prentice Hall PTR, New Jersey,1997.
5. RichardM.Christensen,"Mechanics of compositematerials",DoverPublications,2005.
6. Sanjay K. Mazumdar, "Composites Manufacturing: Materials, Product, and Process Engineering",CRCPress,2001

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Understand different types of textile reinforcements	3	2	3	2	-	1
CO2	Understand different types of matrices	3	2	3	2	-	1
CO3	Understand manufacturing of composites	3	2	3	2	-	1
CO4	Evaluate the properties of thermoset and thermoplastic composite	3	2	3	2	-	1
CO5	Mechanics of composites failure	3	2	3	2	-	1
	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

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 **9**

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 9

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 9

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 9

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 9

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

1. Wright W.D., “The Measurement of Colour”, Adam Hilger Ltd., 1969, ISBN: 0852741340 |ISBN-13: 9780852741344
2. Sule A.D., “Computer Colour Analysis”, New Age International Publishers, 2005, ISBN: 8122410847 | ISBN-13: 9788122410846.
3. Shah H.S., and Gandhi R. S., “Instrumental Colour Measurement and Computer Aided Colour Matching for Textiles”, Mahajan Book Publication, 1990.ISBN: 8185401004 / ISBN: 9788185401003.
4. Park J., “Instrumental Colour Formulation: A Practical Guide”, Wood head Publishing, 1993, ISBN: 0901956546 | ISBN-13: 9780901956545
5. Kuehni R.G., “Computer Colorant Formulation”, Lexington Books, 1976, ISBN: 0669033359 | ISBN-13: 9780669033359
6. ChoudhuryA. K. R., “Modern Concepts of Colour and Appearance”, Oxford and IBH Publishing Ltd., 2000,ISBN: 1578080797 | ISBN-13: 9781578080793
7. McLaren K., “The Colour Science of Dyes & Pigments”, Adam Hilger Ltd., 1983, ISBN: 0852744269 | ISBN-13: 9780852744260
8. Travis D., “Effective Colour Displays”, Academic Press, 1991,ISBN: 0126976902 | ISBN 13:9780126976908.
9. Gulrajani M. L. (Ed.), “Colour Measurement - Principles, advances and industrial applications'', Wood head publishing Ltd, 2010, ISBN: 1845695593 | ISBN-13:9781845695590

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Light matter interaction using various theories and laws	2	1	2	3	-	-
CO2	Colour vision theories, tests and colour mixing	2	1	2	3	-	-
CO3	Concepts of colour and colour order system	2	1	2	3	-	-
CO4	Concepts of Metamerism, colour difference assessment	2	1	2	3	-	-
CO5	Numerical colour matching	2	1	2	3	-	-
	Overall CO	2	1	2	3	-	-

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 L T P C
3 0 0 3

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 9

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 9

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 9

Two and three factor full factorial experiments, 2^K factorial Experiments, Confounding and Blocking designs; application in textile experiments.

UNIT IV SPECIAL EXPERIMENTAL DESIGNS 9

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 9

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.

TOTAL: 45 PERIODS

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 reponse surface methodology and other experimental design
CO5: Analyse the design parameters and case studies related to textile engineering

REFERENCES

1. Montgomery, D.C., Design and Analysis of experiments, John Wiley and Sons, 2003.
2. Nicolo Belavendram, Quality by Design; Taguchi techniques for industrial experimentation, Prentice Hall, 1995.
3. Phillip J.Rose, Taguchi techniques for quality engineering, McGraw Hill, 1996.
4. Leaf G.A.V., -Practical Statistics for the Textile Industry, Part I and II, The Textile Institute, Manchester, 1984, ISBN:0900739517.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome					
		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Understand the fundamentals of experimental design	3	3	2	2	-	1
CO2	Carryout statistical analysis and understand the single factor experiments	3	3	2	2	-	1
CO3	Design the experiment, conduct statistical tests and analyse the results to arrive at the conclusion	3	3	2	2	-	1
CO4	Understand the reponse surface methodology and other experimental design	3	3	2	2	-	1
CO5	Analyse the design parameters and case studies related to textile engineering	3	3	2	2	-	1
	Overall CO	3	3	2	2	-	1

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 L T P C
2 0 0 0

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

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

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

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

AX4092 **DISASTER MANAGEMENT** **L T P C**
2 0 0 0

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 6

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 6

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

UNIT III DISASTER PRONE AREAS IN INDIA 6

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 6

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 6

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:

1. Goel S. L., Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi,2001.

AX4093 **CONSTITUTION OF INDIA** **L T P C**
2 0 0 0

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 nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and 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

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT 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

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT 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.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

AX4094	நற்றமிழ் இலக்கியம்	L T P C 2 0 0 0

UNIT I **சங்க இலக்கியம்** **6**

1. தமிழின் துவக்க நூல் தொல்காப்பியம்
   – எழுத்து, சொல், பொருள்
2. அகநானூறு (82)
   - இயற்கை இன்னிசை அரங்கம்
3. குறிஞ்சிப் பாட்டின் மலர்க்காட்சி
4. புறநானூறு (95,195)
   - போரை நிறுத்திய ஔவையார்

UNIT II **அறநெறித் தமிழ்** **6**

1. அறநெறி வகுத்த திருவள்ளுவர்
   - அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புரவறிதல், ஈகை, புகழ்
2. பிற அறநூல்கள் - இலக்கிய மருந்து
   – ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம், ஆசாரக்கோவை
   (தூய்மையை வலியுறுத்தும் நூல்)

UNIT III **இரட்டைக் காப்பியங்கள்** **6**

1. கண்ணகியின் புரட்சி
   - சிலப்பதிகார வழக்குரை காதை
2. சமூகசேவை இலக்கியம் மணிமேகலை
   - சிறைக்கோட்டம் அறக்கோட்டமாகிய காதை

UNIT IV **அருள்நெறித் தமிழ்** **6**

1. சிறுபாணாற்றுப்படை
   - பாரி முல்லைக்குத் தேர் கொடுத்தது, பேகன் மயிலுக்குப் போர்வை கொடுத்தது, அதியமான் ஔவைக்கு நெல்லிக்கனி கொடுத்தது, அரசர் பண்புகள்
2. நற்றிணை
   - அன்னைக்குரிய புன்னை சிறப்பு
3. திருமந்திரம் (617, 618)
   - இயமம் நியமம் விதிகள்
4. தர்மச்சாலையை நிறுவிய வள்ளலார்
5. புறநானூறு
   - சிறுவனே வள்ளலானான்
6. அகநானூறு (4) - வண்டு
   நற்றிணை (11) - நண்டு
   கலித்தொகை (11) - யானை, புறா
   ஐந்திணை 50 (27) - மான்

ஆகியவை பற்றிய செய்திகள்

UNIT V **நவீன தமிழ் இலக்கியம்** **6**

1. உரைநடைத் தமிழ்,
- தமிழின் முதல் புதினம்,
- தமிழின் முதல் சிறுகதை,
- கட்டுரை இலக்கியம்,
- பயண இலக்கியம்,
- நாடகம்,
2. நாட்டு விடுதலை போராட்டமும் தமிழ் இலக்கியமும்,
3. சமுதாய விடுதலையும் தமிழ் இலக்கியமும்,
4. பெண் விடுதலையும் விளிம்பு நிலையினரின் மேம்பாட்டில் தமிழ் இலக்கியமும்,
5. அறிவியல் தமிழ்,
6. இணையத்தில் தமிழ்,
7. சுற்றுச்சூழல் மேம்பாட்டில் தமிழ் இலக்கியம்.

TOTAL : 30 PERIODS

<u>தமிழ் இலக்கிய வெளியீடுகள் / புத்தகங்கள்</u>

1. தமிழ் இணைய கல்விக்கழகம் (Tamil Virtual University)
   - www.tamilvu.org
2. தமிழ் விக்கிப்பீடியா (Tamil Wikipedia)
   -https://ta.wikipedia.org
3. தர்மபுர ஆதீன வெளியீடு
4. வாழ்வியல் களஞ்சியம்
   - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்
5. தமிழ்கலைக் களஞ்சியம்
   - தமிழ் வளர்ச்சித் துறை (thamilvalarchithurai.com)
6. அறிவியல் களஞ்சியம்
   - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்

OCE431 INTEGRATED WATER RESOURCES MANAGEMENT L T P C
3 0 0 3

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 9

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 9

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 9

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 9

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 9

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.

TOTAL: 45 PERIODS

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:

1. Cech Thomas V., Principles of water resources: history, development, management and policy. John Wiley and Sons Inc., New York. 2003.
2. Mollinga .P. etal " Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications, 2006.
3. Technical Advisory Committee, Integrated Water Resources management, Technical Advisory Committee Background Paper No: 4. Global water partnership, Stockholm, Sweden. 2002.
4. Technical Advisory Committee, Dublin principles for water as reflected in comparative assessment of institutional and legal arrangements for Integrated Water Resources

Management, Technical Advisory Committee Background paper No: 3. Global water partnership, Stockholm, Sweden. 1999.
5. Technical Advisory Committee, Effective Water Governance". Technical Advisory Committee Background paper No: 7. Global water partnership, Stockholm, Sweden, 2003.

OCE432 WATER, SANITATION AND HEALTH L T P C
3 0 0 3

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 9

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 9

Third World Scenario – Poor and Multidimensional Deprivation--Health Burden in Developing Scenario -Factors contribute to water, sanitation and hygiene related diseases-Social: Social Stratification and Literacy Demography: Population and Migration- Fertility - Mortality-Environment: Water Borne-Water Washed and Water Based Diseases - Economic: Wage - Water and Health Budgeting -Psychological: Non-compliance - Disease Relapse - Political: Political Will.

UNIT III CHALLENGES IN MANAGEMENT AND DEVELOPMENT 9

Common Challenges in WASH - Bureaucracy and Users- Water Utilities -Sectoral Allocation:-Infrastructure- Service Delivery: Health services: Macro and Micro- level: Community and Gender Issues- Equity Issues - Paradigm Shift: Democratization of Reforms and Initiatives.

UNIT IV GOVERNANCE 9

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 9

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.

TOTAL: 45 PERIODS

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

1. Bonitha R., Beaglehole R.,Kjellstorm, 2006, "Basic Epidemiology", 2nd Edition, World Health

Organization.
2. Van Note Chism, N. and Bickford, D. J. (2002), Improving the environment for learning: An expanded agenda. New Directions for Teaching and Learning, 2002: 91–98. doi: 10.1002/tl.83Improving the Environment for learning: An Expanded Agenda
3. National Research Council. Global Issues in Water, Sanitation, and Health: Workshop Summary**.** Washington, DC: The National Academies Press, 2009.
4. Sen, Amartya 1997. On Economic Inequality. Enlarged edition, with annex by JamesFoster and Amartya Sen, Oxford: Claredon Press, 1997.
5. Intersectoral Water Allocation Planning and Management, 2000, World Bank Publishers www. Amazon.com
6. Third World Network.org (www.twn.org).

OCE433 PRINCIPLES OF SUSTAINABLE DEVELOPMENT L T P C
3 0 0 3

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 CHALLEGES 9

Definition of sustainability – environmental, economical and social dimensions of sustainability - sustainable development models – strong and weak sustainability – defining development-millennium development goals – mindsets for sustainability: earthly, analytical, precautionary, action and collaborative– syndromes of global change: utilisation syndromes, development syndromes, and sink syndromes – core problems and cross cutting Issues of the 21 century - global, regional and local environmental issues – social insecurity - resource degradation –climate change – desertification.

UNIT II PRINCIPLES AND FRAME WORK 9

History and emergence of the concept of sustainable development - our common future - Stockholm to Rio plus 20– Rio Principles of sustainable development – Agenda 21 natural step-peoples earth charter – business charter for sustainable development –UN Global Compact - Role of civil society, business and government – United Nations' 2030 Agenda for sustainable development – 17 sustainable development goals and targets, indicators and intervention areas

UNIT III SUSTAINABLE DEVELOPMENT AND WELLBEING 9

The Unjust World and inequities - Quality of Life - Poverty, Population and Pollution - Combating Poverty - - Demographic dynamics of sustainability - Strategies to end Rural and Urban Poverty and Hunger – Sustainable Livelihood Framework- Health, Education and Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities and Industry for Prevention, Precaution , Preservation and Public participation.

UNIT IV SUSTAINABLE SOCIO-ECONOMIC SYSTEMS 10

Sustainable Development Goals and Linkage to Sustainable Consumption and Production – Investing in Natural Capital- Agriculture, Forests, Fisheries - Food security and nutrition and sustainable agriculture- Water and sanitation - Biodiversity conservation and Ecosystem integrity – Ecotourism - Sustainable Cities – Sustainable Habitats- Green Buildings - Sustainable Transportation — Sustainable Mining - Sustainable Energy– Climate Change –Mitigation and Adaptation - Safeguarding Marine Resources - Financial Resources and Mechanisms

UNIT V ASSESSING PROGRESS AND WAY FORWARD 8

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

Ecological Footprint- Human Development Index- Human Development Report – National initiatives for Sustainable Development - Hurdles to Sustainability - Science and Technology for sustainable development –Performance indicators of sustainability and Assessment mechanism – Inclusive Green Growth and Green Economy – National Sustainable Development Strategy Planning and National Status of Sustainable Development Goals

TOTAL: 45 PERIODS

OUTCOMES:

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

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

REFERENCES:

1. Tom Theis and Jonathan Tomkin, Sustainability: A Comprehensive Foundation, Rice University, Houston, Texas, 2012
2. A guide to SDG interactions:from science to implementation, International Council for Science, Paris,2017
3. Karel Mulder, Sustainable Development for Engineers - A Handbook and Resource Guide, Rouledge Taylor and Francis, 2017.
4. The New Global Frontier - Urbanization, Poverty and Environmentin the 21st Century - *George Martine,Gordon McGranahan,Mark Montgomery and Rogelio Fernández-Castilla,* IIED and UNFPA, Earthscan, UK, 2008
5. Nolberto Munier, Introduction to Sustainability: Road to a Better Future, Springer, 2006
6. Barry Dalal Clayton and Stephen Bass, Sustainable Development Strategies- a resource book", Earthscan Publications Ltd, London, 2002.

OCE434 ENVIRONMENTAL IMPACT ASSESSMENT L T P C
3 0 0 3

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 9

Historical development of Environmental Impact Assessment (EIA). Environmental Clearance- EIA in project cycle. legal and regulatory aspects in India – types and limitations of EIA –EIA process-screening – scoping - terms of reference in EIA- setting – analysis – mitigation. Cross sectoral issues –public hearing in EIA- EIA consultant accreditation.

UNIT II IMPACT INDENTIFICATION AND PREDICTION 10

Matrices – networks – checklists – cost benefit analysis – analysis of alternatives – expert systems in EIA. prediction tools for EIA – mathematical modeling for impact prediction – assessment of impacts – air – water – soil – noise – biological — cumulative impact assessment

UNIT III SOCIO-ECONOMIC IMPACT ASSESSMENT 8

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 9

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 9

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

TOTAL: 45 PERIODS

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
3. Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York. 1996
4. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey. 2003
5. Lee N. and George C. 2000. Environmental Assessment in Developing and Transitional Countries. Chichester: Willey
6. World Bank –Source book on EIA ,1999
7. Sam Mannan, Lees' Loss Prevention in the Process Industries, Hazard Identification Assessment and Control, 4th Edition, Butterworth Heineman, 2012.

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 9

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 9

Introduction to Bitcoin, The Bitcoin Network, The Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, Blockchain and Digital Currency, Transactional Blocks, Impact of Blockchain Technology on Cryptocurrency.

UNIT III INTRODUCTION TO ETHEREUM 9

Introduction to Ethereum, Consensus Mechanisms, Metamask Setup, Ethereum Accounts, , Transactions, Receiving Ethers, Smart Contracts.

UNIT-IV INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING 10

Introduction to Hyperledger, Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer. Solidity - Language of Smart Contracts, Installing Solidity & Ethereum Wallet, Basics of Solidity, Layout of a Solidity Source File & Structure of Smart Contracts, General Value Types.

UNIT V BLOCKCHAIN APPLICATIONS 8

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

TOTAL: 45 PERIODS

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:

1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained”, Second Edition, Packt Publishing, 2018.
2. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction” Princeton University Press, 2016
3. Antonopoulos, Mastering Bitcoin, O’Reilly Publishing, 2014. .
4. Antonopoulos and G. Wood, “Mastering Ethereum: Building Smart Contracts and Dapps”, O’Reilly Publishing, 2018.
5. D. Drescher, Blockchain Basics. Apress, 2017.

OIC432 DEEP LEARNING L T P C
3 0 0 3

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 6

Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.

UNIT II NEURAL NETWORKS 9

About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Pre-processing for neural networks, Feature Engineering. Overfitting and Underfitting. Hyperparameters.

UNIT III CONVOLUTIONAL NEURAL NETWORK 10

About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers. Dense Layers. Backpropagation Through the Convolutional Layer. Filters and Feature Maps. Backpropagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various Optimizers. LeNet, AlexNet, VGG16, ResNet. Transfer Learning with Image Data. Transfer Learning using Inception Oxford VGG Model, Google Inception Model, Microsoft ResNet Model. R-CNN, Fast R-CNN, Faster R-CNN, Mask-RCNN, YOLO

UNIT IV NATURAL LANGUAGE PROCESSING USING RNN 10

About NLP & its Toolkits. Language Modeling . Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip-Gram Model for Word Embedding. Part of Speech (PoS) Global Co-occurrence Statistics–based Word Vectors. Transfer Learning. Word2Vec. Global Vectors for Word Representation GloVe. Backpropagation Through Time. Bidirectional RNNs (BRNN) . Long Short Term Memory (LSTM). Bi-directional LSTM. Sequence-to-Sequence Models (Seq2Seq). Gated recurrent unit GRU.

UNIT V DEEP REINFORCEMENT & UNSUPERVISED LEARNING 10

About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. About Autoencoding. Convolutional Auto Encoding. Variational Auto Encoding. Generative Adversarial Networks. Autoencoders for Feature Extraction. Auto Encoders for Classification. Denoising Autoencoders. Sparse Autoencoders

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
3. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017
5. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017

OME431 VIBRATION AND NOISE CONTROL STRATEGIES L T P C
3 0 0 3

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 9

Introduction – Sources and causes of Vibration-Mathematical Models - Displacement, velocity and Acceleration - Classification of vibration: free and forced vibration, undamped and damped vibration, linear and non-linear vibration - Single Degree Freedom Systems - Vibration isolation - Determination of natural frequencies

UNIT- II BASICS OF NOISE 9

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 9

Experimental Methods in Vibration Analysis.- Vibration Measuring Instruments - Selection of Sensors - Accelerometer Mountings - Vibration Exciters - Mechanical, Hydraulic, Electromagnetic and Electrodynamics – Frequency Measuring Instruments -. System Identification from Frequency Response -Testing for resonance and mode shapes

UNIT- IV INSTRUMENTATION FOR NOISE MEASUREMENT AND ANALYSIS 9

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 9

Specification of Vibration Limits – Vibration severity standards - Vibration as condition Monitoring Tool – Case Studies - Vibration Isolation methods - Dynamic Vibration Absorber – Need for Balancing - Static and Dynamic Balancing machines – Field balancing - Major sources of noise - Noise survey techniques – Measurement technique for vehicular noise - Road vehicles Noise standard – Noise due to construction equipment and domestic appliances – Industrial noise sources and its strategies – Noise control at the source – Noise control along the path – Acoustic Barriers – Noise control at the receiver -- Sound transmission through barriers – Noise reduction Vs Transmission loss - Enclosures

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:

1. Singiresu S. Rao, “Mechanical Vibrations”, Pearson Education Incorporated, 2017.

2. Graham Kelly. Sand Shashidhar K. Kudari, “Mechanical Vibrations”, Tata McGraw –Hill Publishing Com. Ltd., 2007.
3. Ramamurti. V, “Mechanical Vibration Practice with Basic Theory”, Narosa Publishing House, 2000.
4. William T. Thomson, “Theory of Vibration with Applications”, Taylor & Francis, 2003.
5. G.K. Grover, “Mechanical Vibrations”, Nem Chand and Bros.,Roorkee, 2014.
6. A.G. Ambekar, “Mechanical Vibrations and Noise Engineering”, PHI Learning Pvt. Ltd., 2014.
7. David A. Bies and Colin H. Hansen, “Engineering Noise Control – Theory and Practice”, Spon Press, London and New York, 2009.

OME432ENERGY CONSERVATION AND MANAGEMENT IN DOMESTIC SECTORS **L 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. 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 **9**

Primary energy resources - Sectorial energy consumption (domestic, industrial and other sectors), Energy pricing, Energy conservation and its importance, Energy Conservation Act-2001 and its features – Energy star rating.

UNIT II HEATING, VENTILLATION & AIR CONDITIONING **9**

Basics of Refrigeration and Air Conditioning – COP / EER / SEC Evaluation – SPV system design & optimization for Solar Refrigeration.

UNIT III LIGHTING, COMPUTER, TV **9**

Specification of Luminaries – Types – Efficacy – Selection & Application – Time Sensors – Occupancy Sensors – Energy conservation measures in computer – Television – Electronic devices.

UNIT IV ENERGY EFFICIENT BUILDINGS **9**

Conventional versus Energy efficient buildings – Landscape design – Envelope heat loss and heat gain – Passive cooling and heating – Renewable sources integration.

UNIT V ENERGY STORAGE TECHNOLOGIES **9**

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:

1. Yogi Goswami, Frank Kreith, Energy Efficiency and Renewable energy Handbook, CRC Press, 2016
2. ASHRAE Handbook 2020 – HVAC Systems & Equipment
3. Paolo Bertoldi, Andrea Ricci, Anibal de Almeida, Energy Efficiency in Household Appliances and Lighting, Conference proceedings, Springer, 2001
4. David A. Bainbridge, Ken Haggard, Kenneth L. Haggard, Passive Solar Architecture: Heating, Cooling, Ventilation, Daylighting, and More Using Natural Flows, Chelsea Green Publishing, 2011.
5. Guide book for National Certification Examination for Energy Managers and Energy Auditors
   (Could be downloaded from www.energymanagertraining.com)
6. Ibrahim Dincer and Mark A. Rosen, Thermal Energy Storage Systems and Applications, John Wiley & Sons 2002.
7. Robert Huggins, Energy Storage: Fundamentals, Materials and Applications, 2nd edition, Springer, 2015
8. Ru-shiliu, Leizhang, Xueliang sun, Electrochemical technologies for energy storage and conversion, Wiley publications, 2012.

OME433	ADDITIVE MANUFACTURING	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION 9

Need - Development - Rapid Prototyping Rapid Tooling – Rapid Manufacturing – Additive Manufacturing. AM Process Chain- Classification – Benefits.

UNIT II DESIGN FOR ADDITIVE MANUFACTURING 9

CAD Model Preparation - Part Orientation and Support Structure Generation -Model Slicing - Tool Path Generation Customized Design and Fabrication - Case Studies.

UNIT III VAT POLYMERIZATION 9

Stereolithography Apparatus (SLA)- Materials -Process -Advantages Limitations- Applications. Digital Light Processing (DLP) - Materials – Process - Advantages - Applications. Multi Jet Modelling (MJM) - Principles - Process - Materials - Advantages and Limitations.

UNIT IV MATERIAL EXTRUSION AND SHEET LAMINATION 9

Fused Deposition Modeling (FDM)- Process-Materials - Applications and Limitations. Sheet Lamination Process: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding – Thermal Bonding- Materials- Application and Limitation - Bio-Additive Manufacturing Computer Aided Tissue Engineering (CATE) – Case studies

POWDER BASED PROCESS

Selective Laser Sintering (SLS): Process –Mechanism– Typical Materials and Application- Multi Jet Fusion - Basic Principle-– Materials- Application and Limitation - Three Dimensional Printing - Materials -Process - Benefits and Limitations. Selective Laser Melting (SLM) and Electron Beam Melting (EBM): Materials – Process - Advantages and Applications. Beam Deposition Process: Laser Engineered Net Shaping (LENS)- Process -Material Delivery - Process Parameters - Materials -Benefits -Applications.

UNIT V CASE STUDIES AND OPPORTUNITIES ADDITIVE MANUFACTURING PROCESSES 9

Education and training - Automobile- pattern and mould - tooling - Building Printing-Bio Printing - medical implants -development of surgical tools Food Printing -Printing Electronics. Business Opportunities and Future Directions - Intellectual Property.

TOTAL: 45 PERIODS

REFERENCES:

1. Andreas Gebhardt and Jan-Steffen Hötter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, United States, 2015, ISBN: 978-1- 56990-582-1.
2. Ian Gibson, David W. Rosen and Brent Stucker "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", 2nd edition, Springer., United States, 2015, ISBN13: 978-1493921126.
3. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590
4. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.
5. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third edition, World Scientific Publishers, 2010.

OME434 ELECTRIC VEHICLE TECHNOLOGY L T P C

3 0 0 3

UNIT I NEED FOR ELECTRIC VEHICLES 9

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 ARCHITECHTURE 9

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 9

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 9

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 9

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:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, 2nd edition CRC Press, 2011.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
3. James Larminie, John Lowry, Electric Vehicle Technology Explained - Wiley, 2003.
4. Ehsani, M, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2005

OME435	NEW PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

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. Identfying 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. Appling the principles of Industrial design and prototype for new product design and development.

UNIT I INTRODUCTION TO PRODUCTDESIGN & DEVELOPMENT 9

Introduction – Characteristics of Successful Product Development – People involved in Product Design and Development – Duration and Cost of Product Development – The Challenges of Product Development – The Product Development Process – Concept Development: The Front-End Process – Adapting the Generic Product Development Process – Product Development Process Flows – Product Development Organizations.

UNIT II OPPORTUNITY DENTIFICATION & PRODUCT PLANNING 9

Opportunity Identification: Definition – Types of Opportunities – Tournament Structure of Opportunity Identification – Effective Opportunity Tournaments – Opportunity Identification Process – Product Planning: Four types of Product Development Projects – The Process of Product Planning.

UNIT III IDENTIFYING CUSTOMER NEEDS & PRODUCT SPECIFICATIONS 9

Identifying Customer Needs: The Importance of Latent Needs – The Process of Identifying Customer Needs. Product Specifications: Definition – Time of Specifications Establishment – Establishing Target Specifications – Setting the Final Specifications

UNIT IV CONCEPT GENERATION, SELECTION & TESTING 9

Concept Generation: Activity of Concept Generation – Structured Approach – Five step method of Concept Generation. Concept Selection: Methodology – Concept Screening and Concepts Scoring. Concept testing: Seven Step activities of concept testing.

UNITV INDUSTRIAL DESIGN & PROTOTYPING 9

Industrial Design: Need and Impact–Industrial Design Process. Prototyping – Principles of Prototyping – Prototyping Technologies – Planning for Prototypes.

TOTAL: 45 PERIODS

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:

1. Ulrich K.T., Eppinger S. D. and Anita Goyal, "Product Design and Development "McGraw-Hill Education; 7 edition, 2020.

REFERENCES:

1. Belz A., 36-Hour Course: "Product Development" McGraw-Hill, 2010.
2. Rosenthal S.,"Effective Product Design and Development", Business One Orwin,Homewood, 1992,ISBN1-55623-603-4.

OBA431 SUSTAINABLE MANAGEMENT LT P C
3 0 0 3

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 9

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 9

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 9

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 9

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 9

Energy management, Water management, Waste management, Wild Life Conservation, Emerging trends in sustainable management, Case Studies.

TOTAL: 45 PERIODS

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 sustainabilityperformances.
CO4: Knowledge of innovative practices in sustainable business and community management
CO5: Deep understanding of sustainable management of resources and commodities

REFERENCES:

1. Daddi, T., Iraldo, F., Testa, Environmental Certification for Organizations and Products: Management, 2015
2. Christian N. Madu, Handbook of Sustainability Management 2012
3. Petra Molthan-Hill, The Business Student's Guide to Sustainable Management: Principles and Practice, 2014
4. Margaret Robertson, Sustainability Principles and Practice, 2014
5. Peter Rogers, An Introduction to Sustainable Development, 2006

OBA432 MICRO AND SMALL BUSINESS MANAGEMENT L T P C
3 0 0 3

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 9

Creation, Innovation, entrepreneurship and small business - Defining Small Business –Role of Owner – Manager – government policy towards small business sector –elements of entrepreneurship –evolution of entrepreneurship –Types of Entrepreneurship – social, civic, corporate - Business life cycle - barriers and triggers to new venture creation – process to assist start ups – small business and family business.

UNIT II SCREENING THE BUSINESS OPPORTUNITY AND FORMULATING THE BUSINESS PLAN 9

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 9

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 9

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

margin- Pricing for profit - Credit policy issues and relating these to cash flow management and profitability.

UNIT V VALUING SMALL BUSINESS AND CRISIS MANAGEMENT 9

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

1. Hankinson,A.(2000). “The key factors in the profile of small firm owner-managers that influence business performance. The South Coast Small Firms Survey, 1997-2000.” Industrial and Commercial Training 32(3):94-98.
2. Parker,R.(2000). “Small is not necessarily beautiful: An evaluation of policy support for small and medium-sized enterprise in Australia.” Australian Journal of Political Science 35(2):239-253.
3. Journal articles on SME’s.

OBA433 INTELLECTUAL PROPERTY RIGHTS L T P C
3 0 0 3

COURSE OBJECTIVE

- To understand intellectual property rights and its valuation.

UNIT I INTRODUCTION 9

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 9

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 9

International Treaties and conventions on IPRs, The TRIPs Agreement, PCT Agreement, The Patent Act of India, Patent Amendment Act (2005), Design Act, Trademark Act, Geographical Indication Act, Bayh- Dole Act and Issues of Academic Entrepreneurship.

UNIT IV STRATEGIES IN INTELLECTUAL PROPERTY 9

Strategies for investing in R&D, Patent Information and databases, IPR strength in India, Traditional Knowledge, Case studies.

UNIT V MODELS **9**

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

1. V. Sople Vinod, Managing Intellectual Property by (Prentice hall of India Pvt.Ltd), 2006.
2. Intellectual Property rights and copyrights, EssEss Publications.
3. Primer, R. Anita Rao and Bhanoji Rao, Intellectual Property Rights, Lastain Book company.
4. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2006.
5. WIPO Intellectual Property Hand book.

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 **9**

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 **9**

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 **9**

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 MANJAGEMENT **9**

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

1. Brad Agle, Aaron Miller, Bill O' Rourke, The Business Ethics Field Guide: the essential companion to leading your career and your company, 2016.
2. Steiner & Steiner, Business, Government & Society: A managerial Perspective, 2011.
3. Lawrence & Weber, Business and Society: Stakeholders, Ethics, Public Policy, 2020.

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

IoT reference model and architecture -Node Structure - Sensing, Processing, Communication, Powering, Networking - Topologies, Layer/Stack architecture**,** IoT standards, Cloud computing for IoT, Bluetooth, Bluetooth Low Energy beacons.

UNIT III PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT 9

PROTOCOLS:

NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe 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 **9**

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:

1. ArshdeepBahga and VijaiMadisetti : A Hands-on Approach “Internet of Things”,Universities Press 2015.
2. Oliver Hersent , David Boswarthick and Omar Elloumi “ The Internet of Things”, Wiley,2016.
3. Samuel Greengard, “ The Internet of Things”, The MIT press, 2015.
4. Adrian McEwen and Hakim Cassimally“Designing the Internet of Things “Wiley,2014.
5. Jean- Philippe Vasseur, Adam Dunkels, “Interconnecting Smart Objects with IP: The Next Internet” Morgan Kuffmann Publishers, 2010.
6. Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things”, John Wiley and sons, 2014.
7. Lingyang Song/DusitNiyato/ Zhu Han/ Ekram Hossain,” Wireless Device-to-Device Communications and Networks, CAMBRIDGE UNIVERSITY PRESS,2015.
8. OvidiuVermesan and Peter Friess (Editors), “Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers Series in Communication, 2013.
9. Vijay Madisetti , ArshdeepBahga, “Internet of Things (A Hands on-Approach)”, 2014.
10. Zach Shelby, Carsten Bormann, “6LoWPAN: The Wireless Embedded Internet”, John Wiley and sons, 2009.
11. Lars T.Berger and Krzysztof Iniewski, “Smart Grid applications, communications and security”, Wiley, 2015.
12. JanakaEkanayake, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama and Nick Jenkins, “ Smart Grid Technology and Applications”, Wiley, 2015.
13. UpenaDalal,”Wireless Communications & Networks,Oxford,2015.

ET4072 MACHINE LEARNING AND DEEP LEARNING **L T P C**
3 0 0 3

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 **9**

Various paradigms of learning problems, Supervised, Semi-supervised and Unsupervised algorithms

UNIT II NEURAL NETWORKS 9

Differences between Biological and Artificial Neural Networks - Typical Architecture, Common Activation Functions, Multi-layer neural network, Linear Separability, Hebb Net, Perceptron, Adaline, Standard Back propagation Training Algorithms for Pattern Association - Hebb rule and Delta rule, Hetero associative, Auto associative, Kohonen Self Organising Maps, Examples of Feature Maps, Learning Vector Quantization, Gradient descent, Boltzmann Machine Learning.

UNIT III MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS 9

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 9

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 9

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:

1. J. S. R. Jang, C. T. Sun, E. Mizutani, Neuro Fuzzy and Soft Computing - A Computational Approach to Learning and Machine Intelligence, 2012, PHI learning
2. Deep Learning, Ian Good fellow, YoshuaBengio and Aaron Courville, MIT Press, ISBN: 9780262035613, 2016.
3. The Elements of Statistical Learning. Trevor Hastie, Robert Tibshirani and Jerome Friedman. Second Edition. 2009.
4. Pattern Recognition and Machine Learning. Christopher Bishop. Springer. 2006.
5. Understanding Machine Learning. Shai Shalev-Shwartz and Shai Ben-David. Cambridge University Press. 2017.

PX4012 RENEWABLE ENERGY TECHNOLOGY L T P C
3 0 0 3

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

UNIT I INTRODUCTION 9
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 9
Solar Energy: Sun and Earth-Basic Characteristics of solar radiation- angle of sunrays on solar collector-Estimating Solar Radiation Empirically - Equivalent circuit of PV Cell- Photovoltaic cell-characteristics: P-V and I-V curve of cell-Impact of Temperature and Insolation on I-V characteristics-Shading Impacts on I-V characteristics-Bypass diode -Blocking diode.

UNIT III PHOTOVOLTAIC SYSTEM DESIGN 9
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 9
Origin of Winds: Global and Local Winds- Aerodynamics of Wind turbine-Derivation of Betz's limit-Power available in wind-Classification of wind turbine: Horizontal Axis wind turbine and Vertical axis wind turbine- Aerodynamic Efficiency-Tip Speed-Tip Speed Ratio-Solidity-Blade Count-Power curve of wind turbine - Configurations of wind energy conversion systems: Type A, Type B, Type C and Type D Configurations- Grid connection Issues - Grid integrated SCIG and PMSG based WECS.

UNIT V OTHER RENEWABLE ENERGY SOURCES 9
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:
1. S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford UniversityPress, 2009.
2. Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993.
3. Rai. G.D," Solar energy utilization", Khanna publishes, 1993.

4. Chetan Singh Solanki, “Solar Photovoltaics: Fundamentals, Technologies and Applications”, PHI Learning Private Limited, 2012.
5. John Twideu and Tony Weir, “Renewal Energy Resources” BSP Publications, 2006
6. Gray, L. Johnson, “Wind energy system”, prentice hall of India, 1995.
7. B.H.Khan, " Non-conventional Energy sources", , McGraw-hill, 2nd Edition, 2009.
8. Fang Lin Luo Hong Ye, " Renewable Energy systems", Taylor & Francis Group,2013.

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 9

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 9

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 9

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 9

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9

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.

TOTAL : 45 PERIODS

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

1. Stuart Borlase 'Smart Grid: Infrastructure, Technology and Solutions', CRC Press 2012.
2. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, 'Smart Grid: Technology and Applications', Wiley, 2012.
3. Mini S. Thomas, John D McDonald, 'Power System SCADA and Smart Grids', CRC Press, 2015
4. Kenneth C.Budka, Jayant G. Deshpande, Marina Thottan, 'Communication Networks for Smart Grids', Springer, 2014
5. SMART GRID Fundamentals of Design and Analysis, James Momoh, IEEE press, A John Wiley & Sons, Inc., Publication.

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 -A Cryptography primer- Intrusion detection system- Intrusion Prevention system - Security web applications- Case study: OWASP - Top 10 Web Application Security Risks.

UNIT II NETWORK SECURITY 9

Internet Security - Intranet security- Local Area Network Security - Wireless Network Security - Wireless Sensor Network Security- Cellular Network Security - Mobile security - IOT security - Case Study - Kali Linux.

UNIT III SECURITY MANAGEMENT 9

Information security essentials for IT Managers- Security Management System - Policy Driven System Management- IT Security - Online Identity and User Management System. Case study: Metasploit

UNIT IV CYBER SECURITY AND CLOUD SECURITY 9

Cyber Forensics- Disk Forensics – Network Forensics – Wireless Forensics – Database Forensics – Malware Forensics – Mobile Forensics – Email Forensics- Best security practices for automate Cloud infrastructure management – Establishing trust in IaaS, PaaS, and SaaS Cloud types. Case study: DVWA

UNIT V PRIVACY AND STORAGE SECURITY 9

Privacy on the Internet - Privacy Enhancing Technologies - Personal privacy Policies - Detection of Conflicts in security policies- privacy and security in environment monitoring systems. Storage Area Network Security - Storage Area Network Security Devices - Risk management - Physical Security Essentials.

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

1. John R. Vacca, Computer and Information Security Handbook, Third Edition, Elsevier 2017
2. Michael E. Whitman, Herbert J. Mattord, Principles of Information Security, Seventh Edition, Cengage Learning, 2022
3. Richard E. Smith, Elementary Information Security, Third Edition, Jones and Bartlett Learning, 2019
4. Mayor, K.K.Mookhey, Jacopo Cervini, Fairuzan Roslan, Kevin Beaver, Metasploit Toolkit for Penetration Testing, Exploit Development and Vulnerability Research, Syngress publications, Elsevier, 2007. ISBN : 978-1-59749-074-0
5. John Sammons, "The Basics of Digital Forensics- The Primer for Getting Started in Digital Forensics", Syngress, 2012
6. Cory Altheide and Harlan Carvey, "Digital Forensics with Open Source Tools",2011 Syngress, ISBN: 9781597495875.
7. Siani Pearson, George Yee "Privacy and Security for Cloud Computing" Computer Communications and Networks, Springer, 2013.

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

Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines –Emulation – Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization –Management Virtualization — Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization- Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation

UNIT II CLOUD PLATFORM ARCHITECTURE 12

Cloud Computing: Definition, Characteristics - Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design – Layered cloud Architectural Development – Architectural Design Challenges

UNIT III AWS CLOUD PLATFORM - IAAS 9

Amazon Web Services: AWS Infrastructure- AWS API- AWS Management Console - Setting up AWS Storage - Stretching out with Elastic Compute Cloud - Elastic Container Service for Kubernetes- AWS Developer Tools: AWS Code Commit, AWS Code Build, AWS Code Deploy,

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

Windows Azure: Origin of Windows Azure, Features, The Fabric Controller – First Cloud APP in Windows Azure- Service Model and Managing Services: Definition and Configuration, Service runtime API- Windows Azure Developer Portal- Service Management API- Windows Azure Storage Characteristics-Storage Services- REST API- Blops

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

1. Bernard Golden, Amazon Web Service for Dummies, John Wiley & Sons, 2013.
2. Raoul Alongi, AWS: The Most Complete Guide to Amazon Web Service from Beginner to Advanced Level, Amazon Asia- Pacific Holdings Private Limited, 2019.
3. Sriram Krishnan, Programming: Windows Azure, O'Reilly,2010.
4. Rajkumar Buyya, Christian Vacchiola, S.Thamarai Selvi, Mastering Cloud Computing , MCGraw Hill Education (India) Pvt. Ltd., 2013.
5. Danielle Ruest, Nelson Ruest, —Virtualization: A Beginner‟s Guide‖, McGraw-Hill Osborne Media, 2009.
6. Jim Smith, Ravi Nair , "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
7. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
8. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
9. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.

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

Introduction. A UX process lifecycle template. Choosing a process instance for your project. The system complexity space. Meet the user interface team. Scope of UX presence within the team. More about UX lifecycles. Business Strategy. Value Innovation. Validated User Research. Killer UX Design. The Blockbuster Value Proposition. What Is a Value Proposition?.

UNIT II CONTEXTUAL INQUIRY 10

The system concept statement. User work activity data gathering. Look for emotional aspects of work practice. Abridged contextual inquiry process. Data-driven vs. model-driven inquiry. Organizing concepts: work roles and flow model. Creating and managing work activity notes. Constructing your work activity affinity diagram (WAAD). Abridged contextual analysis process. History of affinity diagrams.

UNIT III DESIGN THINKING, IDEATION, AND SKETCHING 9

Design-informing models: second span of the bridge . Some general “how to” suggestions. A New example domain: slideshow presentations. User models. Usage models. Work environment models. Barrier summaries. Model consolidation. Protecting your sources. Abridged methods for design-informing models extraction. Design paradigms. Design thinking. Design perspectives. User personas. Ideation. Sketching

UNIT IV UX GOALS, METRICS, AND TARGETS 8

Introduction. UX goals. UX target tables. Work roles, user classes, and UX goals. UX measures. Measuring instruments. UX metrics. Baseline level. Target level. Setting levels. Observed results. Practical tips and cautions for creating UX targets. How UX targets help manage the user experience engineering process.

UNIT V ANALYSING USER EXPERIENCE 10

Sharpening Your Thinking Tools. UX Research and Strength of Evidence. Agile Personas. How to Prioritize Usability Problems. Creating Insights, Hypotheses and Testable Design Ideas. How to Manage Design Projects with User Experience Metrics. Two Measures that Will Justify Any Design Change. Evangelizing UX Research. How to Create a User Journey Map. Generating Solutions to Usability Problems. Building UX Research Into the Design Studio Methodology. Dealing with Common objections to UX Research. The User Experience Debrief Meeting. Creating a User Experience Dashboard.

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

1. UX for Developers: How to Integrate User-Centered Design Principles Into Your Day-to-Day Development Work, Westley Knight. Apress, 2018
2. The UX Book: Process and Guidelines for Ensuring a Quality User Experience, Rex Hartson, Pardha Pyla. Morgan Kaufmann, 2012
3. UX Fundamentals for Non-UX Professionals: User Experience Principles for Managers, Writers, Designers, and Developers, Edward Stull. Apress, 2018
4. Lean UX: Designing Great Products with Agile Teams, Gothelf, Jeff, Seiden, and Josh.

O'Reilly Media, 2016
5. Designing UX: Prototyping: Because Modern Design is Never Static, Ben Coleman, and Dan Goodwin. SitePoint, 2017

MU4153 PRINCIPLES OF MULTIMEDIA L T P C
3 0 0 3

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 9

Introduction to Multimedia – Characteristics of Multimedia Presentation – Multimedia Components – Promotion of Multimedia Based Components – Digital Representation – Media and Data Streams – Multimedia Architecture – Multimedia Documents, Multimedia Tasks and Concerns, Production, sharing and distribution, Hypermedia, WWW and Internet, Authoring, Multimedia over wireless and mobile networks.

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 9

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.
2. External learning – Adobe after effects, Adobe Media Encoder, Adobe Audition.

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

UNIT III MULTIMEDIA TOOLS 9

Authoring Tools – Features and Types – Card and Page Based Tools – Icon and Object Based Tools – Time Based Tools – Cross Platform Authoring Tools – Editing Tools – Painting and Drawing Tools – 3D Modeling and Animation Tools – Image Editing Tools – Sound Editing Tools – Digital Movie 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 9

Compression Types and Techniques: CODEC, Text Compression: GIF Coding Standards, JPEG standard – JPEG 2000, basic audio compression – ADPCM, MPEG Psychoacoustics, basic Video compression techniques – MPEG, H.26X – Multimedia Database System – User Interfaces – OS Multimedia Support – Hardware Support – Real Time Protocols – Play Back Architectures – Synchronization – Document Architecture – Hypermedia Concepts: Hypermedia Design – Digital Copyrights, Content analysis.

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 9

ADDIE Model – Conceptualization – Content Collection – Storyboard–Script Authoring Metaphors – Testing – Report Writing – Documentation. Multimedia for the web and mobile platforms. Virtual Reality, Internet multimedia content distribution, Multimedia Information sharing – social media sharing, cloud computing for multimedia services, interactive cloud gaming. Multimedia information retrieval.

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:

1. Li, Ze-Nian, Drew, Mark, Liu, Jiangchuan, “Fundamentals of Multimedia”, Springer, Third Edition, 2021.
2. Prabhat K.Andleigh, Kiran Thakrar, “MULTIMEDIA SYSTEMS DESIGN”, Pearson Education, 2015.
3. Gerald Friedland, Ramesh Jain, “Multimedia Computing”, Cambridge University Press, 2018. (digital book)
4. Ranjan Parekh, “Principles of Multimedia”, Second Edition, McGraw-Hill Education, 2017

DS4015 **BIG DATA ANALYTICS** **L T P C**
3 0 0 3

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 9

Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis –Nature of Data - Analytic Processes and Tools - Analysis Vs Reporting - Modern Data Analytic Tools- Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error.

UNIT II SEARCH METHODS AND VISUALIZATION 9

Search by simulated Annealing – Stochastic, Adaptive search by Evaluation – Evaluation Strategies –Genetic Algorithm – Genetic Programming – Visualization – Classification of Visual Data Analysis Techniques – Data Types – Visualization Techniques – Interaction techniques – Specific Visual data analysis Techniques

UNIT III MINING DATA STREAMS 9

Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions

UNIT IV FRAMEWORKS 9

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 9

Overview, Programming structures: Control statements -Operators -Functions -Environment and scope issues -Recursion -Replacement functions, R data structures: Vectors -Matrices and arrays - Lists -Data frames -Classes, Input/output, String manipulations

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

REFERENCE:

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
2. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 3rd edition 2020.
3. Norman Matloff, The Art of R Programming: A Tour of Statistical Software Design, No Starch Press, USA, 2011.
4. Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, John Wiley & sons, 2012.
5. Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	3	3	3	3	2	1
2	3	3	3	3	2	1
3	3	3	3	3	2	1
4	3	3	3	3	2	1
5	3	3	3	3	2	1
Avg	3	3	3	3	2	1

NC4201 INTERNET OF THINGS AND CLOUD L T P C

3 0 0 3

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 9

Introduction to IoT – IoT definition – Characteristics – IoT Complete Architectural Stack – IoT enabling Technologies – IoT Challenges. Sensors and Hardware for IoT – Hardware Platforms – Arduino, Raspberry Pi, Node MCU. A Case study with any one of the boards and data acquisition from sensors.

UNIT II PROTOCOLS FOR IoT 9

Infrastructure protocol (IPV4/V6/RPL), Identification (URIs), Transport (Wifi, Lifi, BLE), Discovery, Data Protocols, Device Management Protocols. – A Case Study with MQTT/CoAP usage-IoT privacy, security and vulnerability solutions.

UNIT III CASE STUDIES/INDUSTRIAL APPLICATIONS 9

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 9

Introduction to Cloud Computing - Service Model – Deployment Model- Virtualization Concepts – Cloud Platforms – Amazon AWS – Microsoft Azure – Google APIs.

UNIT V IoT AND CLOUD 9

IoT and the Cloud - Role of Cloud Computing in IoT - AWS Components - S3 – Lambda - AWS IoT Core -Connecting a web application to AWS IoT using MQTT- AWS IoT Examples. Security Concerns, Risk Issues, and Legal Aspects of Cloud Computing- Cloud Data Security

TOTAL:45 PERIODS

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

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman ,CRC Press, 2017
2. Adrian McEwen, Designing the Internet of Things, Wiley,2013.
3. EMC Education Services, “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, Wiley publishers, 2015.
4. Simon Walkowiak, “Big Data Analytics with R” PackT Publishers, 2016
5. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications”, Wiley Publishers, 2015.

MX4073 MEDICAL ROBOTICS L T P C
3 0 0 3

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 9

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 9

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 9

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 9

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 9

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

TOTAL:45 PERIODS

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

1. Nagrath and Mittal, “Robotics and Control”, Tata McGraw Hill, First edition, 2003
2. Spong and Vidhyasagar, “Robot Dynamics and Control”, John Wiley and Sons, First edition, 2008
3. Fu.K.S, Gonzalez. R.C., Lee, C.S.G, “Robotics, control”, sensing, Vision and Intelligence, Tata McGraw Hill International, First edition, 2008
4. Bruno Siciliano, Oussama Khatib, Springer Handbook of Robotics, 1st Edition, Springer, 2008
5. Shane (S.Q.) Xie, Advanced Robotics for Medical Rehabilitation - Current State of the Art and Recent Advances, Springer, 2016
6. Sashi S Kommu, Rehabilitation Robotics, I-Tech Education and Publishing, 2007
7. Jose L. Pons, Wearable Robots: Biomechatronic Exoskeletons, John Wiley & Sons Ltd, England, 2008
8. Howie Choset, Kevin Lynch, Seth Hutchinson, “Principles of Robot Motion: Theory, Algorithms, and Implementations”, Prentice Hall of India, First edition, 2005
9. Philippe Coiffet, Michel Chirouze, “An Introduction to Robot Technology”, Tata McGraw Hill, First Edition, 1983
10. Jacob Rosen, Blake Hannaford & Richard M Satava, “Surgical Robotics: System Applications & Visions”, Springer 2011
11. Jocelyn Troccaz, Medical Robotics, Wiley, 2012
12. Achim Schweikard, Floris Ernst, Medical Robotics, Springer, 2015

VE4202 EMBEDDED AUTOMATION L T P C
3 0 0 3

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 9

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 9

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 9

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 9

Fundamentals of Image Processing - Filtering - Morphological Operations - Feature Detection and Matching - Blurring and Sharpening - Segmentation - Thresholding - Contours - Advanced Contour Properties - Gradient - Canny Edge Detector - Object Detection - Background Subtraction

UNIT – V HOME AUTOMATION 9

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

TOTAL: 45 PERIODS

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:

1. Dhananjay V. Gadre, "Programming and Customizing the AVR Microcontroller", McGraw-Hill, 2001.
2. Joe Pardue, "C Programming for Microcontrollers ", Smiley Micros, 2005.
3. Steven F. Barrett, Daniel J. Pack, "ATMEL AVR Microcontroller Primer : Programming and Interfacing", Morgan & Claypool Publishers, 2012
4. Mike Riley, "Programming Your Home - Automate With Arduino, Android and Your Computer", the Pragmatic Programmers, Llc, 2012.
5. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2011.
6. Kevin P. Murphy, "Machine Learning - a Probabilistic Perspective", the MIT Press Cambridge, Massachusetts, London, 2012.