B.Tech. (Textile Technology)

Revised 2018 Regulations, Curriculum & Syllabi

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

An Autonomous Institution Affiliated to Anna University - Chennai • Approved by AICTE • Accredited by NAAC with "A+" Grade

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CONTENTS

VISION OF THE DEPARTMENT

To be a leading technology and managerial resource for the global growth of the Indian textile industry.

MISSION OF THE DEPARTMENT

- To build and nurture a new generation of textile technologists with the potential to be the future leaders of the textile industry.
- To provide quality education and empower the students and staff with the technical, managerial, entrepreneurial and life-long learning competencies required to attain the vision.
- To impart ethical and value-based education by promoting activities addressing the social needs.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I. Analyse the properties of textile materials to enable the selection of materials for different kinds of textile and apparel manufacturing systems.

II. Compare various technological systems of manufacturing the quality textile materials and apply them for the development of new processes and products.

III. Demonstrate the management responsibilities related to issues namely social, ethical environmental, and personal aspects of textile industry.

PROGRAMME OUTCOMES (POs)

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

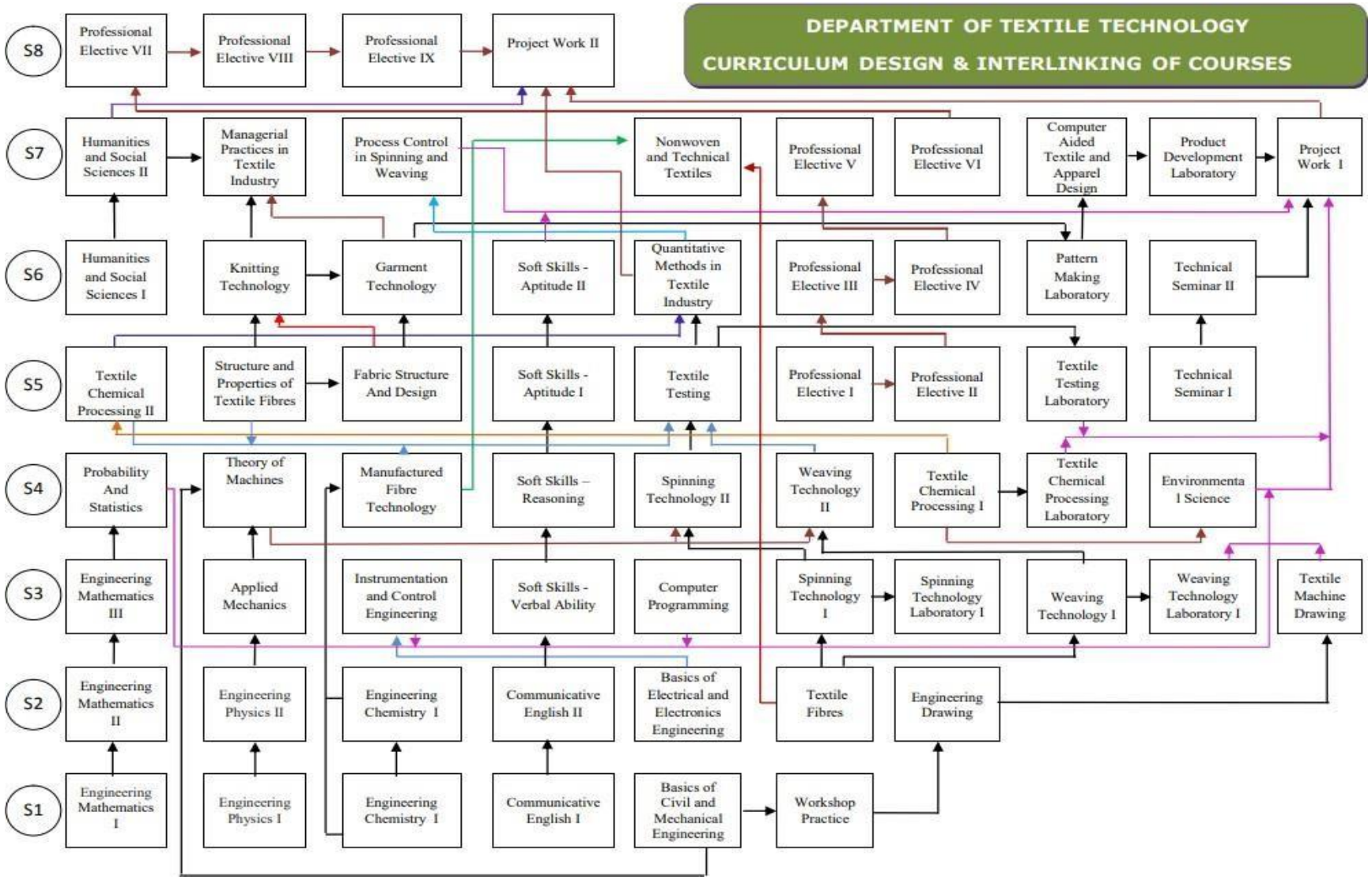
10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Demonstrate knowledge 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.
12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
2. Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

MAPPING OF PEOs AND POs

PEO(s)	Programme Outcomes(s)													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
I	X	X		X	X		X		X	X			X	X
II	X	X	X	X	X	X	X	X	X		X	X	X	X
III			X	X		X	X	X	X	X	X	X	X	X


DEPARTMENT OF TEXTILE TECHNOLOGY
CURRICULUM DESIGN & INTERLINKING OF COURSES
S8
Professional Elective VII
Professional Elective VIII
Professional Elective IX
Project Work II
S7
Humanities and Social Sciences II
Managerial Practices in Textile Industry
Process Control in Spinning and Weaving
Nonwoven and Technical Textiles
Professional Elective V
Professional Elective VI
Computer Aided Textile and Apparel Design
Product Development Laboratory
Project Work I
S6
Humanities and Social Sciences I
Knitting Technology
Garment Technology
Soft Skills - Aptitude II
Quantitative Methods in Textile Industry
Professional Elective III
Professional Elective IV
Pattern Making Laboratory
Technical Seminar II
S5
Textile Chemical Processing II
Structure and Properties of Textile Fibres
Fabric Structure And Design
Soft Skills - Aptitude I
Textile Testing
Professional Elective I
Professional Elective II
Textile Testing Laboratory
Technical Seminar I
S4
Probability And Statistics
Theory of Machines
Manufactured Fibre Technology
Soft Skills – Reasoning
Spinning Technology II
Weaving Technology II
Textile Chemical Processing I
Textile Chemical Processing Laboratory
Environmental Science
S3
Engineering Mathematics III
Applied Mechanics
Instrumentation and Control Engineering
Soft Skills - Verbal Ability
Computer Programming
Spinning Technology I
Spinning Technology Laboratory I
Weaving Technology I
Weaving Technology Laboratory I
Textile Machine Drawing
S2
Engineering Mathematics II
Engineering Physics II
Engineering Chemistry I
Communicative English II
Basics of Electrical and Electronics Engineering
Textile Fibres
Engineering Drawing
S1
Engineering Mathematics I
Engineering Physics I
Engineering Chemistry I
Communicative English I
Basics of Civil and Mechanical Engineering
Workshop Practice

(Candidates admitted during Academic Year 2021-2022)

DEPARTMENT OF TEXTILE TECHNOLOGY

REVISED R2018 CURRICULUM

Minimum Credits to be Earned: 162

I SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
18TT101	ENGINEERING MATHEMATICS I	3	1	0	4	4	40	60	100	BS
18TT102	ENGINEERING PHYSICS I	2	0	2	3	4	50	50	100	BS
18TT103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
18TT104	BASICS OF CIVIL AND MECHANICAL ENGINEERING	4	0	0	4	4	40	60	100	ES
18HS101	COMMUNICATIVE ENGLISH I	1	0	2	2	3	100	0	100	HS
18TT106	WORKSHOP PRACTICE	0	0	2	1	4	100	0	100	ES
Total		**12**	**1**	**8**	**17**	**23**	-	-	-	**-**

II SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
18TT201	ENGINEERING MATHEMATICS II	3	1	0	4	4	40	60	100	BS
18TT202	ENGINEERING PHYSICS II	2	0	2	3	4	50	50	100	BS
18TT203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
18TT204	BASICS OF ELECTRICAL AND ELECTRONICSENGINEERING	2	0	2	3	4	50	50	100	ES
18TT205	TEXTILE FIBRES	2	0	2	3	4	50	50	100	PC
	LANGUAGE ELECTIVE	0	0	0	2	2	100	0	100	HS
18TT207	ENGINEERING DRAWING	1	0	4	3	5	100	0	100	ES
Total		**12**	**1**	**12**	**21**	**27**	-	-	-	-

III SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
18TT301	ENGINEERING MATHEMATICS III	3	1	0	4	4	40	60	100	BS
18TT302	APPLIED MECHANICS	3	0	0	3	4	40	60	100	ES
18TT303	INSTRUMENTATION AND CONTROL ENGINEERING	2	0	2	3	4	50	50	100	ES
18TT304	COMPUTER PROGRAMMING	2	0	2	3	4	50	50	100	ES
18TT305	SPINNING TECHNOLOGY- I	3	0	0	3	3	40	60	100	PC
18TT306	WEAVING TECHNOLOGY- I	3	0	0	3	3	40	60	100	PC
18TT307	SPINNING TECHNOLOGY LABORATORY- I	0	0	4	2	4	100	0	100	PC
18TT308	WEAVING TECHNOLOGY LABORATORY- I	0	0	4	2	4	100	0	100	PC
18GE301	SOFT SKILLS – VERBAL ABILITY	2	0	0	0	2	100	0	100	EEC
Total		**18**	**1**	**12**	**23**	**32**	-	-	-	-
IV SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
18TT401	ENGINEERING MATHEMATICS IV	3	1	0	4	4	40	60	100	BS
18TT402	THEORY OF MACHINES	3	0	0	3	3	40	60	100	ES
18TT403	STRUCTURE AND PROPERTIES OF TEXTILE FIBRES	3	0	0	3	3	40	60	100	PC
18TT404	SPINNING TECHNOLOGY II	3	0	2	4	5	50	50	100	PC
18TT405	WEAVING TECHNOLOGY II	3	0	2	4	5	50	50	100	PC
18TT406	TEXTILE CHEMICAL PROCESSING I	3	0	0	3	3	40	60	100	PC
18TT407	TEXTILE CHEMICAL PROCESSING LABORATORY	0	0	4	2	4	100	0	100	PC
18TT408	TEXTILE MACHINE DRAWING AND TECHNICAL SEMINAR	0	0	4	2	4	100	0	100	PC
18HS001	ENVIRONMENTAL SCIENCE	2	0	0	0	2	100	0	100	HS
18GE401	SOFT SKILLS- REASONING	2	0	0	0	2	100	0	100	EEC
Total		**22**	**1**	**12**	**25**	**35**	-	-	-	-

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
21TT501	TEXTILE CHEMICAL PROCESSING II	3	0	2	4	4	50	50	100	PC
21TT502	MANUFACTURED FIBRE TECHNOLOGY	3	0	0	3	3	40	60	100	PC
21TT503	FABRIC STRUCTURE AND DESIGN	3	0	0	3	3	40	60	100	PC
21TT504	TEXTILE TESTING	3	0	0	3	3	40	60	100	PC
	PROFESSIONAL ELECTIVE I	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE II	3	0	0	3	3	40	60	100	PE
21TT507	FABRIC STRUCTURE AND DESIGN LABORATORY	0	0	2	1	2	100	0	100	PC
21TT508	TEXTILE TESTING LABORATORY	0	0	4	2	4	100	0	100	PC
18GE501	SOFT SKILLS - APTITUDE I	0	0	2	0	2	100	0	100	EEC
Total		**18**	**0**	**10**	**22**	**27**	**-**	**-**	-	**-**
VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
21HS002	HUMAN VALUES AND ETHICS	2	0	0	2	2	40	60	100	HSS
21TT602	KNITTING TECHNOLOGY	3	0	2	4	5	50	50	100	PC
21TT603	GARMENT TECHNOLOGY	3	0	0	3	3	40	60	100	PC
	PROFESSIONAL ELECTIVE III	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE IV	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE V	3	0	0	3	3	40	60	100	PE
21TT607	PATTERN MAKING LABORATORY	0	0	4	2	4	100	0	100	PC
18GE601	SOFT SKILLS - APTITUDE II	0	0	2	0	2	100	0	100	EEC
Total		**17**	**0**	**8**	**20**	**25**	-	-	-	**-**

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
21TT701	QUANTITATIVE METHODS IN TEXTILEINDUSTRY	3	1	0	4	5	40	60	100	PC
21TT702	TECHNICAL TEXTILES	3	0	0	3	3	40	60	100	PC
	PROFESSIONAL ELECTIVE VI	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE VII	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE VIII	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE IX	3	0	0	3	3	40	60	100	PE
21TT707	COMPUTER-AIDED TEXTILE AND APPARELDESIGN LABORATORY	0	0	4	2	4	60	40	100	PC
21TT708	PRODUCT DEVELOPMENT LABORATORY	0	0	2	1	2	60	40	100	PC
21TT709	PROJECT WORK I	0	0	6	3	6	60	40	100	EEC
Total		**18**	**1**	**12**	**25**	**32**	-	-	-	-
VIII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hour/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
21TT801	PROJECT WORK II	0	0	18	9	18	60	40	100	EEC
Total		**0**	**0**	**18**	**9**	**18**	**-**	**-**	**-**	**-**

ELECTIVES

LANGUAGE ELECTIVES

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
18HS201	COMMUNICATIVE ENGLISH II	1	0	2	2	3	100	0	100	HSS
18HSH01	HINDI	1	0	2	2	3	100	0	100	HSS
18HSF01	FRENCH	1	0	2	2	3	100	0	100	HSS
18HSG01	GERMAN	1	0	2	2	3	100	0	100	HSS
18HSC01	CHINESE	1	0	2	2	3	100	0	100	HSS
18HSJ01	JAPANESE	1	0	2	2	3	100	0	100	HSS

PROFESSIONAL ELECTIVES

VERTICAL I - TEXTILE AND CLOTHING SCIENCE

21TT001	LONG STAPLE SPINNING TECHNOLOGY	3	0	0	3	3	40	60	100	PE
21TT002	TEXTURIZING TECHNOLOGY	3	0	0	3	3	40	60	100	PE
21TT003	THEORY OF SPINNING	3	0	0	3	3	40	60	100	PE
21TT004	HIGH PERFORMANCE FIBRES	3	0	0	3	3	40	60	100	PE
21TT005	THEORY OF WEAVING	3	0	0	3	3	40	60	100	PE
21TT006	CLOTHING SCIENCE	3	0	0	3	3	40	60	100	PE

VERTICAL II - TEXTILE MACHINERY AND MAINTENANCE

21TT007	MECHANICS OF TEXTILE MACHINES	3	0	0	3	3	40	60	100	PE
21TT008	MAINTENANCE MANAGEMENT	3	0	0	3	3	40	60	100	PE
21TT009	MANAGERIAL PRACTICES IN TEXTILEINDUSTRIES	3	0	0	3	3	40	60	100	PE
21TT010	UTILITIES ENGINEERING	3	0	0	3	3	40	60	100	PE
21TT011	INDUSTRIAL ENGINEERING	3	0	0	3	3	40	60	100	PE
21TT012	PROCESS CONTROL IN SPINNING ANDWEAVING	3	0	0	3	3	40	60	100	PE

VERTICAL III - ADVANCES IN TEXTILE AND CHEMICAL PROCESSING

21TT013	ADVANCES IN CHEMICAL PROCESSINGTECHNOLOGY	3	0	0	3	3	40	60	100	PE

21TT014	PROCESS AND QUALITY CONTROL IN TEXTILE CHEMICAL PROCESSING	3	0	0	3	3	40	60	100	PE
21TT015	COLOUR SCIENCE	3	0	0	3	3	40	60	100	PE
21TT016	TEXTILE EFFLUENT TREATMENT	3	0	0	3	3	40	60	100	PE
21TT017	ADVANCED KNITTING TECHNOLOGY	3	0	0	3	3	40	60	100	PE
21TT018	ADVANCES IN TECHNICAL TEXTILES	3	0	0	3	3	40	60	100	PE
VERTICAL IV GARMENT MANUFACTURING										
21TT019	APPAREL PRODUCTION PLANNING ANDCONTROL	3	0	0	3	3	40	60	100	PE
21TT020	PATTERN ENGINEERING	3	0	0	3	3	40	60	100	PE
21TT021	GARMENT PRODUCTION MACHINERY AND EQUIPMENT	3	0	0	3	3	40	60	100	PE
21TT022	MANAGEMENT OF APPAREL UNITS	3	0	0	3	3	40	60	100	PE
21TT023	APPAREL MARKETING AND MERCHANDISING	3	0	0	3	3	40	60	100	PE
21TT024	COSTING AND FINANCIAL MANAGEMENT	3	0	0	3	3	40	60	100	PE
VERTICAL V TECHNICAL TEXTILES										
21TT025	COATED AND LAMINATED TEXTILES	3	0	0	3	3	40	60	100	PE
21TT026	NANO TEXTILES	3	0	0	3	3	40	60	100	PE
21TT027	TEXTILE COMPOSITES	3	0	0	3	3	40	60	100	PE
21TT028	HOME TEXTILES	3	0	0	3	3	40	60	100	PE
21TT029	SPECIALITY TEXTILES	3	0	0	3	3	40	60	100	PE
21TT030	NONWOVEN TECHNOLOGY	3	0	0	3	3	40	60	100	PE

HONOURS DEGREE (With Specialization)										
VERTICAL V TECHNICAL TEXTILES										
21TTH01	HOME TEXTILES	3	0	0	3	3	40	60	100	PE
21TTH02	NONWOVEN TECHNOLOGY	3	0	0	3	3	40	60	100	PE
21TTH03	TEXTILE COMPOSITES	3	0	0	3	3	40	60	100	PE
21TTH04	SPECIALITY TEXTILES	3	0	0	3	3	40	60	100	PE
21TTH05	COATED AND LAMINATED TEXTILES	3	0	0	3	3	40	60	100	PE
21TTH06	NANO TEXTILES	3	0	0	3	3	40	60	100	PE
21TTH07	HIGH PERFORMANCE FIBRES	3	0	0	3	3	40	60	100	PE
21TTH08	INDUSTRIAL ENGINEERING	3	0	0	3	3	40	60	100	PE

21TTH09	TEXTURISING TECHNOLOGY	3	0	0	3	3	40	60	100	PE
21TTH10	PATTERN ENGINEERING	3	0	0	3	3	40	60	100	PE
21TTH11	APPAREL MARKETING AND MERCHANDISING	3	0	0	3	3	40	60	100	PE
21TTH12	APPAREL PRODUCTION PLANNING AND CONTROL	3	0	0	3	3	40	60	100	PE

MINOR DEGREE (Other than TXT Students)										
VERTICAL V TECHNICAL TEXTILES										
21TTM01	HOME TEXTILES	3	0	3	3	3	40	60	100	PE
21TTM02	NONWOVEN TECHNOLOGY	3	0	0	3	3	40	60	100	PE
21TTM03	TEXTILE COMPOSITES	3	0	0	3	3	40	60	100	PE
21TTM04	SPECIALITY TEXTILES	3	0	0	3	3	40	60	100	PE
21TTM05	COATED AND LAMINATED TEXTILES	3	0	0	3	3	40	60	100	PE
21TTM06	NANO TEXTILES	3	0	0	3	3	40	60	100	PE

ONE CREDIT COURSES										
18TT0XA	COTTON FIBRES: OPTIONS AND ALTERNATIVES	1	0	0	1	1	100	0	100	OC
18TT0XB	FANCY YARNS	1	0	0	1	1	100	0	100	OC
18TT0XC	DENIM FABRICS AND GARMENTS	1	0	0	1	1	100	0	100	OC
18TT0XD	TESTING OF DYES	1	0	0	1	1	100	0	100	OC
18TT0XE	TESTING OF AUXILIARIES	1	0	0	1	1	100	0	100	OC
18TT0XF	ECO PROCESSING	1	0	0	1	1	100	0	100	OC
18TT0XG	ERECTION AND COMMISSIONING OFTEXTILE MACHINES	1	0	0	1	1	100	0	100	OC
18TT0XH	WORKLOAD AND WORK ASSIGNMENTS	1	0	0	1	1	100	0	100	OC
18TT0XI	AIR ENGINEERING IN TEXTILE INDUSTRY	1	0	0	1	1	100	0	100	OC
18TT0XJ	PRODUCT CERTIFICATION	1	0	0	1	1	100	0	100	OC
18TT0XK	ENERGY CONSERVATION IN THE TEXTILEINDUSTRY	1	0	0	1	1	100	0	100	OC
18TT0XL	INDUSTRIAL ENGINEERING IN APPAREL MANUFACTURING	1	0	0	1	1	100	0	100	OC
18TT0XM	INDUSTRIAL EXPORT MERCHANDISING	1	0	0	1	1	100	0	100	OC
18TT0XN	YARN COSTING	1	0	0	1	1	100	0	100	OC
18TT0XO	FABRIC COSTING	1	0	0	1	1	100	0	100	OC
18TT0XP	GARMENT COSTING	1	0	0	1	1	100	0	100	OC

18TT0XQ	MEDICAL TEXTILES	1	0	0	1	1	100	0	100	OC
18TT0XR	GARMENT PRINTING	1	0	0	1	1	100	0	100	OC
18TT0XS	ADVANCEMENT IN GARMENT MANUFACTURING	1	0	0	1	1	100	0	100	OC
18TT0XT	SMART TEXTILES	1	0	0	1	1	100	0	100	OC
18TT0XU	GARMENT FINISHING	1	0	0	1	1	100	0	100	OC
18TT0XV	QUALITY AUDITS FOR EXPORT MERCHANDISING	1	0	0	1	1	100	0	100	OC
ADDITIONAL ONE CREDIT COURSES										
18GE0XA	ETYMOLOGY	1	0	0	1	1	100	0	100	EEC
18GE0XB	GENERAL PSYCHOLOGY	1	0	0	1	1	100	0	100	EEC
18GE0XC	NEURO BEHAVIOURAL SCIENCE	1	0	0	1	1	100	0	100	EEC
18GE0XD	VISUAL MEDIA AND FILM MAKING	1	0	0	1	1	100	0	100	EEC
18GE0XE	YOGA FOR HUMAN EXCELLENCE	1	0	0	1	1	100	0	100	EEC
18GE0XF	VEDIC MATHEMATICS	1	0	0	1	1	100	0	100	EEC
18GE0XG	ABNORMAL PSYCHOLOGY	1	0	0	1	1	100	0	100	EEC
18GE0XH	YOGA FOR ENERGETIC LIFE	1	0	0	1	1	100	0	100	EEC
18GE0XI	BLOG WRITING	1	0	0	1	1	100	0	100	EEC
18GE0XJ	INTERPERSONAL SKILLS	1	0	0	1	1	100	0	100	EEC
18GE0XK	COMMUNITY SERVICE AND LEADERSHIPDEVELOPMENT	1	0	0	1	1	100	0	100	EEC
18GE0XL	NATIONAL CADET CORPS	1	0	0	1	1	100	0	100	EEC
18GE0XM	NEW AGE INNOVATION AND ENTREPRENEURSHIP	1	0	0	1	1	100	0	100	EEC
18GE0XN	DISRUPTIVE INNOVATION-BASED STARTUP ACTIVITIES	1	0	0	1	1	100	0	100	EEC
18GE0XO	SOCIAL PSYCHOLOGY	1	0	0	1	1	100	0	100	EEC

OPEN ELECTIVES										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**MaximumMarks**			**Category**
							CIA	**ES**	**Total**	
21OCE01	ENERGY CONSERVATION AND MANAGEMENT	3	0	0	3	3	40	60	100	OE
21OCS01	OBJECT ORIENTED PROGRAMMING	3	0	0	3	3	40	60	100	OE
21OCS02	JAVA FUNDAMENTALS	3	0	0	3	3	40	60	100	OE
21OCS03	KNOWLEDGE DISCOVERY IN DATABASES	3	0	0	3	3	40	60	100	OE
21OCS04	E-LEARNING TECHNIQUES	3	0	0	3	3	40	60	100	OE
21OCS05	SOCIAL TEXT AND MEDIA ANALYTICS	3	0	0	3	3	40	60	100	OE
21OME01	DIGITAL MANUFACTURING	3	0	0	3	3	40	60	100	OE
21OME02	INDUSTRIAL PROCESS ENGINEERING	3	0	0	3	3	40	60	100	OE
21OME03	MAINTENANCE ENGINEERING	3	0	0	3	3	40	60	100	OE
21OME04	SAFETY ENGINEERING	3	0	0	3	3	40	60	100	OE
21OBT01	BIOFUELS	3	0	0	3	3	40	60	100	OE
21OFD01	TRADITIONAL FOODS	3	0	0	3	3	40	60	100	OE
21OFD02	FOOD LAWS AND REGULATIONS	3	0	0	3	3	40	60	100	OE
21OFD03	POST-HARVEST TECHNOLOGY OF FRUITS ANDVEGETABLES	3	0	0	3	3	40	60	100	OE
21OFD04	CEREAL, PULSES AND OIL SEED TECHNOLOGY	3	0	0	3	3	40	60	100	OE
21OFT01	FASHION CRAFTSMANSHIP	3	0	0	3	3	40	60	100	OE
21OFT02	INTERIOR DESIGN IN FASHION	3	0	0	3	3	40	60	100	OE
21OFT03	SURFACE ORNAMENTATION	3	0	0	3	3	40	60	100	OE
21OPH01	NANOMATERIALS SCIENCE	3	0	0	3	3	40	60	100	OE
21OPH02	SEMICONDUCTOR PHYSICS AND DEVICES	3	0	0	3	3	40	60	100	OE
21OPH03	APPLIED LASER SCIENCE	3	0	0	3	3	40	60	100	OE
21OPH04	BIO-PHOTONICS	3	0	0	3	3	40	60	100	OE
21OPH05	PHYSICS OF SOFT MATTER	3	0	0	3	3	40	60	100	OE
21OCH01	CORROSION SCIENCE AND ENGINEERING	3	0	0	3	3	40	60	100	OE
21OCH02	POLYMER SCIENCE	3	0	0	3	3	40	60	100	OE
21OCH03	ENERGY STORING DEVICES	3	0	0	3	3	40	60	100	OE
21OMA01	GRAPH THEORY AND COMBINATORICS	3	0	0	3	3	40	60	100	OE
21OGE01	PRINCIPLES OF MANAGEMENT	3	0	0	3	3	40	60	100	OE
21OGE02	ENTREPRENEURSHIP DEVELOPMENT I	3	0	0	3	3	40	60	100	OE
21OGE03	ENTREPRENEURSHIP DEVELOPMENT II	3	0	0	3	3	40	60	100	OE
21OGE04	NATION BUILDING, LEADERSHIP AND SOCIALRESPONSIBILITY	3	0	0	3	3	40	60	100	OE

SUMMARY OF CREDIT DISTRIBUTION

S. No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDIT	CREDITS in %	RANGE OF TOTAL CREDITS	
		I	II	III	IV	V	VI	VII	VIII			Min	Max
1	BS	10	10	4	4	0	0	0	0	28	17	15%	20%
2	ES	5	6	9	3	0	0	0	0	23	14	15%	20%
3	HSS	2	2	0	0	0	2	0	0	6	4	5%	10%
4	PC	0	3	10	18	16	9	10	0	66	41	30%	40%
5	PE	0	0	0	0	6	9	12	0	27	17	10%	15%
6	EEC	0	0	0	0	0	0	3	9	12	7	7%	10%
Total		**17**	**21**	**23**	**25**	**22**	**21**	**25**	**9**	**162**	**100.0**	-	-

BS - Basic Sciences
ES - Engineering Sciences
HSS - Humanities and Social Sciences
PC - Professional Core
PE - Professional Elective
EEC - Employability Enhancement Course
CA - Continuous Assessment
ES - End Semester Examination

18TT101 ENGINEERING MATHEMATICS I 3 1 0 4

Course Objectives

- Understand the concepts of vectors and Eigenvectors for different matrices to describe the stability of the linear systems in engineering fields.
- Exemplify the concepts of differentiation and integration to identify the area of 2D and 3D surfaces in engineering problems.
- Explain the concepts of analytic functions in complex domain to predict the nature of different engineering systems.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Represent the different forms of coordinate system in complex plane and characteristics of linear systems by Eigenvalues and Eigen vectors.
2. Analyse various types of functions and their differentiation techniques involved in engineering fields.
3. Implement different methods of integration used in engineering problems.
4. Execute the suitable integration technique to calculate the area and volume of different surfaces.
5. Apply the concept of analytic function to estimate the integral in complex plane.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3												
2	2	3												
3	2	3												
4	3	3												
5	1	3												

UNIT I **9 Hours**

COMPLEX NUMBERS, VECTORS AND MATRICES

Complex plane, polar coordinates and polar form of complex numbers, powers and roots, fundamental theorem of algebra. Vector algebra in 2-D and 3-D space, dot product and cross product. Matrices: Eigen values and Eigen vectors, Properties of eigen values and eigen vectors.

UNIT II **9 Hours**

CALCULUS

Limits and Continuity of Functions: Limits of functions, types of limits, evaluation of limits, continuity of functions, properties of continuous functions. Derivatives: Derivatives, differentiability, rules and properties, differentiation of transcendental functions, higher order derivatives, implicit differentiation, and differentiation of hyperbolic functions. Integration: Anti-derivatives, Riemann Sum, indefinite and definite integration, Mean Value Theorem for definite integral, Fundamental Theorem of Calculus.

UNIT III **9 Hours**

INTEGRATION METHODS

Basic integration formulae for algebraic and transcendental functions. Integration by special devices: integration by parts, rationalizing substitution or trigonometric substitution, partial fractions, reduction formulas, improper integrals, convergence tests.

UNIT IV **9 Hours**

APPLICATIONS OF DERIVATIVES AND INTEGRATIONS

Extreme values, points of inflection and curve sketching, Rolles Theorem, Mean Value Theorem, optimization, indeterminate forms, L Hospitals Rule. Area between curves, volume of a general solid by slicing and cylindrical shell methods, volume of a solid of revolution, length of plane curves, area of a surface of revolution.

UNIT V **9 Hours**

COMPLEX ANALYSIS

Analytic Functions- Properties of Analytic function - Determination of Analytic Function using Milne Thompson method. Cauchy's Integral Formula - Classification of Singularities - Cauchy's Residue Theorem.

Total: 60 Hours

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley, 2001.
2. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.
3. Kreysgiz E, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 1999.
4. Anton H, Calculus with Analytic Geometry, 5th edition, John Wiley & Sons, 1995.
5. Ayres F Jr and Mendelson E, Schaum s Outline of Theory and Problems of Calculus, 4th edition, McGraw Hill, 1999.

18TT102 ENGINEERING PHYSICS I 2 0 2 3

Course Objectives

- Illustrate the Newtons laws of motion and wave motion with applications.
- Understand the basic properties of electricity, magnetism and optics.
- Differentiate the special theory of relativity and quantum physics from classical physics.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO9.Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Illustrate the Newtons three laws of motion and apply the same to solve the real-world problems involving elevator, at wood machine and acceleration of objects.
2. Exemplify the physical characteristics of simple harmonic motion, wave motion and find the solutions for wave equations.
3. Infer the fundamental laws, properties of electricity and magnetism and apply the same to electric and magnetic elements.
4. Apply the principles of physical and geometrical optics in the mirrors, lenses, microscopes and diffraction gratings.
5. Outline the importance of special theory of relativity, quantum physics and analyse the wave and particle nature of matter.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1							2					
2	2								2					
3	2	1							-					
4	2	1							-					
5	2	1							-					

UNIT I **6 Hours**

MECHANICS

Newtons laws of motion: Concept of force and its nature -Newtons first law and inertial frames - definition of mass - Newtons second law-gravitational force and weight- Newtons third law. Applications of Newtons laws: particle in equilibrium, particle under net force - weighing a mass in an elevator, the at wood machine and acceleration of two objects connected by a cord

UNIT II **6 Hours**

OSCILLATIONS AND WAVES

Fundamentals of simple harmonic motion - energy of simple harmonic oscillator - spring mass system - time period of simple pendulum, compound pendulum and torsional pendulum - Damped oscillations. Travelling wave motion - sinusoidal waves on strings - speed of a wave - reflection and transmission - rate of energy transfer in wave motion

UNIT III **6 Hours**

ELECTRICITY AND MAGNETISM

Point charges - electric fields - Gauss law and its applications - electric potential - capacitance - energy stored in a capacitor. Concept and source of magnetic fields - Amperes theorem - determination of magnetic field due to different current distributions - Faradays law - self-induction and mutual induction - energy stored in an inductor

UNIT IV **6 Hours**

LIGHT AND OPTICS

Nature of light - laws of reflection and refraction - refractive index and Snell's law - dispersion of light - total internal reflection - image formation: concave mirrors - convex mirrors - thin lenses - compound microscope - human eye. Conditions of interference - Youngs double slit experiment - intensity distribution of interference - phase change due to reflection - diffraction-narrow slit diffraction - single slit and two slit - intensity distribution - diffraction grating - applications

UNIT V **6 Hours**

MODERN PHYSICS

Special theory of relativity - simultaneity and time dilation - twin paradox - length contraction - relativistic mass variation - space time graph. Black body radiation and Planck hypothesis - allowed energy levels - thermal radiation from different objects. - photoelectric and Compton effect. Matter waves - de-Broglie hypothesis - wave nature of particles - Davission-Germer experiment

EXPERIMENT 1 **5 Hours**

Determination of resultant of system of concurrent coplanar forces-Parallelogram law of forces

EXPERIMENT 2 **5 Hours**

Determination of moment of inertia-Torsional pendulum

EXPERIMENT 3 **5 Hours**

Determination of wavelength of mercury spectral lines-spectrometer

EXPERIMENT 4 **4 Hours**

Determination of refractive index of solid and liquid-travelling microscope

EXPERIMENT 5 **3 Hours**

Determination of wavelength of laser-diffraction grating.

EXPERIMENT 6 **4 Hours**

Determination of frequency of a tuning fork-Meldes apparatus

EXPERIMENT 7 **4 Hours**

Thickness of a thin wire using interference of light-Air wedge method

Total: 60 Hours

Reference(s)

1. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2011.
2. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011.
3. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017.
4. H D Young and R A Freedman, Sears and Zemanskys University Physics with Modern Physics, Pearson education, 2016.
5. R K Gaur and S L Gupta, Engineering Physics, Dhanpat Rai Publications, 2012.

18TT103 ENGINEERING CHEMISTRY I 2 0 2 3

Course Objectives

- Differentiate between ionic, covalent, coordinate bonding and classify the bonding between dye and fabric as ionic or covalent.
- Review the basics of polymer chemistry and the mechanism involved to prepare advanced polymers for textile applications.
- Understand the concept of electrochemistry for determination of electrode potential, pH and applications as conducting polymers.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Outline the influence of different chemical bonds on the dye fibre interaction.
2. Classify polymers and identify the method to determine the molecular weight of selected polymers.
3. Identify the mechanism of polymerisation for commercially available natural/synthetic polymers.
4. Apply the concepts of electrochemistry to determine the electrode potential and pH of acidic or basic solutions.
5. Interpret the importance of conducting polymers in textile research.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	2	1												
3	2	2												
4	3	2												
5	3	2					1							

UNIT I **6 Hours**

CHEMICAL BONDING

Ionic, covalent and co-ordinate bonds (overview only) -hydrogen bonding and its consequences - Van der Waals forces (dipole-dipole and dipole-induced dipole) - Interaction between fibres/polymers and dyes (basic concept only) - dye substrate affinity (dyes for cellulose fibres and silk)

UNIT II **7 Hours**

INTRODUCTION TO POLYMERS

Monomers - degree of polymerization - homo polymer - hetero polymer - copolymer - tacticity. Classification of polymers based on source (natural and synthetic) and application (plastics, fibres and elastomers). Polymer molecular weight determination: Number average, weight average and viscosity average method. Functionality of monomer

UNIT III **7 Hours**

MECHANISM OF POLYMERISATION

Types of polymerizations: Addition, condensation and copolymerization. Mechanism of addition polymerisation: Free radical, ionic (cationic and anionic) - coordination polymerisation (Ziegler Natta)

UNIT IV **6 Hours**

ELECTROCHEMISTRY IN TEXTILES

Conductivity of electrolytes - electrochemical cell - electrode potential - salt bridge - cell reaction - cell representation. Types of electrodes - calomel electrode - determination of single electrode potential. Influence of pH in textiles - Ion-selective electrode: Glass electrode - measurement of pH using glass electrode

UNIT V **4 Hours**

CONDUCTING POLYMERS

Conducting polymers: Definition - characteristics of conducting polymers - polypyrrole, polyaniline and polythiophene - applications

EXPERIMENT 1 **2 hours**

Lab safety rules and guidelines for students

EXPERIMENT 2 **2 hours**

Preparation of N/10 and M/10 oxalic acid and sodium carbonate solutions

EXPERIMENT 3 **4 hours**

Collect and document three natural as well as synthetic fibers and list its properties and uses

EXPERIMENT 4 **4 hours**

Identify thermo from thermosetting plastics and determine the density of the given thermoplastic materials by density test.

EXPERIMENT 5 **2 hours**

Determination of molecular weight of a polymer by Ostwald viscometer

EXPERIMENT 6 **2 hours**

Determination of strength of hydrochloric acid in a given solution using pH meter

EXPERIMENT 7 **2 hours**

Conductometric titration of mixture of acids (HCl and CH3COOH)

EXPERIMENT 8 **2 hours**

Application of calomel electrode to determine the redox potential of Fe(II) solution

EXPERIMENT 9 **2 hours**

Conductometric titration of strong acid (HCl) Vs strong base (NaOH)

EXPERIMENT 10 **4 hours**

Rust printing on natural polymer (cotton) - An innovative approach

EXPERIMENT 11 **4 hours**

Natural dyeing on cotton/silk fibre using traditional process in the presence of natural and metal mordant

Total: 60 Hours

Reference(s)

1. J.D. Lee, Concise inorganic chemistry, Blackman Science Ltd, France, Wiley-India, 5th edition (Reprint), 2016.
2. V.R. Gowariker, N.V. Viswanathan and Jayader Sreedhar, Polymer Science, New Age International (P) Limited, 2nd edition, 2015.
3. B. R. Puri, L. R. Sharma and Madan S. Pathania, Principles of Physical Chemistry, Shoban Lal Nagin Chand & Co., 2010.
4. P. C. Jain and M. Jain, Engineering Chemistry, Dhanpat Rai Publications., New Delhi, 2016.
5. F.W. Billmeyer, Text book of polymer science, Jr. John Wiley and Sons, 2000.
6. www.ch.ic.ac.uk/local/organic/tutorial/steinke/4yrPolyConduct 2003.pdf

18TT104 BASICS OF CIVIL AND MECHANICAL ENGINEERING

4 0 0 4

Course Objectives

- To impart basic knowledge in the field of Civil Engineering
- To guide students to select the good building materials
- To create awareness on various types of water supply and transportation systems
- To impart basic knowledge in the various engineering materials and manufacturing Processes.
- To understand the working principles of various Internal Combustion Engines, Refrigeration, Boiler and power plants.
- To understand the working principles of various Boilers and power plants.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO12. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1. Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2. Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Understand the fundamental philosophy of Civil Engineering.
2. Identify the nature of building components, functions, construction practices and material qualities.
3. Understand the fundamental concepts of water supply and transportation systems.
4. Recognize the various engineering materials and manufacturing processes.
5. Understand the working principles and operations Internal Combustion Engines and Refrigeration.
6. Understand the working principles and operations of Boilers and power plants.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-				1	2	1					1	1
2	2	-	-			2	2	1					2	2
3	2		2			2	2	1					-	-
4	1	1	1										-	-
5	2	1	1									1	1	1
6	2	1	1									1	2	2

UNIT I **10 Hours**

INTRODUCTION TO CIVIL ENGINEERING

History, development and scope of Civil Engineering Functions of Civil Engineers. Construction Materials Characteristics of good building materials: Stones - Bricks -Cement - Aggregates and concrete. Surveying: Definition and purpose Classification Basic principles Measurement of length by chains and tapes. 10hours

UNIT II **10 Hours**

GENERAL FEATURES RELATING TO BUILDINGS

Selection of site Basic functions of buildings Major components of buildings. Types of foundation Bearing capacity of soils General Principles of Brick masonry Stone masonry Introduction to Green Building and Interior Design.

UNIT III **10 Hours**

WATER SUPPLY AND TRANSPORTATION SYSTEMS

Sources of water Supply Methods of Rain Water Harvesting Flow Diagram of Water treatment Process Modes of Transportation Systems. Classification of Highways-Components of roads Bituminous and cement concrete roads. Importance of railways - Gauges Components of permanent way Types of bridges. 10hours

UNIT IV **10 Hours**

ENGINEERING MATERIALS AND MANUFACTURING PROCESSES

Materials classification, mechanical properties of cast iron, steel and high-speed steel Casting Process-Introduction to green sand moulding, pattern, melting furnace electric furnace Introduction to metal forming process and types Introduction to arc and gas welding Centre lathe, Drilling and Milling machines principal parts, operations.

UNIT V **10 Hours**

INTERNAL COMBUSTION ENGINES AND REFRIGERATION

Internal Combustion (IC) Classification, main components, working principle of a two and four stroke petrol and diesel engines, differences Refrigeration working principle of vapour compression and absorption system Introduction to Air conditioning.

UNIT VI **10 Hours**

ENERGY, BOILERS, TURBINE AND POWER PLANTS

Energy-Solar, Wind, Tidal, Geothermal, Biomass and Ocean Thermal Energy Conversion (OTEC)Boilers classification, Babcock and Wilcox and La-Mont Boilers, differences between fire tube and water tube boiler Steam turbines- working principle of single stage impulse and reaction turbines Power plant classification, Steam, Hydel, Diesel, and Nuclear power plants.

Total: 60 Hours

Reference(s)

1. N. Arunachalam, Basics of Civil Engineering, Pratheeba Publishers, 2000.
2. M. S. Palanichamy, Basic Civil Engineering, TMH, 2009.
3. G. Shanmugam and M. S. Palanichamy, Basic Civil and Mechanical Engineering, Tata McGraw Hill Publishing Co., New Delhi, 2009.
4. Pravin Kumar, Basic Mechanical Engineering, Pearson Education India, Pearson, 2013.
5. G. Shanmugam and S. Ravindran, Basic Mechanical Engineering, Tata McGraw- Hill Publishing Company Limited, New Delhi, 2013.
6. S. R. J. Shantha Kumar, Basic Mechanical Engineering, Hi-tech Publications, Mayiladuthurai, 2015.

18HS101 COMMUNICATIVE ENGLISH I 1 0 2 2

Course Objectives

- Read and understand the main points on familiar matters regularly encountered in work, school, or leisure
- Listen and respond in most common situations where English is spoken
- Write simple connected texts on topics which are familiar or of personal interest
- Describe experiences and events, hopes and ambitions and briefly give reasons and explanations for opinions and plans

Programme Outcomes (POs)

PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Use appropriate grammar and vocabulary that is expected at the BEC Preliminary exam level
2. Understand the general meaning of non-routine letters within own work area, and short reports of a predictable nature
3. Write formal, routine letters of factual nature, and make notes on routine matters, such as taking/placing orders
4. Follow simple presentations/demonstrations
5. Deal with predictable requests from a visitor, state routine requirements, and offer advice within own job area on simple matters

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2									2					
3														
4										1				
5										2				

UNIT I **9 Hours**

GRAMMAR

Tenses Future continuous, Past continuous, Past perfect, Past simple, Past tense responses, Present perfect continuous, Present perfect/past simple Reported speech Adverbs intensifiers Comparatives and superlatives Conditionals 2nd and 3rd Connecting words expressing cause and effect, contrast Phrasal verbs Prepositions of place Simple passive - Wh-questions in the past Question tags Will and going to, for prediction.

UNIT II **9 Hours**

READING

Understanding short real-world notices, messages Detailed comprehension of factual material; skimming and scanning skills - Interpreting visual information Reading for detailed factual information Reading for gist and specific information - Grammatical accuracy and understanding of text structure - Reading and information transfer.

UNIT III **9 Hours**

WRITING

Internal communication including note, message, memo or email - arranging / rearranging appointments, asking for permission, giving instructions - Business correspondence including letter, fax, email apologising and offering compensation, making or altering reservations, dealing with requests, giving information about a product.

UNIT IV **9 Hours**

LISTENING

Listening for specific information Listening for numbers and letters Note completion Listening for gist listening to monologues (presentations, lectures, announcements and briefings) listening to interacting speakers (telephone conversations, face-to-face conversations, interviews and discussions).

UNIT V **9 Hours**

SPEAKING

Exchanging personal and factual information expressing and finding out about attitudes and opinions organise a larger unit of discourse Turn-taking, negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing and/or disagreeing, suggesting, speculating, comparing and contrasting, and decision-making. 1.Goodbye party for Miss Pushpa T S - Nissim Ezekiel 2. Our Casuarina Tree - Toru Dutt 3. Palanquin Bearers - Sarojini Naidu 4. The Tyger - William Blake 5. Ode on a Grecian Urn - John Keats

Total: 45 Hours

Reference(s)

1. Alexander Garrett, Cambridge BEC Preliminary Students Book with Answers, Cambridge University Press, 2016.
2. Lan Wood, Anne Williams and Anna Cowper. Pass Cambridge BEC Preliminary, Second Edition, New Delhi, 2014.
3. Norman Whitby. Cambridge Business Benchmark. Pre-Intermediate to Intermediate, Students Book. South Asian Edition, 2018.

18TT201 ENGINEERING MATHEMATICS II 3 1 0 4

Course Objectives

- Understand the concepts of partial derivatives and multiple integrals to define the area, volume and extreme values of various surfaces in engineering fields.
- Classify the sequences and series in linear systems is convergent or divergent.
- Formulate the real time engineering problem into mathematical model using ordinary differential equation and solve it by appropriate method.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Illustrate the various parameters in partial differentiation and characterize the maxima and minima functions for signals and systems.
2. Apply multiple integral concepts to calculate the area and volume by appropriate vector integral theorems.
3. Analyse the convergence and divergence of sequences and series by various tests.
4. Construct first order differential equations from real time phenomena and solve it by suitable method.
5. Execute the appropriate method to solve the second order differential equations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3												
2	2	3												
3	2	3												
4	1	3												
5	1	3												

UNIT I **9 Hours**

PARTIAL DIFFERENTIATION

Functions of several variables, plotting of 2-variable functions, introduction to cylindrical and spherical coordinates, chain rule, total differential, gradient, directional derivatives, normal lines and tangent planes, extreme of functions of two variables, applications.

UNIT II **9 Hours**

MULTIPLE INTEGRALS

Double integrals, regions of integrations, triple integrals, applications (Cartesian coordinates only-Greens theorem and Gauss Divergence theorem).

9 Hours

UNIT III

SEQUENCES AND SERIES

Sequences and series, convergence and divergence of series, absolute convergence, conditional convergence, test for convergence and divergence. Power series for functions, interval of convergence, Taylor and Maclaurin series, Taylors Theorem with remainder.

UNIT IV **9 Hours**

FIRST ORDER DIFFERENTIAL EQUATIONS

Separable differential equations, homogeneous differential equations, exact differential equations, integrating factor, Bernoulli's equation, applications.

UNIT V **9 Hours**

SECOND ORDER DIFFERENTIAL EQUATIONS

Second order homogeneous and non-homogeneous equations with constant coefficients, variation of parameters, method of undetermined coefficients, series solutions of differential equations, applications.

FOR FURTHER READING

Application of transformations in design theory.

Total: 60 Hours

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley, 2001.
2. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.Kreysgiz E, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 1999.
3. Ray Wylie and C Louis Barrett, Advanced Engineering Mathematics, Sixth Edition, Tata McGraw-Hill Publishing Company Ltd, 2003.
4. Peter V. O Neil, Advanced Engineering Mathematics, Seventh Edition, Cengage Learning India Private Limited, 2012.
5. Glyn James, Advanced Engineering Mathematics, Third Edition, Wiley India, 2014.

18TT202 ENGINEERING PHYSICS II 2 0 2 3

Course Objectives

- Understand the elastic and surface properties of materials for their relevant applications tovarious streams of engineering and technology.
- Realize the importance of static and dynamic friction in textile materials.
- Apply the concepts involved in thermodynamics for solving the real-world problems.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO9.Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Understand the elastic properties of materials in terms of the three moduli of elasticity andsurface properties of liquids.
2. Exemplify the wave properties, generation of ultrasonics and their applications in the field of non-destructive testing methods.
3. Illustrate the crystal structure, crystal planes and unit cell characteristics of cubic crystal systems.
4. Assess the differences between static and dynamic friction and effect of wear and abrasions intextile machinery parts.
5. Apply the knowledge of thermodynamics in calculating the heat requirement for fabric processand analyze kinetics of dyeing.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1							2					
2	2	1							2					
3	2	1							2					
4	2	1							2					
5	2	1							2					

UNIT I **6 Hours**

ELASTICITY AND SURFACE PROPERTIES

Elasticity: elastic and plastic behaviour of materials - stress - strain diagram - Hooke's law - types of elastic moduli: Youngs modulus - bulk modulus - rigidity modulus - Poisson ratio - factors affecting elasticity. Surface properties: cohesive force - adhesive force - factors affecting surface tension - interfacial tension - emulsions - detergency - foaming - wettability - coefficient of viscosity - Stokes law - Poiseuille's law - coefficient of viscosity of various liquids.

UNIT II **6 Hours**

ULTRASONICS

Properties of ultrasonic waves - generation: magnetostriction and piezoelectric methods - detection of ultrasonic waves - velocity of ultrasonic waves using acoustic grating. Non-destructive testing: pulse echo method - merits and demerits - applications: drilling - cutting - SONAR - Applications of ultrasonic in Textile and apparels

UNIT III **6 Hours**

SOLID STATE PHYSICS

Crystalline and non-crystalline materials - lattice points - space lattice - crystal structure -unit cells - Bravais lattice and crystal systems - Miller indices - procedure for finding Miller indices-relation between interplanar distance and interatomic distance - unit cell characteristics of SC, BCC, FCC and HCP structures

UNIT IV **6 Hours**

FRICTION

Friction: basic laws - static and dynamic friction - adhesion - sheering theory - surface roughness - deformation - ploughing - normal adhesion - effects of speed on friction - wear and abrasion - frictional behaviour of elastomers - rolling friction

UNIT V **6 Hours**

THERMODYNAMICS

Heat - equilibrium and quasistatic process - path functions - comparison between heat and work - internal energy - laws of thermodynamics - isothermal and adiabatic process - work done - reversible and irreversible process - entropy diffusion- model for diffusion - diffusion coefficient - rate of dyeing, equilibrium, exhaustion, migration, adsorption and absorption of dyes - kinetics of dyeing with disperse dyes

EXPERIMENT 1 **4 Hours**

Find the elevation of the given wooden beam at the midpoint by loading at the ends and hence calculate the Youngs modulus of the material.

EXPERIMENT 2 **4 Hours**

Find the depression at the midpoint of the given wooden beam for 50g, 100 g, 150 g, 200 g and 250 g subjected to non-uniform bending and determine the Youngs modulus of the material of the beam.

EXPERIMENT 3 **4 Hours**

Determine the moment of inertia of the disc and calculate the rigidity modulus of a given wire using torsion pendulum (symmetrical masses method).

EXPERIMENT 4 **4 Hours**

Determine the coefficient of viscosity of a given liquid by Poiseuille's method.

EXPERIMENT 5 **4 Hours**

Determine the

(i) wavelength of ultrasonics in a liquid medium,

(ii) velocity of ultrasonic waves in the given liquid

(iii) compressibility of the given liquid using ultrasonic interferometer.

EXPERIMENT 6 **5 Hours**

Determine the coefficient of thermal conductivity of a bad conductor by Lee's disc method.

EXPERIMENT 7 **5 Hours**

Form the interference fringes from the air wedge setup and calculate the thickness of the given material (yarn)

Total: 60 Hours

Reference(s)

1. A. Serway and John W. Jewett, JR. Physics for Scientists and Engineers with Modern Physics, Ninth Edition Raymond, 2016.
2. Bhattacharya, D.K. & Poonam, T. Engineering Physics. Oxford University Press, 2015.
3. Gaur, R.K. & Gupta, S.L. Engineering Physics. Dhanpat Rai Publishers, 2012.
4. Pandey, B.K. & Chaturvedi, S. Engineering Physics. Cengage Learning India, 2012.
5. B.S. Gupta, Friction in textile materials, Woodhead Publishing Pvt. Ltd., 2008.

18TT203 ENGINEERING CHEMISTRY II 2 0 2 3

Course Objectives

- Explain the significance of electromagnetic spectrum on colour theory based on complementary colours of light, chromophore, auxochrome, intensity shifts and illustrate photo processes based on Jablonski diagram.
- Classify dyes based on chromophore and outline the structure, properties and applications of selected natural and synthetic dyes
- Summarize the effect of dyes on human health, environment and analyze the textile effluents in water by chemical methods to treat by adsorption and membrane technology

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Summarize different regions in an electromagnetic spectrum and exemplify chromophores based on intensity shifts.
2. Explain the influence of electromagnetic radiation in photochemical process of dyes.
3. Classify dyes based on chromophore and understand the properties and uses of dyes in textile applications.
4. Outline the effect of dyes on human health, environment and analyze the effluents in water by chemical methods.
5. Apply suitable method to remove textile effluents from waste water by adsorption and membrane technology.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	2	1												
3	2	2												
4	3	2												
5	2	2												

UNIT I **7 Hours**

COLOUR CHEMISTRY

Electromagnetic spectrum - absorption of radiation - electronic, vibrational and rotational transitions. Regions of electromagnetic spectrum - complementary colours - chromophores, auxochromes, hyperchromic shift, hypochromic shift, hypsochromic shift and bathochromic shift - conjugated chromophores.

5 Hours

UNIT II

PHOTOCHEMISTRY OF DYES

Laws of photochemistry. Lambert-Beer Law and its limitations. Photoprocesses - Jablonski diagram (Internal Conversion, Inter-system crossing, Fluorescence, Phosphorescence) - Chemiluminesence and Photo-sensitization. Principle, instrumentation (Block diagram), applications- colorimetric analysis (estimation of prussian blue dye).

UNIT III **6 Hours**

DYES FOR TEXTILES

Classification of dyes - important chemical chromophores of dye classes (azo, anthraquinone and indigoid). Structure, properties and applications of azo dye (Congo red), triaryl methane dye (Malachite green), anthraquinone dye (Alizarin-1,2 dihydroxy anthraquinone) and indigoid dye (Indigo).

UNIT IV **5 Hours**

CHEMICAL METHODS OF ANALYSIS

Effect of textile effluents on environment and human health. Water quality parameters: BOD, COD, DO content (determination of DO content in water by Winkler's method) - neutralization titration (Estimation of alkalinity in water) - complexometric titration (Role of EDTA in textile industry) - redox titration (Iodometry).

UNIT V **7 Hours**

TEXTILE EFFLUENT TREATMENT

Wastewater treatment - treatment with activated carbon. Adsorption: Types (physisorption and chemisorption) - applications of adsorption - adsorption of solutes from solutions - adsorption isotherm: Types (I-V). Membrane Technology: Reverse osmosis - electrodialysis.

FURTHER READING

Finger print region in infra-red spectroscopy.
Dye effluent from textile and its treatment.

EXPERIMENT 1 **2 Hours**

Interpretation of extended chromophore present in organic compound by UV-Visible spectrum.

EXPERIMENT 2 **4 Hours**

To introduce the Lambert - Beer s Law by analyzing the influence of the light path length through the absorption medium on transmittance, the influence of the increased concentration of solution on transmittance and the impact of different substances/species on transmittance.

EXPERIMENT 3 **2 Hours**

Estimation of Prussian blue dye by colorimetric analysis.

EXPERIMENT 4 **4 Hours**

Preparation of natural/ synthetic dye for textile applications.

EXPERIMENT 5 **2 Hours**

Estimation of alkalinity in water sample by volumetric analysis.

EXPERIMENT 6 **4 Hours**

Estimation of hardness in the given water sample(s) by EDTA method.

EXPERIMENT 7 **4 Hours**

Estimation of dissolved oxygen content in water sample(s) by Winkler s method.

EXPERIMENT 8 **4 Hours**

Estimation of chloride present in the given water sample by argentometric method.

EXPERIMENT 9 **4 Hours**

Treatment of water containing dye effluents by activated charcoal method.

Total: 60 Hours

Reference(s)

1. J.D. Lee, Concise inorganic chemistry, Blackman Science Ltd, France, Wiley-India, 5th edition (Reprint), 2016.
2. P. C. Jain and M. Jain, Engineering Chemistry, Dhanpat Rai Publications., New Delhi, 2016.
3. Sashi Chawla, Text Book of Engineering Chemistry, Dhanpat Rai Publications, New Delhi, 2003.
4. B. R. Puri, L. R. Sharma and Madan S. Pathania, Principles of Physical Chemistry, Shoban Lal Nagin Chand & Co., 2010.
5. J. C. Kuriacose and J. Rajaram, Chemistry in Engineering & Technology, Vol. 1&2, TMH, 2009.

18TT204 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

2 0 2 3

Course Objectives

- Explain electrical properties of fibres and nano-materials and their measurement using digital meters.
- Exemplify the operation of electrical drives used in textile industry.
- Explain the electronics used in textile industry.
- Interpret the sensors used in textile industry.
- Attribute the different types of earthing and electrical Safety.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Explain electrical properties of fibres and nano-materials and their measurement using digital meters.
2. Exemplify the operation of electrical drives used in textile industry.
3. Explain the electronics used in textile industry.
4. Interpret the sensors used in textile industry.
5. Attribute the different types of earthing and electrical Safety.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3	3	2									
2	3	2	-	2	3								3	
3	3	2	-	3	2	3	2							2
4	3	2	-	3	3		2						2	
5	3	2	1	3	2	3								

UNIT I **5 Hours**

PROPERTIES OF MATERIALS AND MEASUREMENT

Properties of Materials and Measurement, Electrical properties such as Conductivity, Resistivity, Capacitance of Nano Materials and Fibre, Measurement of Voltage, Current, Power and Power factor using Digital meter - LCRQ meter.

UNIT II **8 Hours**

ELECTRICAL MACHINES AND DRIVES

Construction and Operation of DC motors, Three phase Induction Motor, Servo Motor, DC Generator, speed control of DC motor, speed control of AC motor- VFD.

UNIT III **5 Hours**

FUNDAMENTALS OF ELECTRONICS

Characteristics of PN Junction diode, Timers - Display system, Interfacing DC motor with electronic control system.

UNIT IV **6 Hours**

SENSORS AND PLC

Principles of transducers, strain gauge, photocell, Proximity Sensors, Inductive Sensor, Hall Sensors, Programmable Logic Controller in textile industry.

UNIT V **6 Hours**

EARTHING, SAFETY AND ACCESSORIES

Earthing: Necessity- Types of Earthing, Measurement of Earth Resistance - Types of fuses, MCB, ELCB, Necessity of Insulation - Types of Switches, Sockets and Plugs.

EXPERIMENT 1 **6 Hours**

Measurement of conductivity, resistivity of fibres and conducting polymers.

EXPERIMENT 2 **6 Hours**

Develop a prototype driving mechanism using VFD.

EXPERIMENT 3 **6 Hours**

Develop an electronic speed control system for DC motor.

EXPERIMENT 4 **6 Hours**

Measurement of temperature using thermistors.

EXPERIMENT 5 **6 Hours**

Fuse replacement and earthing methods.

Total: 60 Hours

Reference(s)

1. A.L. Anwari, Basic of electrical engineering, Dhanpat Rai, 2016.
2. Alan.s.moris, Reza Langari, Measurement and instrumentation , Elsevier, 2011.
3. R. S. Sedha, A Textbook of Applied Electronics, S. Chand & Company Ltd, 2013.
4. T.k.Nagsarkar and M.S.Sukhija ,Basic of Electrical Engineering, oxford university, 2011.
5. Smarjith Ghosh, Fundamentals of Electrical and Electronics Engineering, Prentice Hall, 2010.

18TT205 TEXTILE FIBRES 2 0 2 3

Course Objectives

- To teach the fundamentals of natural and manmade fibres and their properties.
- To impart knowledge on the identification of various natural and manmade fibres.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11. Project Management and Finance: 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.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

1. Understand the origin and production of textile fibres.
2. Understand production of natural fibres and their physical and chemical properties.
3. Understand the production of regenerated fibres and their properties.
4. Understand the production of PA and PET fibres and their properties.
5. Understand the production of special fibres and their properties and Identification of fibres.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3									1	2	-	2	
2	3									1	2	2	2	
3	3									1	2	-	2	
4	3									1	2	-	2	
5	3									1	2	-	2	

UNIT I **6 Hours**

INTRODUCTION AND NATURAL FIBRES

Fibre - Staple fibre - Filament - Yarn -Thread - Fabric and Clothing. Characteristics of Textile Fibre - Classification of Textile Fibres. Cotton: Evolution of cotton varieties - Genetically modified Cotton - Organic Cotton & Coloured Cotton - Cultivation and harvesting - Chemical composition - Chemical structure - Physical properties - Chemical properties and End uses

UNIT II **6 Hours**

NATURAL FIBRES (CONT.)

Bast Fibres: Varieties and uses - Flax, Ramie, Hemp, Kenaf, Banana. Jute: Cultivation- Retting -Fibre Extraction - Properties. Wool: Types - Rearing - Shearing - Chemical Composition and structure - Physical and Chemical properties - uses. Silk: Types - Reeling - Throwing - Chemical Composition and Structure - Physical and Chemical properties - uses. Leaf fibres: Sisal - Pine apple - Abaca - Physical properties - Chemical properties and uses. Fruit fibres: Coir - Physical properties - Chemical properties and End uses

UNIT III **6 Hours**

REGENERATED CELLULOSIC FIBRES AND REGENERATED PROTEIN FIBRES

Introduction to fibre forming processes. Viscose rayon: Principle of manufacture - Physical properties - Chemical properties & End uses. Modification of viscose rayon - Tencel - Modal. Alternative to viscose process. Principle of manufacture: Casein fibre- Vicara fibre - Ardil fibre - properties.

UNIT IV **6 Hours**

POLYAMIDE FIBRES AND POLYESTER FIBRE

Classification of Nylon fibres - Manufacture of Nylon 6 - Nylon 66 - Chemical structure and properties - End uses of polyamides -properties and application. Manufacture of polyester - Chemical structure - Physical and chemical properties - End uses.

UNIT V **6 Hours**

SPECIALITY FIBRES AND IDENTIFICATION OF FIBRES

Classification of Speciality fibres - Aromatic polyamides - Glass Fibre - HDPE fibre -HMPE -PBI - Properties and end uses. Feeling Test - Burning test - Microscopic test -Staining Test -Chemical test - Density measurement.

FOR FURTHER READING

Details of major Cotton producing countries, Major wool and silk producing countries, Comparison of regenerated cellulose fibres with cotton and regenerated protein fibres with wool, silk, Comparison of Nylon 6 and Nylon 66, Solubility Parameters.

EXPERIMENT 1 **2 Hours**

Fibre identification techniques: Assessment of physical characteristics by feel, appearance and other subjective techniques

EXPERIMENT 2 **2 Hours**

Fibre identification techniques: Burning test.

EXPERIMENT 3 **4 Hours**

Fibre identification techniques: Microscopic assessment.

EXPERIMENT 4 **6 Hours**

Fibre identification techniques: Solubility test.

EXPERIMENT 5 **4 Hours**

Fibre identification techniques: Measurement of fibre density

EXPERIMENT 6 **4 Hours**

Identification of the given fibres (Cellulosic fibres - 2)

EXPERIMENT 7 **4 Hours**

Identification of the given fibres (Protein fibres - 2)

EXPERIMENT 8 **4 Hours**

Identification of the given fibres (Manufactured fibres - 2)

Total: 60 Hours

Reference(s)

1. H. V. Sreenivasa Murthy, Introduction to Textile Fibres, TAI Publications, Mumbai, 1987.
2. S. P. Mishra, A Textbook of Fibre Science and Technology, New Age publication, 2000.
3. Natural Fibres Hand Book with Cultivation and Uses, NIIR board of Consultants and Engineers, 2007.
4. J. Gordon Cook, Handbook of Textile Fibres: Natural Fibres: Volume 1, Woodhead Textiles Series No. 4, Woodhead Publishing Limited, UK, 2001.
5. J. Gordon Cook, Handbook of Textile Fibres: Manmade Fibre: Volume 2, Woodhead Textiles Series No. 4, Woodhead Publishing Limited, UK, 1999.

18TT207 ENGINEERING DRAWING 1 0 4 3

Course Objectives

- Create an engineering drawing concept as per industrial standards.
- Construct orthographic projections of points and lines.
- Construct projection of planes and simple solids.
- Develop section of solids and development of surfaces.
- Demonstrate the orthographic projection from isometric view and vice versa.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO9.Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

1. Create an engineering drawing concept as per industrial standards
2. Construct orthographic projections of points and lines.
3. Construct projection of planes and simple solids.
4. Develop section of solids and development of surfaces.
5. Demonstrate the orthographic projection from isometric view and vice versa.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2								2	1			1	
2	2								2	1			1	
3	1								2	1			1	
4	1								2	1			1	
5	1								2	1			1	

UNIT I **10 Hours**

FUNDAMENTALS OF ENGINEERING DRAWINGS

Definition, standards, drawing tools, drawing sheets, scales, line and its types. Practices on lettering, numbering, dimensioning of drawings. Construction of conic sections-ellipse, parabola and hyperbola using eccentricity method.

UNIT II **12 Hours**

PROJECTION OF POINTS

Principles of projection, Projection of points in four quadrants, first angle projection of straight lines - perpendicular to one plane, parallel and inclined to both planes.

UNIT III **10 Hours**

PROJECTION OF PLANES AND SOLIDS

Projection of simple planes and projection of simple solids Ã¢?? parallel, perpendicular and inclined to one plane using change of position method.

UNIT IV **12 Hours**

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES

Section of Solids-Simple position with cutting plane parallel, perpendicular and inclined to one plane. Development of surfaces - simple and truncated solids.

UNIT V **16 Hours**

ORTHOGRAPHIC AND ISOMETRIC PROJECTION

Orthographic and isometric projection of components used in engineering applications.

Total: 60 Hours

Reference(s)

1. K. Venugpoal, Engineering Drawing and Graphics, Sixth edition, New Age International, 2011.
2. Basant Agrawal, Mechanical drawing, Tata McGraw-Hill Education, 2008.
3. Engineering Drawing Practice for Schools & Colleges, Bureau of Indian Standards-Sp46, 2008.
4. K.V. Natarajan, A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 2013.

18TT301 ENGINEERING MATHEMATICS III 3 1 0 4

Course Objectives

- Understand the concepts of Fourier series, Fourier and Laplace transforms which will enable them to model and analyze the physical phenomena
- Implement the Fourier analysis, an elegant method in the study of heat flow, fluid mechanics and electromagnetic fields.
- Apply the numerical techniques to offer an approximate solution for the differential equations in a real-world situation.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Apply the Fourier analysis for the periodicity of combination of sine and cosine functions.
2. Infer different techniques of Fourier transforms for non- periodicity functions
3. Classify partial differential equation and able to solve various equations
4. Interpret the solution of system of linear equations by various numerical techniques
5. Execute the numerical solution of initial and boundary value problems of differential equations by different methods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2												
2	1	2												
3	1	2												
4	1	2	1											
5	1	2	2											

UNIT I **9 Hours**

FOURIERSERIES

Dirichlets conditions - General Fourier series - Odd and even functions - Half range cosine and sine series - Root mean square value.

UNIT II **9 Hours**

FOURIER TRANSFORM

Fourier Integral Theorem- Fourier Transform and Inverse Fourier Transform- Sine and Cosine Transforms - Properties - Transforms of Simple Functions - Convolution Theorem - Parsevals Identity

UNIT III **9 Hours**

PARTIAL DIFFERENTIAL EQUATION

Introduction to partial differential equations - One-dimensional wave equation - Method of separation of variables - D-Alembert's solution of the wave equation. Heat equation. LaPlace's equation

UNIT IV **9 Hours**

NUMERICAL SOLUTION OF SYSTEM OF LINEAR EQUATIONS

Solution of algebraic and transcendental equations: Fixed point iteration method - Newton- Raphson method - Solution of system of linear equations: Gauss elimination method - Inverse of a matrix: Gauss-Jordan method- Eigen values of a matrix by Power method.

UNIT V **9 Hours**

NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS

Solution of first order ordinary differential equations: Eulers method - Fourth order Runge- Kutta method -Milnes predictor and corrector method - Solution of partial differential equations: Parabolic equations by Crank Nicholson method- Hyperbolic equations by explicit finite difference method

Total: 60 Hours

Reference(s)

1. Kreyszig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley, 1993.
2. Johnson Richard A. and Bhattacharyya Gouri K., Statistics, Principles and Methods, 3rdEdition, John Wiley, 1996.
3. ONeil Peter V. Advanced Engineering Mathematics, 4th Edition, PWS-Kent, 1995.
4. James Glyn, Advanced Modern Engineering Mathematics, Addison-Wesley, 1993.
5. Grewal B. S, Numerical Methods in Engineering and Science with Programmes in C & C++, Ninth Edition, Khanna Publications, 2010.
6. Sankara Rao. K, Numerical Methods for Scientists and Engineers, Third Edition, PHI Learning Private Limited, New Delhi, 2009.

18TT302 APPLIED MECHANICS 2 2 0 3

Course Objectives

- To understand the static behaviour of particles and structures
- To analyse the behaviour of rigid bodies in equilibrium

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Compute the resultant force for various systems using laws of mechanics.
2. Compute the frictional forces using free body diagram of particles and rigid bodies.
3. Evaluate the sectional properties of surfaces and solids.
4. Compute the simple stress and strain for one and two dimensional elements.
5. Determine the shear force and bending moment and analyze the flexural member.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	-	-		2									
2	3	1	1		1									
3	1	2	1	2	2									
4	3	1	2	2	2									
5	1	2	1		1									

UNIT I **9 Hours**

STATICS OF PARTICLES

Concurrent forces in plane and space - problems involving the equilibrium of a particle.

UNIT II **9 Hours**

STATICS OF RIGID BODIES IN TWO DIMENSIONS

Rigid bodies -two-dimensional structure - Moment of force - Moment of a couple. Equivalent systems of coplanar forces. Rigid body in equilibrium, problems involving equilibrium of rigid body. Friction: Laws of friction - co-efficient of friction - problems involving dry friction - ladder friction.

UNIT III **9 Hours**

CENTROIDS, CENTRE OF GRAVITY AND MOMENT OF INERTIA

Centroids of areas, determination of moment of inertia of plane figures. Polar moments of inertia, radius of gyration. Kinetics of Particles: Introduction - equation of motion. Work energy method - potential energy.

UNIT IV **9 Hours**

SIMPLE STRESS AND STRAIN

Axial and shear stresses and strain - Elasticity - Hook's law - Factor of safely - Lateral strain - Poisson's ratio - Volumetric strain. Stresses in composite bars due to axial loading.

UNIT V **9 Hours**

SHEAR FORCE AND BENDING MOMENTS

Relationship between loading - Shear force and bending moment - shear force and bending moment diagrams for cantilever, simple supported and overhanging beams subjected to concentrated load and U.D.L. maximum bending moment and point of contra flexure. Theory of bending: Theory of simple bending and assumptions - derivation of formula M/I=f/y=E/R and its application to engineering problems.

Total: 75 Hours

Reference(s)

1. R.K.Bansal, Engineering Mechanics, Laxmi Publications, New Delhi, 1992.
2. S.Rajasekaran & S.Sankarasubramaniyan, Basics of Engineering Mechanics - Structures - Statics & Dynamics, Vikas Publications. New Delhi, 2002.
3. B.C.Punmia, A.K.Jain, Strength of Materials and Theory of Structures - Vol.3, Lakshmi Publications, New Delhi 2007.
4. R.K.Rajput, Strength of Materials, S.Chand & Company Ltd., New Delhi, 2011.

18TT303 INSTRUMENTATION AND CONTROL ENGINEERING **2 0 2 3**

Course Objectives

- To understand the calibration, characteristics and applications of transducers.
- To impart necessary knowledge in the construction and working of recording and indicating instruments.
- To provide knowledge about transfer function, time and frequency response of systems.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO11.Project Management and Finance: 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.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Summarize the functional elements, statics and dynamic characteristic of measurement systems.
2. Interpret the construction and operation of resistive, capacitive, inductive and active type of transducers.
3. Illustrate the construction and working of indicating, recording instruments and data logger.
4. Determine the transfer function of electrical and mechanical systems using the first principle method and block diagram reduction techniques.
5. Determine the time domain and frequency domain specifications for the given transfer function.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1											
2	2	1	1											
3	2	1	2											
4	2	2	1	2	3						2	2	2	2
5	2	2	1	2	3						3	2	2	3

UNIT I **5 Hours**

BASICS OF MEASUREMENT

Definitions of instrument, instrumentation, control, controllers functional elements of measurement system standards static calibration classification of errors Static characteristics of instruments: accuracy, precision, bias, sensitivity, linearity, resolution, threshold and hysteresis dynamic characteristics of zero and first order system.

UNIT II **6 Hours**

TRANSDUCERS

Principle of operation, construction details and applications of resistance potentiometers strain gauges thermistor thermocouple LVDT capacitive transducers piezo electric transducers photoelectric transducer.

UNIT III **5 Hours**

INSTRUMENTATION

Indicating and recording devices: construction and working of PMMC instrument, successive approximation and dual slope type digital instruments cathode ray oscilloscope inkjet and laser printers and XY plotter magnetic disc storage data loggers.

UNIT IV **7 Hours**

SYSTEMS REPRESENTATION

Basic elements in control systems open and closed loop systems transfer function of basic electrical and mechanical systems block diagram reduction techniques

UNIT V **7 Hours**

TIME AND FREQUENCY RESPONSE

Time response time domain specifications standard test inputs first and second order system response to standard test signals steady state error static error constants frequency response bode plots

FOR FURTHER READING

IC temperature sensor Yarn break sensor Applications of capacitive and optical sensors in textile industries Inkjet textile printers Frequency response of systems Polar plot Concepts of stability Characteristic equation Routh Hurwitz criterion Root Locus technique

EXPERIMENT 1 **3 Hours**

Measurement of linear displacement using inductive transducer.

EXPERIMENT 2 **6 Hours**

Light intensity measurement using photo electric transducer

EXPERIMENT 3 **3 Hours**
Measurement of force using strain gauge and load cell

EXPERIMENT 4 **3 Hours**
Measurement of temperature using Thermocouple

EXPERIMENT 5 **3 Hours**
Temperature measurement using Thermistor

EXPERIMENT 6 **6 Hours**
Measurement of voltage, current, frequency and phase angle using CRO

EXPERIMENT 7 **3 Hours**
Determination of Transfer Function for AC Servomotor

EXPERIMENT 8 **3 Hours**
Step response of first order system

Total: 60 Hours

Reference(s)

1. A.K. Sawhney, Puneet Sawhney, A course in Electrical and Electronic Measurements and Instrumentation, Nineteenth edition, Dhanpat Rai & Co (P) Ltd, 2012.
2. H.S.Kalsi, Electronic Instrumentation, Third Edition, Tata McGraw Hill Education Private Limited, 2012.
3. E.O.Doeblin, Measurement Systems: Applications and Design , 6th Edition, Tata McGraw-Hill Book Co., 2012.
4. I.J.Nagrath, M.Gopal, Control Systems Engineering, Fifth Edition, New Age International Publishers, New Delhi, 2012.
5. Katsuhiko Ogata, Modern Control Engineering, Third Edition, Prentice Hall of India Ltd., New Delhi, 2011.
6. D. Patranabis, Sensors and Transducers, 2nd Edition, Prentice Hall India Pvt. Ltd, 2009.

18TT304 COMPUTER PROGRAMMING 2 0 2 3

Course Objectives

- To understand the basics of computer organisation
- To understand the basics of C primitives, operators and expressions
- To understand the different primitive and user defined data types

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Develop solutions using problem solving techniques and number system conversions.
2. Write the programs using operators, type conversion and input-output functions.
3. Apply decision making and looping statements in writing C programs.
4. Apply the concepts of arrays and strings in C programs.
5. Design applications using structures and functions in C.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1			1									
2	1	1			1									
3	1	3			1									
4	2	1			2									
5	2	1			2									

UNIT I **6 Hours**

INTRODUCTION TO COMPUTERS

Introduction to computers - Characteristics of Computers - Evolution of Computers - Computer Generations - Basic Computer Organization - Number System - Problem Solving Techniques - Features of a Good Programming Language.

UNIT II **6 Hours**

INTRODUCTION TO C PROGRAMMING

Overview of C-Structure of C Program-Keywords-Constants- Variables-Data Types-Type conversion Operators and Expressions: Arithmetic-Relational-Logical-Assignment- Increment and Decrement-Conditional-Bitwise -Precedence of operators-Managing I/O Operations-Formatted I/O-Unformatted I/O.

UNIT III **7 Hours**

CONTROL STATEMENTS

Decision Making and Branching: simple if statement-if else statement-nesting of if else Statement-Switch Statement. Decision Making and Looping: while statement-do while statement-for statement-Nested for statement Jump Statements: go to-break-continue-return statement

UNIT IV **7 Hours**

ARRAYS AND STRINGS

Arrays: Introduction, one dimensional array, declaration - Initialization of one-dimensional array, two-dimensional arrays, initializing two dimensional arrays, multi-dimensional arrays. Strings: Declaring and initializing string variables- Reading strings from terminal - writing string to screen - String handling functions.

UNIT V **7 Hours**

STRUCTURES AND FUNCTIONS

Structures and Unions: Introduction-defining a structure- declaring structure variables-accessing structure members-structure initialization-Unions-Enumerated data type, User Defined Functions: Elements of user defined functions -Definition of functions-return values and their types- function calls-function declaration-categories of function -call by value and call by reference-recursion-Preprocessor directives and macros

FOR FURTHER READING

Creating and manipulating document using word - Mail merge - Creating spread sheet with charts and formula using excel - developing power point presentation with Animations - C graphics using built in functions

EXPERIMENT 1 **2 Hours**

Write a C program to perform arithmetic operations on integers and floating-point numbers.

EXPERIMENT 2 **4 Hours**

Write a C program to implement ternary operator and relational operators.

EXPERIMENT 3 **2 Hours**

Write a C program to find the greatest of three numbers using if-else statement.

EXPERIMENT 4 **4 Hours**

Write a C program to display the roots of a quadratic equation with their types using switch case.

EXPERIMENT 5 **2 Hours**

Write a C program to generate a pyramid of numbers using a for loop.

EXPERIMENT 6 **4 Hours**

Write a C program to perform Matrix Multiplication

EXPERIMENT 7 **2 Hours**

Write a C program to check whether the given string is Palindrome or not.

EXPERIMENT 8 **4 Hours**

Write a C program to find the factorial of given number.

EXPERIMENT 9 **6 Hours**

Design a structure to hold the following details of a student. Read the details of a student and display them in the following format Student

details: roll no, name, branch, year, section, cgpa.

****

NAME:

ROLL NO:

BRANCH:

YEAR:

SECTION:

CGPA:

Total: 60 Hours

Reference(s)

1. Pradeep K. Sinha, Priti Sinha, Computer Fundamentals, BPB publications, 2008.
2. Ashok. N. Kamthane, Computer Programming, Second Edition, Pearson Education, 2012.
3. E.Balagurusamy, Programming in ANSI C, Tata McGraw-Hill, 2012.
4. Herbert Schildt, C -The complete Reference, Tata McGraw-Hill, 2013.
5. Byron Gottfried, Programming with C, Schaum"s Outlines, Tata McGraw-Hill, 2013.

18TT305 SPINNING TECHNOLOGY I 3 0 0 3

Course Objectives

- To teach the design, constructional features and working principles of spinning preparation machines.
- To educate on the processing of different types of fibres and their blends.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11.Project Management and Finance: 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.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2. Develop new designs (woven/printed / dyed) and products (knitted /woven/nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Perform count calculations; select ginning machines and produce quality lint; select blow room machinery and use for the production of quality card feed material
2. Assess techniques of producing quality card slivers; select process parameters in carding
3. Outline the techniques of producing quality draw frame sliver; apply 'friction field' theory for control of fibres
4. Examine the techniques of producing quality combed sliver; choose process parameters; apply Gegauf's Noil theory for quality combed material
5. Outline the techniques of producing quality roving with optimum package build.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2		3					1	1	1	3	1
2	2		2		3					1	1	1	3	1
3	2		2		3					1	1	1	3	1
4	2		2		3					1	1	1	3	1
5	2		2		3					1	1	1	3	1

UNIT I **12 Hours**

GINNING AND BLOWROOM

Count systems - Direct and indirect - application in textiles -Ginning: Principles of ginning process. Roller gin and Saw gin. Pre- and post- ginning operations. Developments in ginning. Blowroom: Objectives of blowroom - Design, constructional features, classification and working principles of feeding and opening / coarse cleaning machines.

UNIT II **12 Hours**

BLOWROOM

Design, constructional features and working principles of fine cleaning, blending and card feeding machines. Principles of opening and cleaning. Processing of cotton, manmade fibres and blends. Material transport system - waste and dust collection systems - contamination sorters - waste recycling machines -Technological developments.

UNIT III **12 Hours**

CARDING

Objectives of carding process - Design, Constructional Features and working principles of a modern card and card feeding systems. Processing of cotton, manmade fibres and blends. Mechanism of carding: wire point disposition - fibre configuration, blending, levelling, fibre breakage, hook formation - web formation- fibre transfer efficiency and factors affecting fibre transfer. Card settings. Card clothing. Card wire grinding. Principles of auto levellers. Technological developments

UNIT IV **12 Hours**

DRAWFRAME AND COMBER

Objectives of draw frames Roller arrangements in draw frames and fibre control devices. Top and bottom roller characteristics and maintenance - Principles of doubling and drafting - theory of friction field - drafting waves and control of fibres. Technological developments. Comber preparatory processes: Methods of lap preparation - Lap forming machines. Comber: Objectives - Combing cycle - Design, constructional features and working principles of comber machine; Process parameters. Charles Gegauf's Noil Theory. Technological developments.

UNIT V **12 Hours**

SPEED FRAME

Objectives - Design, constructional features and working principles of speed frame: Creel - drafting system - top and bottom rollers - top arm drafting system - roller settings - roller weighting systems - types of flyers - false twister- spindle - bobbin rail and spindle rail - drive to the machine - flyer lead and bobbin lead - bobbin builder motion. Processing of cotton, manmade fibres and blends. Automatic doffing. Technological developments.

Total: 60 Hours

Reference(s)

1. W. Klein, Rieter Manual of Spinning Volume 1&3, Rieter, 2010.
2. Peter R. Lord, Handbook of Yarn Production, Technology, Science and Economics, CRC Press publication, New York, 2002.
3. Carl A. Lawrence, Fundamentals of Spun Yarn Technology, CRC Press publication, New York, 2002.
4. R. Chattopadhyay, Technology of Carding, NCUTE, IIT Delhi, 2003.
5. R. Chattopadhyay and R. S. Rengasamy, Spinning, Drawing, Combing & Roving, NCUTE Pilot Programme, Indian Institute of Technology, New Delhi, 2003.
6. R. Chattopadhyay, Advances in Technology of Yarn Production, NCUTE, IIT Delhi, 2002.

18TT306 WEAVING TECHNOLOGY I 3 0 0 3

Course Objectives

- To teach the different preparatory processes in weaving.
- To impart thorough knowledge of the concepts involved in these processes.
- To educate on the features of machines required for the different processes.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO11.Project Management and Finance: 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.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven/printed / dyed) and products (knitted /woven/nonwoven for apparel and technical applications.

Course Outcomes (COs)

1. Compare and contrast the different types of warp and weft winding processes in terms of working principles as well as various important settings.
2. Illustrate the two different types of warping processes in terms of working principles and applications.
3. Suggest the sizing recipes for various fabric constructions and analyze the sizing performance.
4. Explain the primary, secondary and auxiliary motions of weaving.
5. Explain the working principles of shedding (tappet, dobby, Jacquard and drop box mechanisms), picking and beat-up, let-off and take-up mechanisms

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3				2						2	1	3	2
2	3				2						2	1	3	2
3	3				2						2	1	3	2
4	3				2						2	1	3	2
5	3				2						2	1	3	2

UNIT I **10 Hours**

WINDING

Objectives - Classification of winders - Characteristics of parallel winding, cross winding and precision winding - Traversing techniques - Types and working principles of yarn clearers - Types of tensioners - guides- knotters and splicers. Stop motions. Automatic cheese and cone winders - creel - tension control - stop motion - length measuring device - auto doff. Winding of cotton, synthetic and blended yarns. Weft Winding-Objectives - Working principle of automatic pirn winding machine - functional elements. Processing of cotton, synthetic and blended yarns.

UNIT II **6 Hours**

WARPING AND SIZING

Warping

Objectives - Beam warping machine - sectional warping machine. Working principles and applications.

Sizing

Objectives - Types and selection of ingredients for sizing - Size preparation: Size add-on - Proceduresand Cooking Parameters. Sizing of cotton and blended yarns.

UNIT III **10 Hours**

SIZING AND DRAWING-IN

Sizing(CONT.)

Sizing machines: Multi-cylinder: Types of creels - Size box - Drying Cylinders - Headstock. Control systems in sizing machines: temperature control - size level control - moisture control - stretch control. Beam pressing devices: mechanical - pneumatic - hydraulic. Single-end sizing process.

Drawing-in Working principles of manual, semiautomatic and automatic drawing-in machines - warp tying- knotting, pinning machines.

UNIT IV **10 Hours**

LOOM PRIMARY MOTIONS

Classification of weaving machines - Basic motions: Primary - Secondary - Auxiliary; Loom timing. Heald wires - Heald frames. Types of sheds - Tappet shedding - Dobby shedding: Climax - Cam - paper - Rotary -Electronic. Jacquard shedding - Single lift - Double lift - Cross-border - Vincenzi - Verdol - electronic jacquard.

UNIT V **9 Hours**

LOOM PRIMARY AND SECONDARY MOTIONS

Loom Primary Motions (Cont.)

Picking: Shuttles - Cone over pick - Under pick: side lever and side shaft - Checking devices. Beating: Reed types- Temples - Sley eccentricity. Loom Secondary Motions; Take up motion: Negative - positive - continuous. Let-off motions: Negative - Positive - Electronic. Types of Backrest. Loom drives. Drop Box Motions; Box motions: 1×2 - 1×4; working principle.

Total: 45 Hours

Reference(s)

1. D. B. Ajgaonkar, M. K Talukdar and Wedekar, Sizing: Material Methods and Machineries, Mahajan Publications Ahmedabad, 1999.
2. P. K. Sriramalu, D. B. Ajgaonkar and M. K. Talukdar, Weaving Machines Mechanisms, Management Mahajan publishers, Ahmedabad 1998.
3. M. K. Talukdar, An Introduction to Winding and Warping Testing Trade Press, Mumbai, 1982.
4. Anon., Woven Fabric Production I, NCUTE Publication, IIT, New Delhi, 2002.
5. Anon., Woven Fabric Production II, NCUTE Publication, IIT, New Delhi, 2002.
6. P. Marks and A. T. C. Robinson Principles of Weaving, The Textile Institute, 1989.

18TT307 SPINNING TECHNOLOGY LABORATORY I **0 0 4 2**

Course Objectives

- To impart hands-on practical knowledge about the concepts learnt in the Course, Spinning Technology.
- To enable the students to make necessary changes in the machinery settings to achieve the desired results in spinning preparatory machinery.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Identify the change points in the spinning machinery (machine settings, change gears, pulleys etc).
2. Change machine settings, process parameters and conduct experiments to obtain improved quality, reduced wastes and increased productivity.
3. Interpret the results for process control.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	1	1					1		1	3	1
2	3	2	1	2	1					1		1	3	1
3	3	2	1	2	1					1		1	3	1

EXPERIMENT 1 **4 Hours**
Measurement and Calculation of Speeds of Ginning Machine, calculation of ginning out turn.

EXPERIMENT 2 **4 Hours**
Measurement of speeds of beaters and openers; adjustments in grid bar settings.

EXPERIMENT 3 **4 Hours**
Settings and Production calculations in Blowroom line. Cleaning efficiency of a beater

EXPERIMENT 4 **4 Hours**
Card - Draft and Production calculations.

EXPERIMENT 5 **4 Hours**
Card - Card Waste study (Zone wise) Cleaning Efficiency Calculation.

EXPERIMENT 6 **4 Hours**
Card - Card Settings for a given cotton mix (at least 4 major settings).

EXPERIMENT 7 **4 Hours**
Draw frame - Draft calculation and Production calculations.

EXPERIMENT 8 **4 Hours**
Draw frame - Sliver hank adjustment by changing draft change gear wheel

EXPERIMENT 9 **4 Hours**
Draw frame - Effect of roller setting change on draw frame sliver unevenness.

EXPERIMENT 10 **4 Hours**
Comber - Speed, Draft calculations.

EXPERIMENT 11 **4 Hours**
Comber - Estimation and alteration of Comber noil percentage - Head-to-head variation and total noil percentage.

EXPERIMENT 12 **4 Hours**
Draft, Twist and Production calculations in speed frame.

EXPERIMENT 13 **4 Hours**
Change roving hank and roving twist in speed frame

EXPERIMENT 14 **4 Hours**
Estimation of Roving stretch percentage.

EXPERIMENT 15 **4 Hours**
Design Experiment, Application Oriented Experiment
Mini Project.

Total: 60 Hours

18TT308 WEAVING TECHNOLOGY LABORATORY I **0 0 4 2**

Course Objectives

- To provide hands-on knowledge on the mechanisms and settings in preparatory machines and looms.
- To conduct application oriented experiments.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO9.Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven /printed /dyed) and products (knitted/woven/nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Set various preparatory processes for weaving operation
2. Operate weaving preparatory machines, plain looms and loom attachments.
3. Dismantle, assemble and set loom mechanisms and motions.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3		2	3	2				2			1	3	2
2	3		2	3	2				2			1	3	2
3	3		2	3	2				2			1	3	2

EXPERIMENT 1 **4 Hours**

Analysis of yarn faults during winding

EXPERIMENT 2 **4 Hours**

Determination of yarn quality after sizing

EXPERIMENT 3 **4 Hours**
Production and Efficiency calculation in Semi-Automatic Pirn Winder

EXPERIMENT 4 **4 Hours**
Production and Efficiency calculation in Automatic Pirn Winder

EXPERIMENT 5 **4 Hours**
Create a section in sectional warping machine for a given design

EXPERIMENT 6 **4 Hours**
Alter traverse and study the effect on section warping producing two small sections

EXPERIMENT 7 **4 Hours**
Analysis of Cone and Pirn characteristics and Pirn Building Mechanism.

EXPERIMENT 8 **4 Hours**
Dismantling, assembling and setting of Tappet Shedding Motion

EXPERIMENT 9 **4 Hours**
Dismantling, assembling and setting of Over Pick Mechanism

EXPERIMENT 10 **4 Hours**
Dismantling, assembling and setting of Under Pick Mechanism

EXPERIMENT 11 **4 Hours**
Dismantling, assembling and setting of Take-up Mechanism

EXPERIMENT 13 **4 Hours**
Application Oriented Experiment

Total: 60 Hours

18GE301 SOFT SKILLS - VERBAL ABILITY 2 0 0 0

Course Objectives

- To help students gain adequate proficiency in vocabulary.
- To help students become proficient in basic writing skills related to workplace communication.
- To read and understand unabridged text.

Programme Outcomes (POs)

PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Take up verbal ability part of the placement tests with confidence.
2. Write with confidence in professional and workplace communication.
3. Distinguish fact from opinion by reading passages from a text.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									2	2				
2									2	2				
3									2	2				

UNIT I **15 Hours**

INTRODUCTION

Synonyms - Antonyms - Word Groups - Verbal Analogies - Etymology - Critical Reasoning - Cloze Test - One Word Substitution - Idioms and Phrases - Text & Paragraph Completion.

UNIT II **15 Hours**

BASICS OF VERBAL APTITUDE

Sentence Formation - Paragraph Formation - Change of Voice - Change of Speech - Reading Comprehension - Sentence Equivalence - Jumbled Sentences - Spotting Errors -Homophones Homonyms - Commonly Mispronounced/Misspelt Words.

Total: 30 Hours

Reference(s)

1. Murphy, Raymond. English Grammar in Use A Self-Study Reference and Practice Book for Intermediate Learners of English. IV Edition. United Kingdom: Cambridge University Press. 2012.
2. Lewis, Norman. Word Power Made Easy. New York: Pocket Books. 1991.
3. Baron's The Official Guide for New GMAT Review, New Jersey: John Wiley & Sons, Inc. 2015.

18TT401 ENGINEERING MATHEMATICS IV 3 1 0 4

Course Objectives

- Understand the basic concepts of probability and the distributions with characteristics and also two-dimensional random variables.
- Apply different statistical inference techniques in testing of hypothesis in a real time fashion industry.
- Analyse the design in identifying the suitable product by comparing the characteristics of the material in industries.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO9.Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Demonstrate the basic probability axioms and concepts, Probability distributions of the random variables in designing process.
2. Identify the relationship and properties of two-dimensional random variables using Correlation techniques in textile manufacturing.
3. Implement basic statistical inference techniques, including confidence intervals and hypothesis testing to science/engineering problems.
4. Design an experiment using ANOVA technique.
5. Compare statistical data using control chart in quality control.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2							2					
2	2	2												
3	3	2												
4	3	2	2											
5	3	2		2										

UNIT I **9 Hours**

PROBABILITY THEORY

Axioms of probability - Conditional probability - Bayes theorem - Random variable: Probability mass function - Probability density function- Moment Generating Function-Binomial, Poisson and Normal distributions.

UNIT II **9 Hours**

TWO DIMENSIONAL RANDOM VARIABLES

Joint distributions - Marginal and conditional distributions - Covariance - Correlation and Regression analysis in Textile Manufacturing.

UNIT III **9 Hours**

TESTING OF HYPOTHESIS

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample test based on Normal distribution for single mean and difference of means -Small sample tests: t-test for mean-F- test - Chi-square test for Goodness of fit and Independence of attributes.

UNIT IV **9 Hours**

DESIGN OF EXPERIMENTS

One way and Two-way classifications - Completely randomized design - Randomized block design - Latin square design.

UNIT V **9 Hours**

STATISTICAL QUALITY CONTROL

Control charts for measurements (X and R charts) - Control charts for attributes (p, c and np charts) - Tolerance limits - Acceptance sampling.

Total: 60 Hours

Reference(s)

1. Milton J. S. and Arnold Jesse C., Introduction to Probability and Statistics: Principles and Applications for Engineering and the Computing Sciences, McGraw Hill Inc, 3rd Edition, 1995.
2. S.C. Gupta, Fundamentals of Statistics, 7th Edition, Himalaya Publishing House Pvt. Ltd. 2018.
3. Johnson Richard A. and Bhaltacharyya Gouri K., Statistics, Principles and Methods, 3rd Edition, John Wiley, 1996.
4. James Glyn, Advanced Modern Engineering Mathematics, Addison-Wesley, 1993.
5. Kreyszig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley, 1993.

18TT402 THEORY OF MACHINES 3 0 0 3

Course Objectives

- To understand the concepts of various machine parts and its mechanisms.
- To understand the benefits of different cams and follower motions scheme and to construct cam profiles graphically.
- To know the kinematic properties of gears, clutches, flywheel and design of belt and chain drives.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Recognize the concept of mechanisms in the machine parts and determine velocity and acceleration involved in simple mechanisms.
2. Design and construct the cam profile graphically based on follower motions.
3. Design Friction drives like flat and V-belts for power transmission.
4. Classify the gears and gear trains based on the design aspects.
5. Construct and analyze turning moment diagrams of an engine and summarize the importance of balancing of masses.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	2	2												
3	1	1												
4	1	2												
5	3	2												

UNIT I **9 Hours**

BASICS OF MECHANICS

Basic concepts of link, pair, chain, mechanism - Machines and structures- Degree of freedom – Grumbler’s criteria -Kutzback Criterion, Grashoff"s Law. Inversions of Mechanism - Four bar and single slider crank. Determination of velocity and acceleration - Relative velocity method: Four bar and single slider mechanism.

UNIT II **9 Hours**

CAM AND FOLLOWER MECHANISMS

Types of cams and followers - Types of motion - Uniform velocity, simple harmonic motion, uniform acceleration and retardation motion and cycloidal motion. Design of cam profile - Knife edged, roller and oscillating roller follower. Pressure angle and undercutting

UNIT III **12 Hours**

BELT DRIVES AND CLUTCHES

Belt Drives and Clutches

Belt Drives: Types-Velocity Ratio -Slip of belt - Creep of belt. Tensions for flat belt drive - Determination of angle of contact -Initial, centrifugal and maximum tension in the belts - Condition for maximum power. V Belt drive

Friction Clutches - Single Plate and Multiplate Clutches.

UNIT IV **6 Hours**

GEARS AND GEAR TRAINS

Gears - Types - classifications-Nomenclature of spur and helical gears - Law of gearing. Gear trains - Types (Concepts only).

UNIT V **9 Hours**

TURNING MOVEMENT DIAGRAM, FLY WHEEL AND BALANCING

Introduction - Turning moment diagram for a single cylinder four stroke Internal Combustion Engines - Fluctuation of Energy. Introduction to Flywheel (Basics only). Balancing of rotating and reciprocating masses (Basics only).

Total: 45 Hours

Reference(s)

1. S. S. Rattan, Theory of Machines, Tata McGraw-Hill, 2002.
2. K. Slater Textile Mechanics, Vol-I, The Textile Institute, Manchester, UK, 1997.
3. J. E. Shigley and J. J. Uicker, Theory of Machines and Mechanisms, McGraw-Hill Book, New York, 1995.
4. Syad and R L Singal, Kinematics of Machinery, Tech Mac Publishers, 2007.
5. R. S. Rengasamy, Mechanics of Spinning Machines, NCUTE Publication, IIT Delhi, 2002.
6. R. S. Khurmi, Theory of Machines, S Chand & Company Ltd, New Delhi, 2008.

18TT403 STRUCTURE AND PROPERTIES OF TEXTILE FIBRES

3 0 0 3

Course Objectives

- To understand the fundamentals of fibre structure and physical characterization methods.
- To relate the fibre properties such as moisture, mechanical, optical, frictional, electrical and thermal properties in terms of structure of the fibres.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO11.Project Management and Finance: 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.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

1. Suggest a suitable technique for characterization of a given polymer.
2. Describe a fibre in terms of physical and chemical structure in relation to their properties.
3. Analyse the fibres in terms of physical properties (moisture, mechanical, electrical and thermal)
4. Compare different fibres in terms of physical properties.
5. Suggest suitable fibre(s) for a given end use / requirement.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1				3					2	3	3	
2	2	2				3					2	3	3	
3	2	2				3					1	3	3	
4	2	1				1					2	3	3	
5	2	1				3					2	3	3	

UNIT I **9 Hours**

PHYSICAL STRUCTURE OF FIBRES

Requirements for fibre forming polymers. Fine and morphological structure of Cotton - Flax - Jute- Silk -Wool - Viscose - Polyester - Polyamide - Polyacrylonitrile - Polyolefins. Structural models and their limitations. Investigation methods of fibre structure- Microscopic methods: SEM, TEM, AFM. X-ray diffraction methods, Spectroscopic methods: FTIR. Density measurements.

UNIT II **9 Hours**

MOISTURE ABSORPTION PROPERTIES OF FIBRES

Moisture content and regain - hysteresis - Regain curves. Theories of moisture sorption. Measurement methods of regain and their limitations. Equilibrium absorption of moisture by fibres. Factors influencing moisture regain. Differential and integral heat of sorption - Diffusion equations and their limitations - Diffusion coefficient - Conditioning of fibres - Mechanism of conditioning - Swelling of fibres.

UNIT III **12 Hours**

MECHANICAL PROPERTIES OF FIBRES

Definitions: breaking strength, breaking extension, tensile stress, tensile strain, mass specific stress, yield point, initial modulus, secant modulus, work of rupture and work factor. Stress-strain curves for textile fibres and their explanation. Factors influencing tensile properties of fibres. Elastic properties. Methods of tensile testing - CRL / CRT/ CRE methods and their limitations. Mechanical conditioning of fibres. Visco-elastic properties: Time effects - Dynamic mechanical analysis of fibres. Torsional and flexural rigidity - Measurement techniques.

UNIT IV **9 Hours**

OPTICAL AND FRICTIONAL PROPERTIES

Refractive index of fibres - Measurement and factors influencing the results. Birefringence and optical orientation factor. Reflection of light, Lustre index, factors influencing lustre. Absorption of light - dichroism, dichroic ratio. Fibre friction. Theories of friction - Amonton's law, Bowden's adhesion shearing mechanism, Lincoln's law. Measurement of friction and factors influencing fibre friction. Friction in wool - theory of directional frictional effect.

UNIT V **6 Hours**

ELECTRICAL AND THERMAL PROPERTIES

Conduction, dissociation of ion pairs. Measurement of electrical resistance of fibres. Dielectric properties. Static electricity - Thermal properties - Structural changes in fibres on heating. Thermal transitions. Heat setting. Thermal decomposition of fibres.

Total: 45 Hours

Reference(s)

1. W. E. Morton, and J. W. S. Hearle, Physical Properties of Textile Fibres, Woodhead Publishing Limited, Cambridge, UK, 2008.
2. V. B. Gupta and V. K. Kothari, Textile Fibres: Developments and Innovations, Vol. 2, Progress in Textiles: Science & Technology, IAFL Publications, 2000.
3. Woodings, Regenerated Cellulose Fibres, Woodhead publishing Limited, Cambridge, UK, 2001.
4. B. P. Saville, Physical Testing of Textiles, Woodhead Publishing Limited, Cambridge, England 2000.
5. James F. Shackelford and William Alexander, Materials Science and Engineering, CRC Press LLC, New York, 2001.

18TT404 SPINNING TECHNOLOGY II 3 0 2 4

Course Objectives

- To teach the design, constructional details and working principles of spinning machines (ring frames, alternative spinning systems and post spinning machinery.
- To educate the inter-relationship of the process of conversion of fibres to yarns and the related machinery features.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

1. Explain construction and working principles of ring, rotor and jet spinning machines.
2. Compare and contrast ring spinning with open-end spinning processes.
3. Compare the structural features of yarns produced in ring, rotor and jet spinning processes.
4. Compare SIRO, SOLO and Core and wrap spinning technologies and applications.
5. Explain design and working of different types friction spinning systems and post spinning.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	1										2	
2	3	1	1										2	
3	3	1	1										2	
4	3	1	1										2	
5	3	1	1										2	

UNIT I **9 Hours**

RING SPINNING

Objectives - Design constructional features and working principles of ring frame. Processing of cotton, manmade fibres and blends. Compact spinning - Principle of compacting drafted fibre strand -spinning geometry- different methods of compact yarn manufacture - compact yarn properties. Automation: Bobbin transport systems, Automatic doffing, Linkconer. Ring Data systems.

UNIT II **9 Hours**

ROTOR SPINNING

Principles of twist insertion - real and false twist - principle of break/open spinning. Design and constructional features of rotor spinning machine - Rotor drive - Fibre flux density - back doubling - wrapper fibre formation - rotor yarn structure and properties - rotor yarn properties. Automation in Rotor spinning.

UNIT III **9 Hours**

TOW TO TOP, BULK YARN PRODUCTION AND AIR-JET SPINNING

Tow to sliver stretch breaking - Tow to sliver cutting methods - machines. Acrylic Bulk yarn production machines and methods. Basic principle - Methods of fascinated yarn manufacture (MJS system) - Developments - Raw material requirements Classification of fascinated yarn structure - Yarn properties - Yarn quality-Process parameters: Air pressure -draft - delivery rate - ribbon width - feed ratio. Advancements in air-jet spinning: Plyfil spinning - Vortex spinning (Murata MVS and Rieter) Ã¢?? Yarn quality, process parameters and applications.

UNIT IV **9 Hours**

CORE YARN SPINNING, SIRO AND SOLO SPINNING, WRAP SPINNING

Principle - Requirements for core yarn spinning -Methods of core yarn production: Core yarn: Ring - rotor - friction -air-jet spinning. Raw materials. Principle - Yarn manufacture - Yarn characteristics - End uses. Principle - Raw materials - Yarn structure -Properties - Spinning limits and applications. Self-Twisting Principle, Repco Spinning.

UNIT V **9 Hours**

FRICTION SPINNING, ADHESIVE SPINNING AND POST SPINNING PROCESS

Types - Principles of yarn formation - Fibre feed - Fibre assembly - Twist insertion - Yarn withdrawal. Yarn structure - Raw material requirements - Influence of process parameters. Adhesive spinning systems: Twilo and Bobtex processes. Yarn conditioning - Doubling - ring doubling - Two for one twister. Process parameters. Reeling: plain reeling and cross reeling. Bundling and Baling.

EXPERIMENT 1 **3 Hours**

Speeds, draft, twist and production calculations in Ring frame

EXPERIMENT 2 **3 Hours**

Effect of Ring frame builder motion parameters on package characteristics.

EXPERIMENT 3 **4 Hours**

Effect of Roller Pressure on Yarn Quality

EXPERIMENT 4 **4 Hours**

Setting modifications and end breakage studies in ring frame

EXPERIMENT 5 **4 Hours**

Effect of Process Parameters in Rotor Spinning

EXPERIMENT 6 **4 Hours**

Production and twist calculation of Two-For-One twister (TFO)

EXPERIMENT 7 **4 Hours**

Effect of process variables of TFO on two-fold yarn quality.

EXPERIMENT 8 **4 Hours**

Producing 3 different counts in rotor spinning after changing process parameters.

Total: 75 Hours

Reference(s)

1. W. Klein, Rieter Manual of Spinning Volume 4-6, Rieter, 2010.
2. W. Klein, A Practical Guide to Ring Spinning, Vols. 4 - 5, The Textile Institute, Manchester,1987.
3. W. Klein, New Spinning Systems, The Textile Institute, Manchester, U.K., 1993.
4. Carl A. Lawrence, Fundamentals of Spun Yarn Technology, CRC Press publication, New York, 2002.
5. R. V. M. Gowda, New Spinning Systems, NCUTE Publication, New Delhi, 2005.
6. Peter R. Lord, Handbook of Yarn Production, Technology, Science and Economics, CRC Press publication, New York, 2002.

18TT405 WEAVING TECHNOLOGY II 3 0 2 4

Course Objectives

- To import knowledge and advantages of using shuttleless loom.
- study on various shuttleless machine operations and its working principles.
- Give a input on Selvedges and storage devices functions.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO9.Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Select loom parameters of shuttle looms and projectile looms for the fabric production.
2. Choose type of rapier looms and loom parameters for fabric production.
3. Analyse air quality and quantity requirements in air jet weaving; choose air-jet loom parameters for fabric production.
4. Analyse water quality and quantity requirements for water jet weaving; choose water jet loom and multi-phase loom parameters for fabric production.
5. Select the appropriate storage and selvedge devices for shuttleless weaving machines.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	2	3	2				2			2	3	2
2	3	2	2	3	2				2			2	3	2
3	3	1	2	3	2				2			2	3	2
4	3	2	2	3	2				2			2	3	2
5	2	1	2	3	2				2			2	3	2

UNIT I **9 Hours**

SHUTTLE AUTO AND PROJECTILE WEAVING MACHINE

Automatic Loom - Different types - Pirn changing mechanism - Temple and eye cutters - Loom drives. Projectile Weaving Machine: Yarn quality requirements for shuttle less looms - Gripper projectile machines - Working elements and weft insertion cycle in projectile machine - Torsion bar picking mechanism.

UNIT II **9 Hours**

RAPIER WEAVING MACHINE

Classification: Rigid and flexible, Single and double rapiers. Principle of tip and loop transfer Weft insertion cycles. Rapier drives - salient features. Timing diagrams.

UNIT III **9 Hours**

AIR JET WEAVING MACHINE

Requirements for sley drive in shuttle less weaving - Air-jet machines - Principle of weft insertion - Weft insertion cycle. Air quality and quantity requirements.

UNIT IV **9 Hours**

WATER JET WEAVING MACHINE AND MULTIPHASE WEAVING

Water-jet machines - Principle of weft insertion - Weft insertion cycle - Water quality and quantity requirements. Working principle - Shedding and beat-up mechanisms. Circular multiphase weaving machine.

UNIT V **9 Hours**

STORAGE DEVICES AND SELVEDGES

Weft selection, measuring and storage devices and their working principles. Selvedges: Half cross leno - Full cross leno - Twisted - Tuck-in - Bonded and fused.

EXPERIMENT 1 **4 Hours**

Dismantling, assembling and setting of let-off motions (Positive and Negative)

EXPERIMENT 2 **4 Hours**

Dismantling, assembling and setting of weft fork motions (side and centre) and fast reed motion

EXPERIMENT 3 **4 Hours**

Dismantling, assembling and setting of negative dobbies.

EXPERIMENT 4 **4 Hours**

Dismantling, assembling and setting of loom brakes motion and altering back rest attachments.

EXPERIMENT 5 **4 Hours**

Study of Jacquard mechanism and 4 x 1 drop box mechanism.

EXPERIMENT 6 **2 Hours**

Study of automatic pirn changing mechanism and warp stop motions.

EXPERIMENT 7 **4 Hours**

Study of passage of warp sheet, air connections, design of main and relay nozzles in air jet loom.

EXPERIMENT 8 **2 Hours**

Weft accumulator settings and adjustment.

EXPERIMENT 9 **2 Hours**

Application Oriented Design based Experiment.

Total: 75 Hours

Reference(s)

1. P. K. Sriramulu, D. B. Ajgaonkar and M. K. Talukdar, Weaving Machines, Mechanisms and Management, Mahajan Publishers, Ahmedabad 1998.
2. Sabit Adanur, Handbook of Weaving, CRC press, Washington 2001.
3. R. Marks and A. T. C. Robinson, Principles of Weaving, The Textile Institute, Manchester, 1989.
4. J. J. Vincent, Shuttleless Loom, The Textile Institute 1980.

18TT406 TEXTILE CHEMICAL PROCESSING I 3 0 0 3

Course Objectives

- To understand the preparation of fibre, yarn and fabrics dyeing with machinery required.
- To understand the concept of colour measurement and processes involved in the colouration of textile materials.

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PSO2. Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Suggest process parameters for singeing, desizing and scouring.
2. Suggest suitable bleaching and mercerizing method.
3. Appraise the concepts of colour science and methods of measurement of colour parameters.
4. Explain the principles of dyeing and dyeing machines.
5. Develop dye recipe, choose dyeing parameters and evaluate fastness properties.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1											3
2	3	2	1											2
3	3	-	1											3
4	2	1	1											3
5	3	2	1											3

UNIT I **9 Hours**

PREPARATORY IN WET PROCESSING

Wet process sequences for cotton (knitted & woven), wool, silk and blended fabrics. Singeing: Desizing: Scouring: Saponification - emulsification - detergency - Scouring of cotton. Wool: scouring, Crabbing, Milling and carbonization - Silk: Degumming. Scouring of synthetic materials and blends. Features and working principles of - kier. Physical and chemical methods of assessing scoured fabrics - Measurement of residual impurities.

UNIT II **9 Hours**

BLEACHING AND MERCERIZING

Bleaching: Reactions of hypochlorite - hydrogen peroxide - sodium chlorite. Continuous scouring and bleaching process. Combined scouring and Bleaching. Bleaching of blends - Physical and chemical evaluation of bleached materials. Mercerization: Principles and methods - effects of process conditions on structure and properties. Mercerization of cotton / viscose blends. Mercerizing machines - Assessment of mercerized samples. Liquid ammonia treatment

UNIT III **9 Hours**

COLOUR AND MEASUREMENT

Theory, Concepts and communication of colour. Beer-Lambert Law - Colour Primaries and Colour mixing - Eye and Brain system on colour perception - colour vision tests. C.I.E Method of determining the Tristimulus values - Colour difference equation and measurement - Metamerism - Dichroism. Application of C.C.M. in textile industry. Whiteness and Yellowness Index.

UNIT IV **9 Hours**

DYEING

Dyes - properties - Auxochrome, chromophore and common dye structure - dye-fibre interactions - Substantivity - Affinity - Adsorption isotherms. Rate of dyeing and half dyeing time. Classification of dyes (Application and chemical structure) - Properties, Mechanism and Application: Direct, Reactive, Acid, Basic, Vat, Disperse, Sulphur, Azoic and Metal complex dyes.

UNIT V **9 Hours**

DYEING OF SYNTHETIC AND OTHER FIBRES

Dyeing of PET, Nylon, Acrylic, Triacetate and protein fibres. Dyeing of blends.

Fastness Assessment

Assessment of dyed materials: light - washing - rubbing (wet and dry) - perspiration - sublimation fastness.

Wet Processing Machines

Construction (schematic diagram) and working of loose stock, hank and package processing machines - J-box - jigger - winch - jet and soft-over-flow machines - continuous dyeing ranges.

Total: 45 Hours

Reference(s)

1. S. R. Karmakar, Chemical Technology in the Pre-Treatment Processes of Textiles, Elsevier, 1999
2. E.R. Trotman., Dyeing and Chemical Technology of Textile Fibers, B.I. Publishing pvt ltd, New Delhi 1994.
3. C. V. Kaushik, Chemical Processing of Textiles, NCUTE, 2004.
4. V. A. Shenai, Technology of Bleaching and Mercerisation, Sevak Publication, Bombay, 1996.
5. A. D. Sule., Computer Colour Analysis, New age international publishers, 1997.
6. V. A. Shenai, Evaluation of Textile Chemicals, Sevak publications, Mumbai, 1995.

18TT407 TEXTILE CHEMICAL PROCESSING LABORATORY

0 0 4 2

Course Objectives

- To acquire the skills in preparation for textile materials.
- To evaluate the properties of pre-treated materials and the strength of chemicals used in the pre-treatment.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO9.Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO12. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO2. Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Select process parameters for desizing, scouring and carry out in laboratory scale.
2. Choose process parameters and carry out bleaching and mercerization of given samples.
3. Develop dye recipes and new print patterns.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3		1				3			2		2
2	2	2	3		1				3			2		2
3	2	2	3		1				3			2		2

EXPERIMENT 1 **6 Hours**

Hydrolytic desizing, scouring of grey cotton and assessment of the desized and scoured samples.

EXPERIMENT 2 **6 Hours**

Comparison of BAN and Tensile strength of Mercerized Cotton Yarn.

EXPERIMENT 3 **4 Hours**

Comparison of hydrogen peroxide and sodium hypochlorite bleached samples for whiteness.

EXPERIMENT 4 **6 Hours**
Dyeing of cotton using direct dye.

EXPERIMENT 5 **4 Hours**
Dyeing of cotton using reactive dyes (hot and cold brand dyes)

EXPERIMENT 6 **4 Hours**
Dyeing of wool/silk with acid and basic dyes

EXPERIMENT 7 **4 Hours**
Dyeing of polyester with disperse dyes (HTHP)

EXPERIMENT 8 **6 Hours**
Dyeing of cotton with vat and sulphur dyes.

EXPERIMENT 9 **6 Hours**
Assessment of rubbing and perspiration fastness of fabrics dyed with reactive and direct dyes.

EXPERIMENT 10 **6 Hours**
Assessment of ISO light fastness, sublimation fastness of fabrics dyed with direct and disperse dyes.

EXPERIMENT 11 **4 Hours**
Compare ISO Wash fastness and test (at least two methods) and assess the colour difference of the samples

EXPERIMENT 12 **4 Hours**
Mini-project and Discussions

Total: 60 Hours

18TT408 TEXTILE MACHINE DRAWING AND TECHNICAL SEMINAR

0 0 4 2

Course Objectives

- To provide the Practice to draw the two- and three-dimensional views of various parts of textile machines using CAD software.
- To train to create layout drawing for textile machine installation in spinning and weaving laboratories.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Create two- and three-dimensional part drawings of textile machines using of modelling software.
2. Read, understand and draw machine components in spinning according to established engineering practices.
3. Read, understand and draw machine components in weaving and wet processing machines according to established engineering practices.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	3	2									
2	3	2	2	3	2									
3	3	2	2	3	1									

EXPERIMENT 1 **9 Hours**

Introduction to CAD (commands like point, line, circle etc.) and Drawing

EXPERIMENT 2 **9 Hours**

Exercise on two dimensional models (E.g. Square, circle, Rectangle)

EXPERIMENT 3 **9 Hours**

Exercise on three dimensional models (E.g. Cube, Polygon, Cone, Prism)

EXPERIMENT 4 **12 Hours**

Draw two dimensional drawings for the following textile spinning components
a. Bottom roller shaft.
b. Spindle blade (Top Part)
c. Ring (Ring frame)
d. Sprocket wheel
e. Rotor (Rotor spinning Machine)
f. Bolster (Bottom Part of Spindle)
g. Grid bar
h. Stepped pulley

EXPERIMENT 5 **12 Hours**

Sketch the two-dimensional drawing for the following Weaving components a. Dobby hook
b. Weft fork
c. Shuttle
d. Warper beam flange
e. Pirn
f. Cone holder

EXPERIMENT 6 **9 Hours**

Draw proportionate sketches for the following components
a. Padding mangles machine parts
b. Beaker in dyeing machine

Total: 60 Hours

18HS001 ENVIRONMENTAL SCIENCE 2 0 0 0

Course Objectives

- Understand the interdisciplinary and holistic nature of the environment.
- Identify the significance of natural resources and environment on the quality of life and stimulate the quest for sustainable development.
- Assess the socio-economic, political and ethical issues in environmental science.

Programme Outcomes (POs)

PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Examine the importance of interdisciplinary nature of environment studies, uses and exploitation of natural resources.
2. Analyze the different types of ecosystems and biodiversity, its values and also role of professionals in protecting the environment from degradation.
3. Impact the existing environmental challenges related to pollution and its management.
4. Select suitable strategies for sustainable management of components of environmental science.
5. Correlate the impacts of population and human activities on environment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1							3	2						
2							3	2						
3							3	2						
4							3	2						
5							3	2						

UNIT I **6 Hours**

NATURAL RESOURCES

Forest resources: Use - over exploitation - deforestation - case studies. Water resources: Use - over utilization of surface and ground water - conflicts over water. Mineral resources: Use - exploitation - environmental effects of extracting and using mineral resources - case studies. Food resources: Effects of modern agriculture - fertilizer-pesticide problems (eutrophication, blue baby syndrome, biomagnification). Energy resources: renewable (solar, wind, and hydro).

UNIT II **6 Hours**

ECOSYSTEMS AND BIODIVERSITY

Concept of an ecosystem: Structure and function of an ecosystem - producers - consumers - decomposers - food chains - food webs and ecological pyramids - Types of ecosystems: Introduction - characteristic features: desert ecosystem. Biodiversity - value of biodiversity - threats to biodiversity - endangered and endemic species - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT III **6 Hours**

ENVIRONMENTAL POLLUTION

Pollution: Definition - causes - effects - control measures of air pollution - water pollution: (Sewage water treatment by activated sludge and trickling filter process) - noise pollution- thermal pollution. Disaster management: causes - effects - control measures of floods Ã¢?? earthquake

UNIT IV **7 Hours**

SOCIAL ISSUES AND ENVIRONMENT

Sustainable development: Definition - Unsustainable to sustainable development - solid waste management - causes - effects - 5R Principles (landfills, incineration, composting). Water conservation - rain water harvesting - watershed management. Climate change - global warming - acid rain - ozone layer depletion. E-waste.

UNIT V **5 Hours**

HUMAN POPULATION AND ENVIRONMENT

Human population: Population growth - characteristics - variation among nations - population explosion - value education - HIV / AIDS. Role of information technology in environment and human health - occupational safety and health administration (OSHA)

FOR FURTHER READING

Human rights: Biomedical waste -Identification of adulterants in food materials

Total: 30 Hours

Reference(s)

1. Anubha Kaushik, C.P. Kaushik, Environmental Science and Engineering, 4th Multi Colour Edition, New Age International Publishers, New Delhi, 2014
2. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons
3. T. G. Jr. Miller, S. Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi, 2014
4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press
5. A. K. De, Environmental Chemistry, 7th Edition, New age international publishers, New Delhi, 2014.

18GE401 SOFT SKILLS-REASONING 2 0 0 0

Course Objectives

- To acquire command of both the receptive skills (Listening, Reading) and the productive skills (Writing and Speaking) of English language.
- To understand and make effective use of English language in business contexts.

Programme Outcomes (POs)

PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Listen, Read, Speak, and Write Business English at the level of independent users
2. Appear for the Business English Certificate (BEC) Vantage level examination conducted by the Cambridge Assessment English

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3				
2									3	3				

UNIT I **15 Hours**

LISTENING AND READING

Listening for writing short answers - filling gaps in sentences - identifying topic, context and function - identify different functions of language in business situations - identify prompts -identify paraphrases of required information. Scanning - reading for gist - understanding sentence structure - error identification - identify paraphrases - cohesive words and phrases - understand the importance of analysing the distractors - identify grammatical and semantic relationships.

UNIT II **15 Hours**

WRITING AND SPEAKING

Business emails - notes - memos to colleagues or friends - giving instructions - explaining a development - asking for comments - requesting information - agreeing to requests - explaining - apologising - reassuring - complaining - describing - summarising - recommending - persuading turn - taking - sustaining interaction - initiating - responding - giving personal information - talking about present circumstances, past experiences and future plans - expressing opinion - speculating - organising a larger unit of discourse - giving information - expressing and justifying opinions - speculating - comparing and contrasting - agreeing and disagreeing.

UNIT III **15 Hours**

LISTENING AND READING

Listening for writing short answers - filling gaps in sentences - identifying topic, context and function - identify different functions of language in business situations - identify prompts -identify paraphrases of required information - Scanning - reading for gist - understanding sentence structure - error identification - identify paraphrases - cohesive words and phrases - understand the importance of analysing the distractors - identify grammatical and semantic relationships.

UNIT IV **15 Hours**

WRITING AND SPEAKING

Business emails - notes - memos to colleagues or friends - giving instructions - explaining a development - asking for comments - requesting information - agreeing to requests - explaining - apologising - reassuring - complaining - describing - summarising - recommending - persuading turn - taking - sustaining interaction - initiating - responding - giving personal information - talking about present circumstances, past experiences and future plans - expressing opinion - speculating - organising a larger unit of discourse - giving information - expressing and justifying opinions - speculating - comparing and contrasting - agreeing and disagreeing

Total: 60 Hours

Reference(s)

1. Whitehead, Russell and Michael Black. Pass Cambridge BEC Vantage Self - study Practice Tests with Key, Heinle - a part of Cengage Learning, Delhi, 2003.

21TT501 TEXTILE CHEMICAL PROCESSING II 3 0 2 4

Course Objectives

- To understand printing and finishing of textile materials.
- To analyse the design, constructional and operational features of textile Printing and Finishing machinery.
- To acquire the skills related to printing and finishing of textile materials.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9.Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PSO2. Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Select methods, styles of printing and printing ingredients to carry out printing of textile materials.
2. Choose class of dyes according to the type of textile materials.
3. Evaluate finishing operations on textiles.
4. Assess functional finishes on textiles.
5. Appraise an effluent treatment plant.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1					1	2					3
2	1	2	2					1	2					3
3	2	3	1					1	2					3
4	2	3	1					1	2					3
5	1	1	2					1	2					3

UNIT I **9 Hours**

PRINTING METHODS

Hand, block, screen, roller, rotary, inkjet, digital, Transfer, garment printing. Drawback and advantages. Photoelectric method of screen preparation. Styles of Printing: Direct, Discharge and Resist Styles. Printing Ingredients: Printing paste- properties and requirements. After Treatment: Steamers - Agers - Curing process.

UNIT II **9 Hours**

PRINTING

Printing of Cellulose Fabrics: Direct, Reactive, Vat, Azoic and Sulphur Dyes and Pigments Printing of Wool/Silk Fabrics: Acid, Basic and Reactive Dyes. Printing of Synthetics: Disperse Dyes, Acid Dyes and Pigments

UNIT III **9 Hours**

FINISHING

Mechanical and Chemical Finishing - Durable and non-durable finishes - Softening treatment: mechanism - anionic, cationic, non-ionic, amphoteric, reactive softeners, silicone softeners, PE emulsions - Evaluation and testing methods. Heat setting (stenter) - Calendaring - Sanforising. Application of chemical finishes: padding- low wet pick-up methods (foaming, spraying)- coating and laminating. Drying (cylinder, loop, tumble).

UNIT IV **9 Hours**

FUNCTIONAL FINISHES

Flame retardant finish: Mechanism - Assessment methods of FR finish. Water repellent and water proof finishes: Wetting- Contact angle - assessment methods. Soil release finish: mechanism -Evaluation of soil release. Wash and wear finish: mechanism - cross linking agents (formaldehyde and non-formaldehyde)- assessment methods. Mechanism and chemistry: Antistatic finish - UV Protection finish -Antimicrobial finish - Anti odour finish - enzymatic treatment (biopolishing).

UNIT V **9 Hours**

EFFLUENT TREATMENT

Textile Effluent: Characteristics, BOD, COD, TDS and pH. Textile Effluent Treatment: Primary, Secondary Tertiary Membrane technology. Zero Discharge. Effluent (discharge) standards: BIS

EXPERIMENT 1 **4 Hours**

Direct style of printing on cotton fabric using direct dyes and reactive dyes.

EXPERIMENT 2 **2 Hours**

Printing of white and colour khadi paste/Pigment.

EXPERIMENT 3 **4 Hours**

Tie and Dye

EXPERIMENT 4 **2 Hours**

White and vat colour discharge print on reactive dyed cotton fabric.

EXPERIMENT 5 **2 Hours**

Finishing of cotton fabrics with softener and stiffener and the assessment of bending rigidity of the treated fabrics.

EXPERIMENT 6 **2 Hours**

Assessment of flame retardancy of fabric finished with flame retardant.

EXPERIMENT 7 **4 Hours**

Assessment of weight loss, abrasion resistance and pilling performance of biopolished fabric.

EXPERIMENT 8 **10 Hours**

Mini-project and discussions

Total: 75 Hours

Reference(s)

1. W. D. Schindler and P. J. Hauser, Chemical Finishing of Textiles, Woodhead Publishing Limited, 2004.
2. V. A. Shenai, Technology of Printing, Vol. IV, Sevak Publication, Bombay, 1996.
3. P. Vankar, Textile Effluent, NCUTE Publication, New Delhi, 2002.
4. W. C. Leslie Miles, Textile Printing, Society of Dyers and Colourists, 2003.
5. R. S. Bhagwat, Hand book of Textile Processing Machinery, 2003.

21TT502 MANUFACTURED FIBRE TECHNOLOGY 3 0 0 3

Course Objectives

- To understand the processes involved in manufacturing of manmade fibres.
- To understand the post spinning operations of manmade fibres.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO12. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1. Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2. Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. List the fundamental requirements of fibre forming polymers.
2. Illustrate the principles of synthetic fibre formation and their production techniques.
3. List different morphological and fine structures observed in manufactured fibres (melt and solution spun fibres).
4. Outline the need and importance of post spinning processes and their effects on the properties of manufactured fibres.
5. Demonstrate the need, importance of specialty fibres, properties and specific industry application.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	1			1					3	1	1
2	3	2		1	2		2					3	2	2
3	2	2	1	1			2					3	2	2
4	3	2	1	1			2					3	2	1
5	2	2	3	1	2		2					3	2	3

UNIT I **9 Hours**

SPINNING OF MANMADE FIBRES

Fibre forming processes. Melt Solution (Wet- Dry) - Dry-jet wet and Gel Spinning of polymeric fibres. Melt spinning line: Features of screw extruder, static and dynamic mixer - pre-filter - melt manifold - spin-pack - quenching systems. Solution spinning Line: Dope - candle filter - godets - coagulation bath.

UNIT II **9 Hours**

STRUCTURE FORMATION DURING SPINNING

Structure-property relationships in polymers-tacticity - polymer morphology-crystallinity- phase transitions (first and second order)- factors affecting first order and second order transitions. Structure formation: Melt -Solution spun fibres- crystallinity and orientation. Process variables and their influences - Structural changes during high-speed spinning process.

UNIT III **9 Hours**

POST SPINNING OPERATIONS

Spin finishes: Need and composition of spin finish - spin finish application techniques - spin finish for filament - staple fibre production. Drawing: Need for Drawing - Drawing Unit - Spin-draw process- Draw warping. Heat Setting: Need for heat setting - Structural changes during heat setting - Evaluation methods.

UNIT IV **9 Hours**

MASS COLOURATION, TEXTURING AND TOW TO TOP CONVERSION

Mass colouration in solution and melt spinning system: Methods - selection of colouring materials. Effect of additives in structure and properties of fibres. Texturing: Need -Methods - Detailed study of Draw texturing, friction texturing and air jet texturing, Textured yarn characteristics. Tow-to-top conversion methods.

UNIT V **9 Hours**

SPECIALITY FIBRES

Speciality Fibres: Properties and end-uses. Differentially dyeable polyester and nylon. PLA fibre production. Alternative to viscose fibre process. Bi-component and bi-constituent fibres. Non-circular cross sections and hollow fibres.

Total: 45 Hours

Reference(s)

1. V. B. Gupta and V. K. Kothari, Manufactured Fibre Technology, Chapman & Hall, 1997.
2. S. P. Mishra, Science and Technology of Manmade fibres, Suraj Publications, 2007.
3. D. Saravanan, Natural Fibres and Manmade Fibres, Proceedings of AICTE Staff Development Programme, New Delhi, 2006.
4. V. A. Usenko, Fibre chemistry, The Processing of Manmade Fibres, Springer New York Publications, 2004.
5. S. P. Mishra, Fibre Science and Technology, New Age International Publication, 2000.

21TT503 FABRIC STRUCTURE AND DESIGN 3 0 0 3

Course Objectives

- To Import knowledge on different types of fabric structure.
- To give an input on fabric structure analyzing skill.
- To understand the design concepts of fabric structures.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Construct the Design, Draft and Lifting Plans of basic weaves of woven fabrics.
2. Explain construction, properties and applications of different types of specialty weaves.
3. Apply different types of Jacquards and weaving mechanisms to produce ornamental structures.
4. Suggest the design of different types of pile fabrics and stitching methods of double cloth.
5. Relate the colour and pigment theories to create different colour and weave effects in fabrics.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2								-			3	-
2	2	-								-			3	-
3	1	-							3	3		3		3
4	2	2								-			3	-
5	1	-								3		3		3

UNIT I **9 Hours**

BASIC WEAVES

Elements of fabric design: Design, draft, peg plan, repeat. Plain, Twill, Satin, Sateen. Plain Weave Derivatives - Warp rib, Weft rib and Matt weave - Regular and Irregular. Twill weave derivatives - Pointed twill, herringbone twill, broken twill, transposed twill. Types of twill weave.

UNIT II **9 Hours**

WEAVES FOR SPECIAL PURPOSE

Ordinary and Brighton honeycomb, Huck-a-back and modification, Mock leno, Distorted mock leno, Crepe weaves. Gauze and Leno weaves: Russian Cord - Net Leno, Madras Muslin structures.

UNIT III **9 Hours**

SPECIAL WEAVES

Bedford cords - Plain and twill faced, Wadded welts and piques, Wadded piques, Loose and fast back welts and piques, Extra warp and Extra weft figuring. Backed fabrics: Warp and weft backed, Reversible and Non-reversible.

UNIT IV **9 Hours**

PILE AND DOUBLE CLOTH

Pile fabrics: Warp pile, Fast wire pile, Terry weaves, Terry stripes and checks, Weft Pile, Plain back and Twill back velveteen, Lashed Pile Corduroy, Weft plush. Double cloth: Classification, types of stitches, wadded double cloth, warp and weft wadded double cloth, centre warp and weft stitched double cloth.

UNIT V **9 Hours**

COLOUR THEORY AND DROP DESIGNS

Colour theory: Light and Pigment theory, Modification of colour, Applications of colour, Colour and weave effects, Spot figuring, Arrangement of figures, Drop design Half drop bases Sateen system of distribution.

Total: 45 Hours

Reference(s)

1. Z. J. Grosicki, Watson, Textile Design and Colour: Elementary Weaves and Figured Fabrics, Butterworths, London, 2004.
2. Z. J. Grosicki, Watson, Advanced Textile Design: Compound Woven Structures, Butterworths London, 2004.
3. D. Goerner, Woven Structure and Design, Part I, WIRA, 1986.
4. D. Goerner, Woven Structure and Design, Part II, BTTG, 1989.

21TT504 TEXTILE TESTING 3 0 0 3

Course Objectives

- Select suitable sampling technique for fibres, yarns and fabrics; choose instruments and testing methods for fibres and interpret the results.
- Choose instruments and testing methods for yarns, fabrics and interpret the results.
- Demonstrate knowledge of primary and total hand values; interpret the results of KES modules.
- Choose instruments and testing methods for tensile testing of textile materials and interpret the results.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6. he Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11.Project Management and Finance: 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.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Suggest suitable sampling techniques for fibres, yarn and fabrics.
2. Select appropriate method and test the given fibre, yarn and fabric samples for physical parameters / characteristics.
3. Select appropriate method and test the given fibre, yarn and fabric samples for physical properties.
4. Analyse the given test results and infer the conclusions suitable for implementation.
5. Illustrate the principles involved in testing instruments / equipment used in textile industry and factors influencing the test results.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1			1	3	1		2		1	2	1	3	1
2	1			2	3	-		2		2	1	1	3	1
3	1			1	3	1		2		2	2	1	3	3
4	1			3	3	1		2		1	1	1	3	3
5	1			1	3	1		2		2	1	1	3	3

UNIT I **9 Hours**

SAMPLING AND FIBRE TESTING

Sampling: Sampling techniques. Precautions in sampling; Sampling of fibres, yarns and fabrics. Sampling errors. Standard test atmosphere, measurement of relative humidity. Moisture content and regain of textile materials: Measurement methods, Drying methods, Limitations. Fibre Length Measurement; Fibre Fineness Measurement. Measurement of cotton fibre maturity, trash and micro dust. High Volume instruments, Advanced fibre information system.

UNIT II **9 Hours**

YARN TESTING

Yarn count systems, measuring instruments; Yarn Twist: Single, Ply, Cord, Measurement, Contraction. Crimp rigidity. Unevenness: U%, CV% - Imperfections, mass (variation)diagrams, spectrogram, VL curve. Seldom occurring faults: Classification, Measurement, Analysis. Hairiness: Measurement principles, Interpretation.

UNIT III **9 Hours**

FABRIC

Fabric thickness, Areal density, Crimp, Cover factor and fabric sett. Permeability, Air, Water vapour, Breathability, Thermal Insulation. Hand: Stiffness, Flexural rigidity, Drape. Crease recovery and resistance, Abrasion, Pilling, Flex.

UNIT IV **9 Hours**

FABRIC (CONTD…)

Primary and total hand value. KES and FAST modules. Fabric scanning systems. Measurement of Dimensional stability. Friction: Measurement methods for fibre, yarn and fabrics.

UNIT V **9 Hours**

TENSILE TESTING

Tensile Testing, Strength Measurement: Factors influencing tenacity and elongation. Principles, Methods of measuring Tensile characteristics of Fibre, Yarn and Fabric. Tear and Bursting Strength: Dynamic tensile testing. Measurement, Applications. Constant tension transport testing. General Calibration of instruments and equipment. Example Standard testing procedures (from AATCC, ASTM, BIS, BS, DIN, ISO). Labelling standards and methods.

Total: 45 Hours

Reference(s)

1. J. E. Booth, Principles of Textile Testing, CBS Publishers & Distributors, New Delhi, 1996.
2. B. P. Saville, Physical Testing of Textiles, Woodhead Publishing Ltd., England, 1999.
3. V. K. Kothari, Testing and Quality Management, Vol.1, IAFL Publications, New Delhi, 1999.
4. P. J. Morris, J. H. Merkin and R. W. Renal, Modelling of Yarn Properties from Fibre Properties, Journal of Textile Institute, PP, 322, 335, 1999.

21TT507 FABRIC STRUCTURE AND DESIGN LABORATORY **0 0 2 1**

Course Objectives

- To import knowledge on different types of fabric structure.
- To give an input on fabric structure analyzing skill.
- To understand the design concepts of fabric structures.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO9.Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Construct the Design, Draft and Lifting Plans of basic weaves of woven fabrics.
2. Explain construction, properties and applications of different types of specialty weaves.
3. Apply different types of Jacquards and weaving mechanisms to produce ornamental structures.
4. Suggest the design of different types of pile fabrics and stitching methods of double cloth.
5. Relate the colour and pigment theories to create different colour and weave effects in fabrics.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2							3	3		1	3	1
2	2	1							3	3		1	3	1
3	2	1							3	3		2	3	2
4	2	1							3	3		3	3	2
5	2	2							3	3		3	3	2

EXPERIMENT 1 **4 Hours**

Design, Draft and Peg plan of Plain Weave

EXPERIMENT 2 **2 Hours**

Design, Draft and Peg plan of Twill Weaves

EXPERIMENT 3 **2 Hours**
Design, Draft and Peg plan of Satin or Sateen Weave

EXPERIMENT 4 **2 Hours**
Design, Draft and Peg plan of Honey comb weave

EXPERIMENT 5 **2 Hours**
Design, Draft and Peg plan of Huck-a-Back weave

EXPERIMENT 6 **4 Hours**
Design, Draft and Peg plan of Extra Warp or Extra Weft

EXPERIMENT 7 **4 Hours**
Design, Draft and Peg plan of Pile Fabrics (Warp or weft)

EXPERIMENT 8 **4 Hours**
Design, Draft and Peg plan of Analysis of Backed Fabric

EXPERIMENT 9 **2 Hours**
Design, Draft and Peg plan of Bedford cords

EXPERIMENT 10 **4 Hours**
Design, Draft and Peg plan of Analysis of Double Cloth

Total: 30 Hours

Reference(s)

1. Z. J. Grosicki, Watson, Textile Design and Colour: Elementary Weaves and Figured Fabrics, Butterworths, London, 2004.
2. Z. J. Grosicki, Watson, Advanced Textile Design: Compound Woven Structures, Butterworths London, 2004.
3. D. Goerner, Woven Structure and Design, Part I, WIRA, 1986.
4. D. Goerner, Woven Structure and Design, Part II, BTTG, 1989.

21TT508 TEXTILE TESTING LABORATORY 0 0 4 2

Course Objectives

- Draw representative samples, perform testing of fibres, yarns and fabrics.
- Interpret the results obtained for process control and product certification.
- Perform experiments to improvise on applications; design or modify simple instruments; make use of advanced statistical techniques.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Draw representative samples, perform testing of fibres, yarns and fabrics.
2. Interpret the results obtained for process control and product certification.
3. Perform experiments to improvise on applications; design or modify simple instruments; make use of advanced statistical techniques.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1			1	3	1		2				1	3	1
2	1			1	3	1		2				1	3	1
3	1			3	3	1		2				1	3	3

EXPERIMENT 1 **4 Hours**

Measurement of Fibre length by Baer Sorter and Digital Fibrograph.

EXPERIMENT 2 **4 Hours**

Measurement of Fibre fineness and bundle strength testing by Stelometer

EXPERIMENT 3 **6 Hours**
Measurement of linear density of sliver, roving, and yarn and moisture regain of fibre sample.

EXPERIMENT 4 **6 Hours**
Single and ply yarn twist measurement

EXPERIMENT 5 **4 Hours**
Measurement of Single Thread Strength, Lea Strength and Impact strength of yarn and fabric

EXPERIMENT 6 **6 Hours**
Measurement of Yarn evenness and imperfections and assessment using yarn appearance board

EXPERIMENT 7 **4 Hours**
Measurement of Drape Coefficient of fabrics with different areal densities

EXPERIMENT 8 **6 Hours**
Measurement of Fabric thickness, stiffness and crease recovery

EXPERIMENT 9 **4 Hours**
Fabric tensile strength (Strip test and Grab test) and tear strength

EXPERIMENT 10 **6 Hours**
Assessment of Fabric abrasion resistance and fabric pilling

EXPERIMENT 11 **4 Hours**
Measurement of Fabric Air Permeability and bursting strength

EXPERIMENT 12 **6 Hours**
Design / Application oriented experiment

Total: 60 Hours

Reference(s)

1. Department Laboratory manual.

18GE501 SOFT SKILLS -APTITUDE I 0 0 2 0

Course Objectives

- Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values.
- It will provide a lot of activities and examples for a student to learn and develop these life skills.

Programme Outcomes (POs)

PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Explain various concepts of number systems and their techniques in solving the percentage, average and age problems.
2. Analyse the profit and loss of real time situations and the relation between ratio, proportion and variation.
3. Apply different techniques to find the distance, speed and time of various moving objects.
4. Understand the concepts of coding, sequences and series, data interpretation and critical reasoning to solve real time logical reasoning problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									2	3				
2									2	3				
3									2	3				
4									2	3				

UNIT I **2 Hours**

NUMBER SYSTEMS

Introduction - Definition - Classification on Numbers- Power cycles and remainders - Short cut process- Concept of Highest Common Factor-Concept of Least Common Multiple- Divisibility- Number of zeros in an expression.

UNIT II **2 Hours**

PERCENTAGE

Introduction - Definition and Utility of Percentage - Importance of base/denominator for percentage calculations-Concept of percentage values through additions-Fraction to percentage conversion table.

UNIT III **3 Hours**

AVERAGES AND AGES

Introduction-Average of different groups-Addition or removal of items and change in average-Replacement of some of the items.

UNIT IV **3 Hours**

RATIO, PROPORTIONS AND VARIATION

Introduction- Ratio- Properties-Dividing a given number in the given ratio-Comparison of ratios-Proportions-Useful results on proportion- Continued proportion-Relation among the quantities more than two-Variation.

UNIT V **2 Hours**

PROFIT AND LOSS

Gain/Loss and percentage gain or percentage loss-Multiplying equivalents to find sale price-Relation among cost price, sale price, gain/loss and percentage gain or percentage loss-An article sold at two different selling price-Two different articles sold at same selling price-Percentage gain or percentage loss on selling price-Percentage gain or percentage loss on whole property.

UNIT VI **2 Hours**

TIME AND WORK

Introduction-Basic Concepts-Concepts on working with different efficiencies-Pipes and Cisterns-Work Equivalence (Man Days) -Alternative approach.

UNIT VII **2 Hours**

TIME, SPEED AND DISTANCE

Definition-Basics of Time, Speed and Distance - Relative Speed-Problems based on Trains-Problems based on Boats and Streams-Problems based on Races-Time taken with two difference modes of transport-Time and distance between two moving bodies.

UNIT VIII **3 Hours**

CODING AND DECODING

Introduction-Description of Coding Method-Coding patterns - Concepts of Coding and Decoding-Problems involving Coding and Decoding methods.

UNIT IX **2 Hours**

SEQUENCE AND SERIES

Introduction-Sequences of real numbers - Number and Alphabet series-Description of Number and Alphabet series-Analogy-Odd man out-Power series.

UNIT X **3 Hours**

DATA SUFFICIENCY

Introduction to Data Sufficiency - Overview of the wide variety of Data Sufficiency problems - Basic introduction on how to determine what information is sufficient to solve a given problem - Common pitfalls to avoid.

UNIT XI **3 Hours**

DIRECTION

Introduction to Direction - sense test - Overview of the wide variety of Direction Problems-Direction-Plotting diagrams.

UNIT XII **3 Hours**

CRITICAL REASONING

Introduction-Basic concept of critical reasoning- Weaken the argument-Strengthen the argument-Flaw in the argument-Evaluate the conclusion.

Total: 30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc Graw Hill Publications.
2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, SciTech Publications Pvt Ltd, India.
3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.
4. Dr. R S Aggarwal, A Modern Approach to Verbal and Non-Verbal Reasoning, Revised Edition, S Chand Publications.
5. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.
6. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

21HS002 HUMAN VALUES AND ETHICS 2 0 0 2

Course Objectives

- Understand the concept of good values and comprehend the importance of value-based living.
- Recognize the culture of peace through education.
- Identify and apply the practices for value development and clarification.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1: Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Understand the importance of human values and ethics in life.
2. Execute the importance of harmonious living in a diverse society.
3. Analyse the sensitivity to the crying needs of society such as ungodliness, corruption, poverty, and suffering, and play a vital role in eradicating them.
4. Plan intellectually mature, morally upright, ethically correct, and spiritually inspired decisions.
5. Execute a correct balance between professional excellence and social commitment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2		1			2	3	2			2	2	1
2	1	2		2			2	3	2			3	3	2
3	1	2		1			2	3	2			2	2	3
4	1	2		2			2	3	2			3	2	2
5	1	2		1			2	3	2			2	3	2

UNIT I **6 Hours**

COURSE INTRODUCTION - NEED, BASIC GUIDELINES AND ANALYSIS

Importance of Human Values & Ethics in the 21st Century - Understanding the theory of basic human values and ethics - Openness to change - Self enhancement - Conservation - Self-transcendence - Schwartz Value Survey: Self-Assessment

UNIT II **6 Hours**

EMBRACING THE COMMON ETIQUETTE

Altruism- Integrity - Freedom - Justice - Honesty - Truthfulness - Responsibility - Compassion

UNIT III **6 Hours**

CONTINUOUS HAPPINESS AND PROSPERITY

An overview on basic Human Aspirations - Understanding and living in harmony at various levels of life - Embracing self-love and wellness - Understanding harmony in the family and society

UNIT IV **6 Hours**

UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS

Reflection on growing global multifold problems: poverty, pollution, hunger, disease, unemployment, caste system, child labour, gender equality, politics and violence. Understanding the challenges in cultural, personal, social, political, and economic environment

UNIT V **6 Hours**

UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS CO-EXISTENCE

Understanding the harmony in Nature - Holistic perception of harmony at all levels of existence - Practice Exercises and Case Studies will be taken up in Practice Sessions

Total: 30 Hours

Reference(s)

1. Martin, G. The Little Book of Ethics: A Human Values Approach. Australia: G.P. Martin, 2011.
2. Gupta, N. L. Human Values for the 21st Century. India: Anmol Publications Pvt. Limited, 2002.
3. Mishra, A. Happiness Is All We Want. India: Bloomsbury Publishing, 2017.
4. Universal Human Values. (n.p.): Books Clinic Publishing, 2023.
5. A Textbook on Professional Ethics and Human Values. India: New Age International (P) Limited, 2007.

21TT602 KNITTING TECHNOLOGY 3 0 2 4

Course Objectives

- To educate the students on the basics of knit structures and machines.
- To educate the students on single jersey and double jersey knit structure and its derivatives.
- To educate the students on warp knit structure and its derivatives.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Outline the basic operations of knitting machines.
2. Prioritize and suggest knitting machinery for a given end use.
3. Elaborate pattern mechanisms in flat knitting.
4. Differentiate between warp and weft knitting processes.
5. Characterize warp knitting structural models.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1												3	2	2
2	2					1						3	3	2
3			3			1						3	3	2
4			3			1						3	3	2
5	2					1						3	2	2

UNIT I **9 Hours**

KNITTING FUNDAMENTALS

Comparison of weaving and knitting. Weft knitting classifications - Circular-flat-V-bed. Mechanical elements of knitting: Needles types - Sinkers - Cams - Cylinder - Feeder - Take-up. Knitting cycle and yarn path - Structural Elements of Weft Knitting. Single knit and double-knit structures.

UNIT II **9 Hours**

WEFT KNITTING

Basic weft knitting machines, needle operation, fabrics and their characteristics: Single jersey - Rib - Purl - Interlock and derivatives. Notations and needle gaiting. Intelligent yarn delivery systems - open width fabric production - computerized knitting machines - CONTRA knitting techniques. Quality control

UNIT III **9 Hours**

FLAT KNITTING

Basic principles - Elements - Manual - Mechanical - Derivatives structures. Jacquard knitting - Pattern wheel, Pattern drum, Tape patterning devices, Electronic jacquard knitting.

UNIT IV **9 Hours**

WARP KNITTING

Comparison of Warp knitting and weft knitting. Basic structural elements of warp knitting. Overlap, underlap, closed, and open lap stitches. Machine classification - Knitting elements: Tricot - Raschel - Simplex - Multibar machines - Pattern Control Mechanisms - Pattern wheels - Chain links.

UNIT V **9 Hours**

WARP KNITTED STRUCTURES

Basics - Two bar structures - Full tricot - Locknit - Reverse locknit - Satin - Raised loop - Queen's cord - Shark skin - Double atlas. Fabric geometry: Dimensional parameters. An energy model of plain knitted fabrics - Dynamics of yarn tension on Knitting machines.

EXPERIMENT 1 **4 Hours**

Single Jersey fabric structure analysis.

EXPERIMENT 2 **4 Hours**

Derivatives of Single Jersey fabric structure analysis.

EXPERIMENT 3 **4 Hours**

Rib fabric structure analysis.

EXPERIMENT 4 **4 Hours**

Derivatives of Rib fabric structure analysis.

EXPERIMENT 5 **4 Hours**

Interlock fabric structure analysis.

EXPERIMENT 6 **4 Hours**

Derivatives of Interlock Fabric Structure Analysis.

EXPERIMENT 7 **3 Hours**

Warp knit Tricot structure analysis.

EXPERIMENT 8 **3 Hours**

Warp knit Raschel structure analysis.

Total: 75 Hours

Reference(s)

1. David J Spencer, Knitting Technology, 3rd Edition, Wood head Publishing, 2001.
2. N. Anbumani, Knitting Fundamentals, Machines, Structures and Development, New Age International Pvt. Ltd., 2007.
3. Henry Johnson, Introduction to Knitting Technology, Abhishek Publications, Chandigarh, 2006.
4. Samuel Raz, Flat Knitting Technology, C. F. Rees GmbH, Druck-Repro-Verlag, Heidenheim, Germany, 1993.
5. Chandrasekhar Iyer, Bernd Mammal and Wolfgang Schach., Circular Knitting, Meisenbach GmbH, Bamberg, 1995.
6. D. B. Ajgaonkar, Knitting Technology, Universal Publication Corporation, Mumbai, 1998.

21TT603 GARMENT TECHNOLOGY 3 0 0 3

Course Objectives

- To teach principles and practice of apparel manufacturing.
- To impart knowledge on the effect of equipment on product quality and performance

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to the production and quality of fibres, yarns and fabrics.
PSO2. Develop new designs (woven/printed/dyed) and products (knitted /woven/nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Select the appropriate fabrics and trims for a garment.
2. Demonstrate the concepts of pattern making and grading to cut the fabrics as per the specifications.
3. Evaluate sewing machines and sewing threads and give suitable suggestion for making a given garment.
4. Suggest appropriate the apparel production systems for making various garments.
5. Appraise pressing and packing techniques in the production of apparels.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2											2
2	2		3											2
3	2	3											2	
4	2		3										2	
5	2		3										2	

UNIT I **9 Hours**

OVERVIEW

Introduction to Apparel manufacturing process. Functional divisions of an apparel industry. Material Evaluation of Fabric, Trims and Accessories: Receiving and inspecting materials. Types of defects. Common fabric problems for apparel manufacturers.

9 Hours

UNIT II

CUTTING

Basics of Pattern making and grading. Marker planning: requirements - Efficiency Marker making - Cut order planning. Features of a digitizer. Plotters- flatbed plotter, drum plotter. Spreading: Requirements - Methods - Nature of fabric package - Machines. Cutting: requirements - Hand shears - Straight knife - Round knife - Band knife - Computer control - Die - Laser - Plasma torch - Water jet - Quality control in cutting - defects and troubleshooting.

UNIT III **9 Hours**

SEWING

Stitches - properties - Classes. Seams - Properties - Classes. Sewing machine fundamentals - Classification - Stitch forming mechanism - Sewing machine feed mechanisms-Industrial sewing machine working principle. Types of Sewing machine beds. Sewing threads - Types - Characteristics - Thread size - Ticket number. Types of needles - Sewing problems - Quality control in sewing - defects and troubleshooting.

UNIT IV **9 Hours**

APPAREL PRODUCTION SYSTEMS

Basic concepts - Plant layout - Product oriented layout - Process oriented layout - Progressing bundle System (PBS) - Unit Production System (UPS) - Modular Production System (MPS) - Flexible Manufacturing - workflow - Balancing - Buffer.

UNIT V **9 Hours**

PRESSING AND PACKING

Fusing equipments - working principles, types, and its functions. Pressing - purpose of pressing - categories of pressing - pressing equipment and methods-pleating-permanent press - the state of pressing. Packing types of packing-styles of packing. Final inspection. Support materials: Linings - interlinings - waddings - other materials. Closures: Buttons - zippers - hook-and-loop tapes. Trims: labels - threads - laces - embroidery - tapes.

Total: 45 Hours

Reference(s)

1. David J. Tyler, Carr and Latham, Technology of Clothing Manufacture, Blackwell Publishing, 2008.
2. Grace I. Kunz and Ruth E. Glock, Apparel Manufacturing: Sewn Product Analysis, Prentice Hall, 2004.
3. Gerry Cooklin, Introduction to Clothing Manufacture, Blackwell Science Ltd., 2007.
4. H. Peggal, Introduction to Dress Making, Marshal Caverdish, London, 2001.
5. Solinger Jacob, Apparel Manufacturing Analysis, Columbia Boblin Media, 2000.

21TT607 PATTERN MAKING LABORATORY 2 0 2 3

Course Objectives

- To acquire hands-on experience on pattern drafting.
- To understand the types of seams and stitches, sewing threads and their quality.
- To understand various garment parts and their grading methods.
- To acquire the knowledge on use of accessories for garments.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Analyse the human anthropometrics and sizing systems.
2. Draft the pattern for given measurements.
3. Apply different embroidery stitches on apparels.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1										1	-
2	3	2	1										1	-
3	3	2	1											2

EXPERIMENT 1 **6 Hours**

Development of patterns for Baby Frock

EXPERIMENT 2 **6 Hours**

Development of patterns for Salwar Kameez

EXPERIMENT 3 **6 Hours**

Development of patterns for T-shirt

EXPERIMENT 4 **6 Hours**

Development of patterns for Shirt

EXPERIMENT 5 **6 Hours**
Development of patterns for men's trousers

EXPERIMENT 6 **6 Hours**
Development of patterns for Ladies' blouse

EXPERIMENT 7 **6 Hours**
Development of graded patterns any two styles

EXPERIMENT 8 **6 Hours**
Preparing an embroidery design using computerized embroidery machine.

EXPERIMENT 9 **6 Hours**
Preparing samples for seams and seam finishes

EXPERIMENT 10 **6 Hours**
Mini Project - Design and develop any Kid's wear

Total: 60 Hours

Reference(s)

1. Helen Joseph Armstrong, Pattern Making for Fashion Designers 4th Edition, Prentice-Hall, New Jersy, 2006.
2. Le Pechoux B and Ghosh T K, Apparel Sizing and Fit, Textile Progress, Volume 32, The Textile Institute, Manchester, 2002.
3. Ashdow S P, Sizing in clothing - Developing effective sizing systems for ready to wear clothing, CRC press, Textile Institute & Wood Head publishers, England, 2007.
4. Connie Amaden Crawford, The Art of Fashion Draping, Fairchild Publications, New York, 2005.
5. Harold Carr and Barbara Lathom, The Technology of Clothing Manufacture, Blackwell Sciences, Oxford, 1996.

18GE601 SOFT SKILLS-APTITUDE II 0 0 2 0

Course Objectives

- Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values.
- It will provide a lot of activities and examples for a student to learn and develop these life skills.

Programme Outcomes (POs)

PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Apply the concepts of probability, Sets, Permutation and Combinations in estimating data for real time problems.
2. Understand the concept of logarithms, progressions and Simple and Compound interest to solve various practical problems.
3. Analyse objects involving cubes and cuboids in determining the number of sides coloured.
4. Interpret various data from graphs and tables to determine ratio, percentage and averages.
5. Apply the logical reasoning skills for identifying age, relations, visual relations and puzzles.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									2	3				
2									2	3				
3									2	3				
4									2	3				
5									2	3				

Permutation and Combination 2 Hours

Definition-Fundamental Rules-Theorems on Permutation-Theorems on Combination.

Probability 2 Hours

Concept and Importance of Probability-Underlying factors for real Life estimation of probability-Basic facts about probability-Some important consideration while defining event.

Syllogism and Venn Diagram 2 Hours

Concepts on Syllogisms-Venn Diagram-Interpretation-Venn diagram-solving.

Simple Interest and Compound Interest **4 Hours**

Introduction-Definition - Effect of change of P, R, T on simple interest-Amount-Amount becomes N times the principle-Repayment of debt in equal installments-Rate and time are numerically equal-Compound Interest-Conversion Period-Basic Formula-Special cases-To find the principle / Time /Rate-Difference between Compound Interest and Simple Interest-Equal annual installment to pay the borrowed amount.

Mixtures and Alligation **2 Hours**

Definition-Allegation Rule-Mean value (cost price) of the mixture-Some typical situations where allegation can be used.

Cube and Logarithm **4 Hours**

Introduction-Basic Concepts of Cube and Cuboid-Problems involving cubes and cuboids of various dimensions-Problems involving coloured cubes and cuboids - Basic concepts of Logarithm-Laws of Logarithms including change of base-Common logarithm (base 10) - Properties of Logarithms to solve equations involving logarithmic expressions.

Data Interpretation **2 Hours**

Introduction-Ratio-Percentage-Average-Tables - Graphs and Charts.

Progression and Logical Reasoning **2 Hours**

Arithmetic progression-Geometric Progression-Harmonic Progression-Theorems related with progressions.

problem on ages **2 Hours**

Introduction-Basic Concept-Usage of Percentage and Averages -Applications.

Analytical Reasoning **2 Hours**

Introduction-Basic Concept-Non-verbal Analytical Reasoning -Arrangements.

Blood Relation **2 Hours**

Introduction-Basic Concept-Kinds of relation-Tree diagram -Relations.

Visual Reasoning **2 Hours**

Introduction-Basic concepts-odd man out-Next series-Mirror image and water image.

Simplifications **2 Hours**

Introduction-Basic Concepts-Arithmetic Operations-Equation solving methods-Puzzles.

Total: 30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc Graw Hill Publications.
2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, SciTech Publications Pvt Ltd, India.
3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.

4. Dr. R S Aggarwal, A Modern Approach to Verbal and Non-Verbal Reasoning, Revised Edition, S Chand Publications.
5. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.
6. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

21TT701 QUANTITATIVE METHODS IN TEXTILE INDUSTRY

3 1 0 4

Course Objectives

- Compute the production rates of spinning machines and parameters of limit irregularity, yarn twist and moisture of fibres, intermediate products and yarns.
- Prepare yarn realization, spin plan and productivity reports in spinning department.
- Compute the production parameters in weaving preparatory processes.
- Estimate yarn requirements, productivity, yarn-fabric reconciliation in weaving and knitting.
- Compute liquor ratios in textile chemical processing and consumption of utilities; assess degradation due to chemical processing; evaluate whiteness.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO9.Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11.Project Management and Finance: 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.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

1. Calculate production rates of spinning and weaving machines.
2. Calculate parameters of limit irregularity, yarn twist and moisture of fibres, intermediate products and yarns.
3. Prepare yarn realization, spin plan and productivity reports in spinning department.
4. Estimate yarn requirements and prepare reports related to weaving productivity, yarn-fabric reconciliation and knitting.
5. Calculate liquor ratios in textile chemical processing and consumption of utilities and evaluation of fabrics for quality.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2							2	-		1	3	
2	3	2							2	3	2	1	3	
3	3	2							2	-	2	1	3	
4	3	2							2	3		1	3	
5	3	2							2	-		1	3	

UNIT I **9 Hours**

SPINNING

Linear density (count): Tex, English, Denier, Metric, Woollen, Worsted, count conversions, count control (wrapping). Yarn diameter. Index of irregularity. Moisture calculations: Invoice weight. Production, time, speeds and efficiency for all the machines in short-staple spinning including post-spinning operations, Material content (length and mass) in all spinning containers and packages.

UNIT II **9 Hours**

SPINNING (CONTD…)

Twist and twist multipliers in Tex, Ne and Metric systems, Yarn twist contraction. Cleaning efficiency and wastes; Yarn realization, Wastes: soft, hard, invisible loss/gain; Raw material requirements for a given product mix, raw material-yarn production reconciliation; Spin plan: production balancing in spinning. Productivity calculations: Production per spindle, HOK, Conversion to 40s, productivity in winding, worker complement in spinning

UNIT III **9 Hours**

FABRIC FORMATION

Beam count, Production, time, speeds and efficiency for all the machines in weaving processes, Material content (length and mass) in weaving processes, Sectional warping: number of sections, cone angle. Size recipe, size pick-up. Fabric parameters: constructional details, crimp and contraction, Reed count, width in reed, denting. Cover factor: warp, weft, and cloth. Take-up (loom), pick wheels.

UNIT IV **9 Hours**

FABRIC FORMATION (CONTD…)

Hard waste: theoretical and actual, Areal density (GSM), Yarn requirements for a given product mix, yarn-fabric reconciliation. Weave plan: production balancing, Weaving productivity measures, labour complement in weaving. Weaving snap study. Optimization of package sizes: warpers and weavers beams. Knitting production: circular, flat bed and warp, loop length, tightness factor, stitch density, yarn requirements.

UNIT V **9 Hours**

TEXTILE CHEMICAL PROCESSING

Expression of volumes of liquids: w/w, w/v and v/v. Density of salt / chemical solution, °Be to °Tw to g/cc, Normality, Molarity - Molality. Lab-to-shop floor calculations for preparation, colouration and finishing. Estimation of degradation in Preparatory Processes: Calculation of Copper Number, carboxyl group content. Dye exhaustion to the fabric in padding process. Colour difference, shade sorting, CIE Whiteness Index, ASTM Yellowness Index. Utilities consumption.

Total: 60 Hours

Reference(s)

1. J. E. Booth, Textile Mathematics, Volume 1, 2 & 3, The Textile Institute, 2000.
2. R. Sen Gupta, Weaving Calculations, Mc Graw Hill, 1996.
3. Edward S Olson, Textile Wet Processes, Vol. 1 Preparation of Fibres and Fabrics, Mahajan Publishers Private Limited, India, 1997.
4. Jose Cegarra, Publio Puente, Jose Valldeperas, The Dyeing of Textile Materials, Eurotex Publication, Italy, 1992.
5. Gulrajani M L, Sanjay Gupta, Energy Conservation in Textile Wet Processing, Omega Scientific Publishers, New Delhi, 1992.
6. Sule A D, Computer Colour Analysis, New Age International Publishers, New Delhi, 2002.

21TT702 TECHNICAL TEXTILES 3 0 0 3

Course Objectives

- To provide an overview on the application of technical textiles.
- To teach the manufacturing processes of a few important technical textiles.
- To educate on the physical and chemical properties of technical textiles.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO.4Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO9.Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Characterize the different sectors of textile industry and their role in the economy.
2. Assess contribution of various sectors of textile industry to nation's economy.
3. Critique the efforts taken by the Government of India for the growth of Indian Textile Industry.
4. Plan for the utilities in the various sectors of textile Industry.
5. Use personnel management principles in textile industry.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3	1	1		1		2			3	2	
2	3	2	3	1	2		2		1	2		3	2	
3	3	2	3	1	2		1		2			3	2	
4	3	2	3	1	1		2		2			3	2	
5	2	2	3	1	2		2		2	1		3	2	3

UNIT I **12 Hours**

TECHNICAL FIBRES AND COMPOSITES

High strength and modulus organic fibres High chemical and thermal resistance organic fibres. High performance inorganic fibres Ultra fine and Novelty fibres. Classification and major applications of technical textiles and market potential. Reinforcement fibres matrix materials Classification of textile reinforcement structure Composite manufacturing techniques: hand lay-up compression moulding applications of structural composites. Healthcare and hygienic products

UNIT II **6 Hours**

MEDICAL TEXTILES

Classification and fibres used requirements. Detailed study and application of textiles in: implantable non-implantable extracorporeal devices.

UNIT III **6 Hours**

PROTECTIVE TEXTILES

Waterproof fabrics breathable fabrics Fire protection Heat and cold protection Ballistic protective clothing Camouflage textiles NBC protection. Nuclear protective fabrics

UNIT IV **12 Hours**

FILTRATION TEXTILES

Principles of filtration, Filtration requirements: fibres and fabrics Filters in air conditioning Textiles in liquid filtration Designing Testing. Materials Geotextiles functions. Geotextiles applications

UNIT V **9 Hours**

COATED TEXTILES

Fibres and fabrics for coated textiles polymers and additives in coating and coating methods: Calendaring Heat setting Chemical processes.

Tyre cord design Manufacturing techniques. Airbags: materials and properties Manufacturing techniques Seat belts and fabrics liner fabrics. Textiles for aircrafts

Total: 45 Hours

Reference(s)

1. Sabit Adanur and Wellington Sears, Handbook of Industrial Textiles, Technomic Publishing company Inc., USA, 1995.
2. A. R. Horrocks and S. C. Anand, Handbook of Technical Textiles, Woodhead Publishing Limitedand The Textile Institute, 2000.
3. Alagirusamy and A. Das, Technical Textile Yarns, CRC press, 2010.
4. P. W. Harrison, The Design of Textiles for Industrial Applications, Textile Institute,Manchester, 1998.
5. Pushpa Bajaj and A. K. Sengupta, Industrial Applications of Textiles for Filtration and Coated Fabrics, Textile Progress Vol.14, 1992.
6. Jarmila Svedova, Industrial Textiles, Elsevier Science Publishing Co Inc. New York, 1990.

21TT707 COMPUTER AIDED TEXTILE AND APPAREL DESIGN LABORATORY

0 0 4 2

Course Objectives

- To acquire skills in analyzing the fabric structure, woven design and garment design.
- To acquire skills in making patterns of garments and grading.
- To select appropriate software tools for designing and grading activities.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Select CATD software tools to simulate different types woven fabrics with multiple colours.
2. Apply CATD software tools to simulate different types of garments.
3. Compute marker efficiency for a given garment pattern.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1		2		3								2	2
2	1		2		3								2	2
3	1		2		3								2	2

EXPERIMENT 1 **12 Hours**

Design & Development of home textile products with weaves, peg plan in colour order and weave order

EXPERIMENT 2 **6 Hours**

Design & Development of Half drop Design fabrics for home textile products.

EXPERIMENT 3 **6 Hours**

Design & Development of Ogee design repeat fabrics for home textile products

EXPERIMENT 4 **12 Hours**

Development of Extra warp & Extra weft-based designs for Home decorative & Saree development process

EXPERIMENT 5 **12 Hours**

Develop a pattern based on spec sheet and grade the same for different size garments.

EXPERIMENT 6 **12 Hours**

Development of textile designs, pattern drafting and grade for different garment fit

Total: 60 Hours

21TT708 PRODUCT DEVELOPMENT LABORATORY

0 0 2 1

Course Objectives

- To select appropriate process parameters and set the machines.
- To operate the textile machines and equipment available in the laboratories.
- To produce standard textile products using machines available in the laboratories of textile department.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Select the appropriate process parameters to produce a textile product.
2. Select the suitable sequence of operations to produce a particular end product.
3. Create a product as per the plan.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1		1		2								2	2
2	1		1		2								2	2
3	1		1		2								2	2

Total: 30 Hours

21TT709 PROJECT WORK I 0 0 6 3

Course Objectives

- Identify a problem in the field of textiles or related discipline.
- Survey or carry out activities leading to generation of new knowledge.
- Prepare a report and make a presentation.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9.Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11.Project Management and Finance: 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.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Identify and formulate a real-world problem related to textiles.
2. Identify the requirement and develop the design solutions.
3. Identify technical ideas, strategies and methodologies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	3	2			2	2	2	1		2	3
2	3	3	2	3	2			2	2	2	1	-	2	3
3	3	3	2	3	2			2	2	2	1		2	3

Total: 0 Hours

21TT801 PROJECT WORK II 0 0 18 9

Course Objectives

- Identify a problem in the field of textiles or related discipline.
- Survey or carry out activities leading to generation of new knowledge.
- Prepare a report and make a presentation.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9.Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11.Project Management and Finance: 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.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Identify, formulate a real world problem and break-down the complex problems into various concepts and principles based on the literature search.
2. Identify the activities required and methods to fulfill them and prepare a work-plan to execute the activities.
3. Create and / or select appropriate processes / tools for modelling or preparation of work plan (materials and methods).
4. Develop a product or process with systematic approach involving problem analysis, designing solutions (considering health, safety, legal and cultural issues).
5. Prepare the reports and presentations in the specified format.
6. Demonstrate the ability to work in a team by contributing towards achieving the team (project) goal.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	3	2			2	2	2	1	2	2	3
2	3	3	2	3	2			2	2	2	1	2	2	3
3	3	3	2	3	2			2	2	2	1	2	2	3
4	3	3	2	3	2			2	2	2	1	2	2	3
5	3	3	2	3	2			2	2	2	1	2	2	3
6	3	3	2	3	2			2	2	2	1	2	2	2

Total: 0 Hours

18HS201 COMMUNICATIVE ENGLISH II **1 0 2 2**

Course Objectives

- Read and understand ideas of complex text on both concrete and abstract topics
- Listen and understand technical discussions in his/her field of specialisation
- Produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options
- Interact with a degree of fluency and spontaneity that makes regular interaction without strain

Programme Outcomes (POs)

PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Use appropriate grammar and vocabulary that is expected at the BEC Vantage exam level.
2. Understand the general meaning of non-routine letters, and of a report of predictable / unpredictable topic.
3. Write simple reports of factual nature and factual non-routine letters.
4. Ask for factual information and understand the answer; and take/pass on workplace messages
5. Express opinions and present arguments to a limited extent; and give simple, prepared presentations on familiar topics.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2									2					
3									3					
4										1				
5										2				

UNIT I **9 Hours**

GRAMMAR3

Tenses - Future continuous, Future perfect, Future perfect continuous, Past perfect, Past perfect continuous - Adjectives and adverbs - Mixed conditionals - Modals - can't have, needn't have - Modals of deduction and speculation - Narrative tenses - Passives - Phrasal verbs, extended - Relative clauses - Reported speech - Will and going to, for prediction - Wish - Would expressing habits, in the past.

UNIT II **9 Hours**

READING

Scanning and reading for gist - Understanding text structure - Reading for gist and specific information - Vocabulary and structure - Understanding sentence structure and error identification

UNIT III **9 Hours**

WRITING

A message, memo or email, Giving instructions, explaining a development, asking for comments, requesting information, agreeing to requests - Business correspondence: explaining, apologising, reassuring, complaining, short report: describing, summarising - proposal: describing, summarising, recommending, persuading.

UNIT IV **9 Hours**

LISTENING

Listening for and noting specific information - Listening to identify topic, context, Function - Following the main points and retrieving specific information from the text.

UNIT V **9 Hours**

SPEAKING

Giving personal information: Talking about present circumstances, past experiences and future plans, expressing opinions, speculating - Organising a larger unit of discourse: Giving information and expressing and justifying opinions - Turn-taking: negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing/disagreeing, suggesting, speculating, comparing and contrasting, and decision- aking. 1.A Horse and Two Goats - R K Narayan 2.My Lord the Baby - Rabindranath Tagore 3.Twist in the Tale - Jeffery Archer.4.The Third and Final Continent - Jhumpa Lahiri. 5.The Gift of the Magi - O Henry

Total: 45 Hours

Reference(s)

1. Guy Brook-Hart, "BEC Vantage: Business Benchmark Upper-Intermediate- Student's Books" 1st Edition, Cambridge University Press, New Delhi, 2006.
2. Ian Wood, Paul Sanderson, Anne Williams with Marjorie Rosenberg, "Pass Cambridge BEC Vantage- Student's Book" 2nd Edition, Cengage Learning, New Delhi, 2014.
3. Michael Handford, Martin Lisboa, Almut Koester, Angela Pitt, "Business Advantage - Student's Book Upper-Intermediate" Cambridge University Press, New Delhi, 2014.
4. Cambridge Examinations Publishing, "Cambridge BEC VANTAGE - Self-study Edition", Cambridge University Press, UK, 2005.

18HSH01 HINDI **1 0 2 2**

Course Objectives

- To help students acquire the basics of Hindi.
- To teach them how to converse in Hindi on simple day-to-day situations.
- To help students acquire the ability to understand a simple technical text in Hindi.

Programme Outcomes (POs)

PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

Course Outcomes (COs)

1. Construct simple sentences and use vocabulary required for day-to-day conversation.
2. Distinguish and understand the basic sounds of Hindi language.
3. Appear for Hindi examinations conducted by Dakshin Bharat Hindi Prachar Sabha.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3				
2									3	3				
3									3	3				

UNIT I **9 Hours**

Hindi Alphabet: Introduction - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu & Visarg -Table of Alphabet -Vocabulary.

UNIT II **9 Hours**

Nouns: Genders (Masculine & Feminine Nouns long vowels and short vowels - -Masculine & Feminine - Reading Exercises.

UNIT III **9 Hours**

Pronouns and Tenses: Categories of Pronouns - Personal Pronouns - Second person (you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense - Assertive & Negative Sentences - Interrogative Sentences.

UNIT IV **9 Hours**

Classified Vocabulary: Parts of body - Relatives - Spices - Eatables - Fruit & Vegetables - Clothes - Directions - Seasons - Professions.

UNIT V **9 Hours**

Speaking: Model Sentences and Rhymes - Speaking practice for various occasions.

Total: 45 Hours

Reference(s)

1. Hindi Prachar Vahini-1 by Dakshin Bharat Hindi Prachar Sabha Chennai.
2. B.R. Kishore, Self-Hindi Teacher for Non-Hindi Speaking People, Vee Kumar Publications(P)Ltd., New Delhi, 2009.
3. Videos, Stories, Rhymes and Songs.

18HSF01 FRENCH **1 0 2 2**

Course Objectives

- To prepare the students for DELF A1 Examination.
- To teach them to converse fluently in French in day-to-day scenarios.

Programme Outcomes (POs)

PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. To help students acquire familiarity in the French alphabet & basic vocabulary.
2. Listen and identify individual sounds of French.
3. Use basic sounds and words while speaking.
4. Read and understand short passages on familiar topics.
5. Understand and use basic grammar and appropriate vocabulary in completing language tasks.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3				
2									3	3				
3									3	3				
4									3	3				
5									3	3				

UNIT I **9 Hours**

ENTRER EN CONTACT

La langue francaise, alphabets, les numeros, les jours, les mois.| Grammaire Les verbes s appeler,etre, avoir, les articles definis, indefinis | Communication - Saluer, s informer sur quelquun, demander de se presenter | Lexique - Les alphabets, les nationalites, age, les pays, les couleurs, les jours de la semaine, les mois de l annee, les professions

UNIT II **9 Hours**

PARTAGER SON LIEU DE VIE

Les francais et leur habitat, des habitations insolites | Grammaire - Verbes - Conjugaison : Present (Avoir / etre / ER, IR, RE : Regulier et Irregulier) - Adjectifs les propositions de lieu | Communication - Chercher un logement, d ecrire son voisin, s informer sur un logement | Lexique - L habitat, les pieces, l equipement, la description physique

UNIT III **9 Hours**

VIVRE AU QUOTIDIEN

Grammaire - Articles contractes, verbes vouloir, pouvoir, devoir, adjective interrogative, future proche | Communication- Exprimer ses gouts, parler de ses loisirs, justifier un choix, exprimer une envie | Lexique - le temps libre et les loisirs, les saisons, les activites quotidiennes, le temps (le matin, le soir, la nuit)

UNIT IV **9 Hours**

COMPRENDRE SON ENVIRONNEMENT - OUVRIR - LA CULTURE

Grammaire - Verbes - Finir, Sortir, les adjectifs demonstratifs, le passe compose, l imparfait | Communication - Propose quelqu un de faire quelque chose, raconteur une sortie au passe parler un film | Lexique - Les sorties, la famille, art, les vetements et les accessoires

UNIT V **9 Hours**

GOUTER A LA CAMPAGNE

Grammaire La forme negative, les verbes acheter, manger, payer, articles partitifs, le pronom en de quantite | Communication Accepter et refuse rune invitation, donner des instructions, commander au restaurant | Lexique Les services et les commerces, les aliments, les ustensiles, argent

Total: 45 Hours

Reference(s)

1. Grammaire Progressive du Francais, CLE International, 2010.
2. Saison1, Marie Noelle Cocton et al, Didier, 2014.
3. Preparation a l examen du DELF A1 Hachette.
4. Reussir le DELF A1 Bruno Girardeau.
5. Website: Francais Linguaphone Linguaphone Institute Ltd., London, 2000.
6. Francais Harrisonburg: The Rosetta Stone: Fairfield Language Technologies, 2001.

18HSG01 GERMAN **1 0 2 2**

Course Objectives

- To help students appear for the A1 level Examination.
- To teach them how to converse fluently in German in day-to-day scenarios.

Programme Outcomes (POs)

PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Listen and identify individual sounds of German .
2. Use basic sounds and words while speaking.
3. Read and understand short passages on familiar topics.
4. Use basic sentence structures while writing.
5. Understand and use basic grammar and appropriate vocabulary in completing language tasks.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3				
2									3	3				
3									3	3				
4									3	3				
5									3	3				

UNIT I **9 Hours**

Introduction to German language: Alphabet - Numbers - Greetings - Days and Seasons- Working with Dictionary.

UNIT II **9 Hours**

Nouns - articles - Speaking about one self - Listening to CD supplied with the books, paying special attention to pronunciation

UNIT III **9 Hours**

Regular & Irregular verbs - Personal pronouns - family - Introduction to types of sentences.

UNIT IV **9 Hours**

Question words-Types of Questions - Nominative case- Verb Conjugation - country – nationalities.

UNIT V **9 Hours**

Verbs - to be & to have - conjugation - Hobbies - Framing basic Questions and answers.

Total: 45 Hours

Reference(s)

1. Kursbuch and Arbeitsbuch, NETZWERK A1 DEUTSCH ALS FREMDSPRACHE, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2015.
2. Langenscheidt Eurodictionary - German - English / English - German, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2009.
3. Grundkurs, DEUTSCH Lehrbuch Hueber Munichen, 2007.

18HSC01 CHINESE **1 0 2 2**

Course Objectives

- To help students appear for HSK Level 1 Exam
- To help students acquire the basics of Chinese language
- To teach the students how to converse in Chinese in various situations.

Programme Outcomes (POs)

PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Listen and identify individual sounds of Chinese
2. Use basic sounds and words while speaking
3. Read and understand short passages on familiar topics
4. Use basic sentence structures while writing
5. Understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3				
2									3	3				
3									3	3				
4									3	3				
5									3	3				

UNIT I **9 Hours**

Hello | 1. Initials and Finals of Chinese | b, p, m, f, d,,n,l,g,k,h,j,q,x | 2. Tones Four | 3. Chinese Syllables | 4. Tones.

UNIT II **9 Hours**

Thank you | Initials and Finals of Chinese | The Neutral Tone | Rules of Tone Marking and Abbreviation

UNIT III **9 Hours**

1. White's your name - In the school; -In the classroom; -In the school | The Interrogative Pronoun | 2 The Sentence | 3 Interrogative Sentences.

UNIT IV **9 Hours**

She is my Chinese teacher | In the library | The Interrogative Pronouns | The Structural Particle | The interrogative Particle

UNIT V **9 Hours**

Her daughter is 20 years old this year | 1. The Interrogative Pronoun | 2. Numbers below 100 | 3. Indicating a Change | The Interrogative Phrase.

Total: 45 Hours

18HSJ01 JAPANESE **1 0 2 2**

Course Objectives

- To train students for N5 Level Examination
- To teach them use basic Japanese sentences in day-to-day conversation
- To make students familiar with the Japanese cultural facets and social etiquettes

Programme Outcomes (POs)

PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Recognise and write Japanese alphabet.
2. Speak using basic sounds of the Japanese language.
3. Apply appropriate vocabulary needed for simple conversation in Japanese language.
4. Apply appropriate grammar to write and speak in Japanese language.
5. Comprehend the conversation and give correct meaning.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3				
2									3	3				
3									3	3				
4									3	3				
5									3	3				

UNIT I **9 Hours**

Introduction to Japanese - Japanese script- Pronunciation of Japanese (Hiragana)- (Katakana) Long vowels - Pronunciation of in,tsu,ga - Letters combined with ya,yu,yo - Daily Greetings and Expressions - Numerals. N1 wa N2 desu - N1 wa N2 ja arimasen - S ka N1 mo - N1 no N2 - san - Kore - Sore - Are - Kono N - Sono N - Ano N - Sou desu - Sou ja Arimasen - S1 ka - S2 ka - N1 no N2 - Sou desu ka - Koko - Soko - Asoko - Kochira - Sochira Achira - N1 wa N2 (place) desu - Doko - Dochira - N1 no N2 - Ko - So - A - Do (Demonstrative words) - O kuni Kanji10 - Technical Japanese Vocabulary (30 Numbers)

UNIT II **9 Hours**

Introduction to time - Ji - Fun - Pun - Introduction of verbs - V Masu - V Masen - V Mashita - V Masendeshita N (Time) Ni V - N1 Kara - N2 Made - N1 to N2 - S Ne - N (Place) e Ikimasu - Kimasu - Kaerimasu - Doko (e) Mo Ikimasen - Ikimasendeshita - N (Vechile) de Ikimasu - Kimasu - Kaerimasu - N (Person / Animal) to V - Itsu - S Yo N o (transitive) - N o Shimasu - Nani o Shimasuka - Nan and Nani - N (place) de V - V Masenka - V Mashou - o - Kanji 10 - Technical Japanese Vocabulary (30 Numbers) .

UNIT III **9 Hours**

N (tool/means) de V - Word/Sentence wa Go de Nani desu ka - N (person) Ni Agemasu, etc - N (person) Ni Moraimasu etc - Mou V Mashita - Introduction to Adjectives - N wa Na adj (Na) desu - N wa II adj (II) desu - Na adj Na n - II adj (II) N - Totemo - Amari - N wa Dou desuka - N1 wa Donna N2 desuka - S1 Ga S2 - Dore N ga Arimasu - Wakarimasu - N Ga Sukidesu - Kiraidesu - Jozu desu - Heta desu - Donna N - Yoku - Daitai - Takusan - Sukoshi - Amari - Zenzen - S1 kara S2 - Doushite - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

UNIT IV **9 Hours**

N ga Arimasu - Imasu - N1 (place) Ni N2 ga Arimasu - Imasu - N1 (thing/person/place) no N2 (position) - N1 ya N2 - Word (s) desuka - Chirisosu wa Arimasuka - Saying numbers - Quantifier (period) Ni kai V - Quantifier Dake - N dake - Past tense of Noun sentences and Na adjective sentences - Past tense of ii adjective sentences - N1 wa N2 yori adjective desu - N1 to N2 to dochira ga adjective desu ka - N1/N2 no houga adjective desu - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

UNIT V **9 Hours**

N ga hoshi desu - V masu form tai desu - N (place) e V masu form - N Ni - ikimasu - kimasu - kaerimasu N ni V - N o V - dou ko ka - nani ka - go chuu mon - Verb conjugation - Verb groups - Verb te form - V te form kudasai - V te form imasu - V masu from mashouka - S1 ga S2 - N ga V - V te form mo ii desu - V te form wa ikemasen - V te form imasu Shrimasen - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

Total: 45 Hours

Reference(s)

1. Minna no Nihongo Japanese for Everyone Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.
2. Minna no Nihongo Japanese for Everyone Elementary Main Textbook 1-2 Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

21TT001 LONG STAPLE SPINNING TECHNOLOGY 3 0 0 3

Course Objectives

- To understand the properties of long staple fibres.
- To analyse constructional and operational features of long staple spinning machinery.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

1. Classify long staple fibres and select the process sequence for yarn production.
2. Outline carding, gilling and combing processes for long staple yarn production.
3. Evaluate roving and yarn formation processes for long staple yarn production.
4. Assess properties of manmade fibres to be blended with long staple natural fibres.
5. Select process and quality control tools to produce acceptable yarn quality in long staple spinning systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		1										2	
2	2		1										2	
3	2		1										2	
4	2		1										2	
5	2		1										2	

UNIT I **9 Hours**

LONG STAPLE FIBERS

Wool: Properties - Sorting and grading systems - Impurities in wool fibres - Composition of wool fibres - Scouring and carbonizing - Reclaimed wool fibres. Silk fibres - Staple fibre conversion. Bast fibres: Flax - Types - Retting - Fibre extraction.

UNIT II **9 Hours**

CARDING, COMBING AND GILLING

Carding: Requirements - Breaker and finisher carding - Difference between woollen and worsted carding - Condensers. Combing: Types of combers - nip, noble and rectilinear combers - Process variables - Grey combing - Re-combing - Noils. Drawing: Gilling - Open gill - Intersecting gill (screw and chain) - Drafting assembly - Fallers - Drafting rollers - Condensing and Coiling. Oiling of wool fibres: Need - Composition - Application methods - Creel - Delivery spray.

UNIT III **9 Hours**

ROVING AND YARN FORMATION

Speed frame: Drafting assembly - Top roller weighting system - Draft - Suspended flyers - Twist multipliers. Rubbing frame: Factors influencing process: Drafting assembly - Rubbing system - False twisting assembly - Delivery systems: Cans and Tubes. Ring spinning: Features - Draft rollers - Drafting systems - Slip draft - Process variables - Ring and Traveller Specifications - Ring profile: External lubrication of rings - Twistless yarn - Siro-spinning system for two-fold yarn production. Compact Spinning of worsted yarns

UNIT IV **9 Hours**

PROCESSING OF BLENDS AND STRETCH YARNS

Binary blends: Requirements of polyester for wool blending - Polyester/ Wool blends - Polyester / Acrylic blends. Ternary blends: Polyester / Wool / Nylon blends - Polyester / Wool / Flax - Polyester / Wool / Silk blends. Processing of dyed fibres and their blends: Top dyeing - polychromatic printing and blending. Stretch yarns in worsted spinning: Methods - Core yarn process - Siro spinning: Assembly winding - Twisting.

UNIT V **9 Hours**

PROCESS AND QUALITY CONTROL

Assessment of ex tractable and vegetable impurities - Moisture regain and invoice weight. Fibre length distribution (length and weight basis) - Crimp measurement. Fineness of wool fibres - Scouring yield - Worsted spinning: Faller pin specifications - Selection of fallers in open and intersect type gill boxes. Humidity and moisture regain control in drawing. Steaming: Control parameters and their influences. Hairiness: Causes and remedies. Process control in woollen, flax, jute spinning.

Total: 45 Hours

Reference(s)

1. Woollen and Worsted Spinning, Abhishek Publications, Chandigarh, 2002.
2. W.S. Simpson and G H Crawshaw Wool: Science and Technology, Woodhead Publishing Ltd, 2002.
3. W. V. Bergen, Wool Handbook, Vol. I, II, Inter science Publication, New York.

21TT002/21TTH09 TEXTURING TECHNOLOGY 3 0 0 3

Course Objectives

- To understand texturing technology and textured yarn.
- To prepare technological solutions for the challenges in the area of texturing.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

1. Select texturing technique based on the raw materials and end-uses.
2. Outline process parameters and the structure of false-twist textured yarn.
3. Outline process parameters and the structure of air jet textured yarn.
4. Outline process parameters and the structure of BCF textured yarn.
5. Appraise chemo-mechanical and thermo-mechanical method of texturing yarns.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2										3	
2	2		2										3	
3	2		2										3	
4	2		2										3	
5	2		2										3	

UNIT I **9 Hours**

CONCEPTS OF TEXTURING

Purpose, Types of textured yarns, Classification of process, Comparison of textured with other types of yarns and fabrics, suitability of POY, LOY and UDY for texturing, Role of spin finish on textured yarns.

UNIT II **9 Hours**

FALSE TWIST TEXTURING

Basics of false-twist texturing, machine variables, process variables, Draw texturing, simultaneous and sequential draw texturing - Twisting devices. Structure and properties of FT textured yarns.
Applications of false-twist textured yarns

UNIT III **9 Hours**

AIR JET TEXTURING

Basics of air jet texturing, types of yarns produced, machine variables, process variables, Air texturing jet, structure and properties of Air jet textured yarns. Applications of air-jet textured yarns.

UNIT IV **9 Hours**

BCF PROCESS

Basics of BCF Process, BCF Draw texturing machine, machine parameters, process variables, structure and properties of BCF textured yarns. Applications of BCF textured yarns

UNIT V **9 Hours**

OTHER METHODS OF TEXTURING

Stuffer box and edge crimping methods: Principles, limitations and applications. Knit-de-knit and gear crimping methods, texturing of polypropylene, Chemo-mechanical and thermo-mechanical texturing. Testing of Textured Yarns: Measurement of shrinkage force, Crimp contraction - dye uniformity

Total: 45 Hours

Reference(s)

1. J.W.S. Hearle, L. Hollick and D.K. Wilson, Yarn Texturing Technology, Woodhead Publishing, UK, 1998.
2. L. Hes and P. Ursing, Yarn Texturing Technology, Eurotex, Universidade do Minho, 1994.
3. Hassan Mohamed Behery Ali Demir, Synthetic Filament Yarn: Texturing Technology, Prentice Hall, 1997.
4. R. S. Gandhi, Textured yarns, MANTRA, 1998.
5. D. K. Wilson and T. Kollu, The Production of Textured Yarns by the False Twist Technique, Textile Progress, Vol. 21, No.3, Textile Institute, Manchester, U.K., 1991.

21TT003 THEORY OF SPINNING 3 0 0 3

Course Objectives

- To teach the underlying theoretical principles of various processes that take place during spinning.
- To impart knowledge on the mechanisms of yarn formation
- To instill an attitude for fundamental research in spinning technology.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

1. Analyse requirements of blending to optimize spun yarn quality.
2. Outline opening, cleaning and carding actions used in spinning line.
3. Justify the need of doubling and drafting to improve yarn quality.
4. Evaluate fibre properties and process parameters for control of yarn quality
5. Analyse fibre properties and material flow to control evenness and hairiness of yarns.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1		1								2	
2	2	1	1		1								2	
3	2	1	1		1								2	
4	2	1	1		1								2	
5	2	1	1		1								2	

UNIT I **9 Hours**

BLENDING

Blending requirements, Principles, Blending delay time, Blend proportion, Perfect blend, Blending deficiencies, Optimum blending. Mixing: Optimization, linear programming, goal programming, Index of blend irregularity.

UNIT II **9 Hours**

OPENING, CLEANING AND CARDING

Intensity of opening. Opening and cleaning principles: tearing, picking, plucking, beating, combing, tossing. Degree of cleaning, carding and doffing disposition, Centrifugal forces. Action between feed roller and Licker-in, three licker-in theory, main cylinder and flats wide-width theory, Fibre transfer, mechanism of elimination of neps

UNIT III **9 Hours**

DOUBLING AND DRAFTING

Principle, Perfect draft, Actual draft, Law of Doubling, Addition of irregularity, Roller Drafting, Apron drafting, Drafting by opening roller. Periodic variations, Roller nip movements, Roller speed variation, stick-slip curve. Drafting force, Piecing irregularity in combing

UNIT IV **9 Hours**

YARN FORMATION

Mechanism of twist, Fibre migration phenomena: Obliquity, coherence curve. Twist insertion techniques: False, Flyer, Ring and traveller twisting, up twisting - down twisting - Cabling. Open-end, Self-twisting, balancing of twist. Roving bobbin and cop build Tension variation. Traveller lag. Balloon Theory.

UNIT V **9 Hours**

EVENNESS

Random fibre distribution. Feed and regulation: blowroom, carding, Chute feed system, draw frame, comber, roving, yarn regularity. Hairiness.

Total: 45 Hours

Reference(s)

1. R. Chattopadhyay, Advances in Technology of Yarn Production, NCUTE Publication, New Delhi, 2002.
2. Carl Lawrence, Fundamentals of Spun Yarn Technology, CRC Press limited, U.K., 2003.
3. K. Slater, Yarn Evenness, Textile Progress, The Textile Institute, Manchester, U.K., 1986.
4. W. Klein, The Technology of Short Staple Spinning, Vol. I, V, The Textile Institute, 2010.
5. Anindhaya Ghosh and R. S. Rengasamy, Predictive Model for Strength of Spun Yarns: An Over View, Autex Research Journal, March 2005.

21TT004/21TTH07 HIGH PERFORMANCE FIBERS 3 0 0 3

Course Objectives

- To understand the structure and manufacturing methods for high performance fibres.
- To understand the physical and chemical properties of high-performance fibres.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Compare and contrast HP fibres with apparel grade fibres in terms of structure and properties.
2. Outline the structure, properties and manufacturing methods of non-polymeric fibres.
3. Outline the structure, properties and manufacturing methods of inorganic fibres.
4. Compare manufacturing methods of polymeric high technology fibres.
5. Evaluate the properties of chemical and thermal resistance fibres.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3	1						-		3	-	
2	3	2		1						-		3	-	
3	3	2	3	1						-		3	-	
4	3	2	3	1						-		3	-	
5	3	2	3		2					1		3	2	3

UNIT I **9 Hours**

STRUCTURE AND PROPERTIES

Limitations of conventional fibres. Classifications of high-performance fibres and applications. Structure and properties of high-performance fibres: Micro and fine structural features. Physical properties: tensile, compression and bending properties, fracture morphology.

UNIT II **9 Hours**

NON-POLYMERIC FIBRES

Carbon fibres: Classification, conversion of precursors to carbon fibres: PAN, rayon and pitch-based carbon fibres. Structural aspects of PAN based and pitch-based carbon fibres. Glass fibres: Types and compositions, Manufacturing processes, fibre structure, properties, applications.

UNIT III **9 Hours**

INORGANIC FIBRES

Ceramic fibres, Classification of silicon carbide fibres. Aluminium Oxide fibres, Compositions of Aluminium Oxide fibres. Manufacturing process, Fibre structure, properties, applications. Lead fibres, preparation of Lead fibre, Structure and properties of lead fibres, applications, Radiation Shielding Materials.

UNIT IV **9 Hours**

POLYMERIC HIGH-PERFORMANCE FIBRES

Aramids: spinning, structure and properties, liquid crystal structure, applications. Comparison of para and meta-aramids. Gel spun high performance PE fibres: difference between HMPE, UHMWPE and other polyethylene fibres, manufacturing and applications.

UNIT V **9 Hours**

CHEMICAL AND THERMAL RESISTANT FIBRES

Need for chemically and thermally resistant fibres. Chlorinated and fluorinated fibres: manufacturing and properties. Thermally resistant fibres: additives, types of additives and concentration. PEK, PEEK, PPS, PEI, PBI fibres, structure and properties, fibre formation and applications.

Total: 45 Hours

Reference(s)

1. J. W. S. Hearle, High Performance Fibres, Woodhead Publishing Ltd., 2001.
2. S. K. Mukhopadyay, High Performance Fibres, Textile Progress Vol. 25, The Textile Institute, Manchester, 1993.
3. Menachem Lewin, Jack Preston, High Technology Fibres, Part A, B, C, Mercel Dekkar Inc, 1993.

21TT005 THEORY OF WEAVING 3 0 0 3

Course Objectives

- To acquire the fundamental understanding of weaving motion.
- To develop an attitude to carry out fundamental research in weaving technology.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO11.Project Management and Finance: 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.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Analyse principles of shedding motions and shedding operations in a loom.
2. Appraise picking motions from the perspectives of design and operations.
3. Discuss the critical components involved in beat-up mechanism.
4. Appraise projectile and rapier looms from design and operation perspectives.
5. Evaluate air-jet, water jet and multi-phase looms for design and operations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3		3		2						1		3	2
2	3		3		2						1		3	2
3	3		3		2						1		3	2
4	3		3		2						1		3	2
5	3		3		2						1		3	2

UNIT I **9 Hours**

THEORY OF SHEDDING

Geometry of warp shed -Types of shed, Characteristics of different sheds, Design of cams, Design of heald reversing motion. Matched cam shedding, Factors that limits the size of repeat, Mechanics of dobby shedding, Lever, Cam dobby. Electronic dobby - Geometry of Jacquard shedding. Fine Pitch Jacquard.

UNIT II **9 Hours**

THEORY OF PICKING

Dynamics of shuttle movement in the shuttle box, Elastic properties of the picking mechanism, Retardation of shuttle, Rest position of shuttle, Shuttle flight.

UNIT III **9 Hours**

MECHANICS OF BEAT UP

Types of Beat-up mechanisms - 4 link and 6 link beat up - Cam beat up - Sley speed and acceleration - Beat up theory - Beat up time. Sley eccentricity and its effects - Dwell period - Warp and cloth control: Bumping conditions - disturbed weaving conditions - causes for variation in pick spacing Weft Measurement; Weft accumulation systems - Pick length measurement - Weft tensioning - Weft unwinding for individual pick.

UNIT IV **9 Hours**

WEFT INSERTION - PROJECTILE AND RAPIER

Weft velocity in shuttleless looms, Rate of weft insertion, Weft insertion cycle, Projectile flight through the warp. Types of Rapier weaving machines, Weft insertion in loop form, Tip transfer system, Rapier guide control in the warp sheet, Rapier speeds

UNIT V **9 Hours**

WEFT INSERTION - AIR JET, WATER JET, MULTI PHASE

Air jet loom =Jet guides - Design concepts of air jet picking - Theory of air jet picking - Timing diagram - Weft motion through the shed - relay nozzles - Textile dust remover. Water jet loom - Tractive force in the weft thread - Jet and weft thread velocity - Braking of the weft thread - Timing diagram for weft insertion. Multiphase weaving: Technological problems in multiphase weaving

Total: 45 Hours

Reference(s)

1. R. Marks, T. C. Robinson, Principles of Weaving, Textile Institute, Manchester, 1989.
2. Sabit Adanur, Handbook of Weaving, Technomic publishing company Inc., USA, 2001.
3. M. K. Talukdar, P. K. Sriramulu and D. B. Ajgaonkar, Weaving Machines, Mechanisms, Management, Mahajan Publishers Pvt. Ltd., 2004.
4. P. R. Lord and M. H. Mohamed, Conversion of Yarn to Fabric, Woodhead Publishing Limited, 1992.

21TT006 CLOTHING SCIENCE 3 0 0 3

Course Objectives

- To acquire knowledge of textiles from the perspective of human-clothing interface.
- To acquire knowledge on the effects of fibre, yarn, fabrics on garment appearance, comfort, durability, protection and care.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Select the transmission characteristics for the development of end-use specific garments.
2. Apply transformation characteristics of textiles to produce functional and aesthetic textiles.
3. Determine fabric hand, fit and size parameters for clothing comfort.
4. Choose component and materials for apparels based on the principles of clothing science
5. Develop apparels for specific end uses.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1											1
2	1	1	1											2
3	1	2	2											2
4	1	1	2											3
5	1	2	2											2

UNIT I **9 Hours**

TRANSMISSION CHARACTERISTICS

Air permeability - Heat transmission - Thermal resistance - Light permeability - Water permeability - Moisture transmission - wicking characteristics - Radioactivity transmission.

UNIT II **9 Hours**

TRANSFORMATION CHARACTERISTICS

Crease resistance and recovery - Crock resistance - Dimensional stability - Hygral expansion - Relaxation shrinkage - Swelling shrinkage and felting shrinkage. Pilling - Scorching and Soiling - Flame retardancy - Fusing and Mildew resistance

UNIT III **9 Hours**

FABRIC HANDLE AND COMFORT

Bending - Compression- Tensile - Shear - surface friction - Bias extension - Formability - Tailorability - Objective evaluation of fabric handle by KES and FAST Fabric parameters and its influence on fabric comfort. Garment fit and size on comfort.

UNIT IV **9 Hours**

AESTHETICS

Subjective and objective evaluation: Drape - Colour, colour fastness - Shade variation and measurement. Design Logic of Apparel Product. Classification of textile products, Components and Materials - Specification and Properties of textile products - Selection of constituent fibres and yarns - Selection of constituent fabrics and apparels

UNIT V **9 Hours**

DEVELOPMENT OF APPARELS FOR SPECIFIC END USE

Fit analysis for various end uses: Winter - summer wear - innerwear - Sports - Casual - Swim wear. Protective wear; Ballistic protection - UV protection - Functional and quality requirements.

Total: 45 Hours

Reference(s)

1. D. R. Buchanan, The Science of Clothing Comfort, Textile Progress, Vol.31, No.1/2, 1999.
2. K. Slater, Comfort Properties of Textiles, The Textile Institute, Manchester, Vol. 9, No.4, 1997.
3. Pradip V. Metha, An Introduction to Quality Control for the Apparel Industry, ASQC Quality Press, Marcel Dekker Inc New York, 1992.
4. R. Ed Postle, S. Kawabata and M. Niwa, Objective Evaluation of Fabrics, Textile Machinery Society, Japan, Osaka, 1983.
5. Miller, Textiles: Properties and Behaviours in Clothing Use, The Textile Institute, 1998.

21TT007 MECHANICS OF TEXTILE MACHINES 3 0 0 3

Course Objectives

- To understand the principles of Mechanics as applied to Textile Machinery.
- To apply mechanics for design of Textile Mechanisms.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

1. Select power transmission systems for textile machinery.
2. Suggest the types and use of epicyclical gear trains in textile machinery.
3. Design cone-drum based speed control systems and cams/tappets used in textile machinery.
4. Analyse energy and power requirements of textile machine sub-systems.
5. Analyse stress levels in power transmission elements and control systems in textile machinery.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2											2	
2	1	1											2	
3	1	2											2	
4	1	1											2	
5	1	2											2	

UNIT I **9 Hours**

POWER TRANSMISSION

Selection of drives. Flexible drives: Belts - Types, analysis of belt tension, optimum belt velocity for maximum power transmission, contact angles and belt length. Rigid Drives: Gear trains Types, nomenclature, velocity ratio of normal gear trains, force analysis in gear drives. Bearing- Types.

UNIT II **9 Hours**

DIFFERENTIAL GEARING

Types, nomenclature, velocity ratio of epicyclic gear trains, force analysis in gear drives. Differential Gearing in Speed Frame and Comber.

UNIT III **9 Hours**

DESIGN OF CONE DRUMS AND CAMS

Design perspectives. Construction of cone drums, Feed regulation in scutcher and builder motion in Speed Frame. Construction of cams - Ring frame builder motion, tappet shedding motion.

UNIT IV **9 Hours**

MOMENTS, KINETIC / POTENTIAL ENERGY, POWER CONSUMPTION

Calendar roller loading, top arm loading, shuttle movement, bale lifting, power consumption by ring frame traveller and picking process.

UNIT V **9 Hours**

STRESSES IN TRANSMISSION SHAFTS AND DRAFTING ROLLERS

Material properties, safety factor, tensile, compressive, shear, bending and torsional stresses. Laws of friction. Application of friction, Tension devices, negative let-off motions, brakes and clutches. Brakes -Band, block, pivoted double block, internal expanding brake. Clutches - Jaw / Toothed, Friction Clutches, Single Plane, Multi Plane, Cone Clutches. Centrifugal clutch

Total: 45 Hours

Reference(s)

1. Rengasamy R S, Mechanics of Spinning Machines, NCUTE, New Delhi, 2002.
2. Slater K, Textile Mechanics, Vol. I, Textile Institute, Manchester, 1977.
3. Slater K, Textile Mechanics, Vol. II Textile Institute, Manchester, 1987.
4. Booth J E, Textile Mathematics, Vol. II, Textile Institute, Manchester, 1977.

21TT008 MAINTENANCE MANAGEMENT 3 0 0 3

Course Objectives

- To impart the knowledge in settings and maintenance schedule for various machinery in textile mills.
- To teach the activities in the machinery audit.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO9.Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

1. Prepare maintenance schedules for various textile machines.
2. Develop procedures involved in maintaining textile machines.
3. Analyse the performance of machines in terms of efficiency.
4. Select appropriate lubricants for various machine parts.
5. Appraise the activities involved in maintenance records.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2		2				2				1	
2	2	1	2		2				2				1	
3	1	1	3		2				2				1	
4		1	2		2				2				1	
5	2	2			2				2				1	

UNIT I **9 Hours**

CONCEPTS

Maintenance: Objectives - Types - Organizational structure - Duties - personnel. Systems and procedures: Planning - Scheduling - Controlling - Implementation of planned maintenance - Backlogs - Rescheduling. Housekeeping - Cleanliness - Machinery Audit. Maintenance Records: Maintenance Ledger - Machine cards - Maintenance cost control. Safety: Accidents - Causes and prevention - safety in material handling, maintenance.

UNIT II **9 Hours**

SPINNING PREPARATION

Maintenance schedules - Frequency - manpower - Time required - Special tools - Gauges. Maintenance of Card Clothing: Wire inspection - Grinding procedure - Burnishing - Flat end milling - Aprons - Flyer - Bottom roller - Top roller - Cots: selection - mounting - Buffing frequency - Grinding - Berkolising - Acid treatment - Cot life - Top roller greasing

UNIT III **9 Hours**

SPINNING AND POST SPINNING

Maintenance schedules - Frequency - manpower - Time required - Special tools - Gauges. Roller Eccentricity and its control - Tolerances for drafting rollers. Maintenance schedules: Cone winding - Reeling - Bundling Baling. Lubrication: Spindle oil topping - Replenishing.

UNIT IV **9 Hours**

WEAVING

Maintenance schedules for cone winding - pirn winding - warping - sizing - auto and non-auto weaving machines. Weaving machinery layout - material handling and equipment. Weaving machinery audit

UNIT V **9 Hours**

WEAVING ACCESSORIES MAINTENANCE

Shuttle care - selection - seasoning - life of shuttle. Maintenance of reed. Drop wires maintenance. Maintenance of picker - picking bands - healds - heald frames - pirns - shuttleless loom accessories. Maintenance of Utilities: Maintenance of Powerhouse: Electrical powerhouse - equipment - motors - starters - lighting. Humidification plant - compressors - air lines - generators.

Total: 45 Hours

Reference(s)

1. T. V. Ratnam, Maintenance Management in Spinning, SITRA, Coimbatore, 2009.
2. K. Balasubramanyan, J. S. Manoharan, Maintenance Management in Weaving, SITRA, Coimbatore, 2008.
3. Neeraj Nijhawan, Comprehensive Handbook of Spinning Maintenance, Part 1: Maintenance Management, The Textile Association, Mumbai, India, 2006.
4. Neeraj Nijhawan, Comprehensive Handbook of Spinning Maintenance, Part 2: Spinning Accessories, The Textile Association, Mumbai, India, 2006.
5. Neeraj Nijhawan, Comprehensive Handbook of Spinning Maintenance, Part 3: General Engineering, The Textile Association, Mumbai, India, 2006.
6. T. R. Banga, N. K. Agarwal and S. C. Sharma, Industrial Engineering and Management, Khanna Publishers, Chennai, 1995.

21TT009 MANAGERIAL PRACTICES IN TEXTILE INDUSTRIES

3 0 0 3

Course Objectives

- To impart knowledge on the fundamental principles of management as applied to the textile industry.
- To educate the students on the interaction of government and society with the textile industry and its effect and their management.

Programme Outcomes (POs)

PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

1. Characterize the different sectors of textile industry and their role in the economy
2. Assess contribution of various sectors of textile industry to nation's economy
3. Critique the efforts taken by the Government of India for the growth of Indian Textile Industry
4. Plan for the utilities in the various sectors of textile Industry
5. Use personnel management principles in textile industry

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1													3	
2													2	
3							3						3	
4		2											2	
5						2	2	2					3	

UNIT I **9 Hours**

TEXTILE INDUSTRY

Global scenario, Indian textile Industry, Indian Textile Policy, Trade policy, Fiscal policy, NTC, STC, Textile committee, National Hand loom Development Corporation, Mills association, Research Institutions, Technical Textile Units, Current five-year Plan: Targets and achievements; statistics on global and national fibre, yarn and fabric production, consumption, exports and imports.

UNIT II **9 Hours**

CENTRAL AND STATE GOVERNMENT SCHEMES

Technology Up-gradation Fund Scheme (TUFS), Textile Workers Rehabilitation Fund Scheme, Group Work Shed Scheme, Comprehensive Power loom Cluster Development Scheme, Group Insurance scheme, Scheme for Integrated Textile Parks, Hank Yarn Obligation (HYO); Yarn Bank Scheme. Technology Missions for Technical textiles. Centres of Excellence

UNIT III **9 Hours**

MILL ORGANIZATION AND PLANNING

Organizational Structure and Functioning of Centralized and Decentralized Sectors: Spinning, Weaving, Composite mill, Chemical processing Units. ERP, MIS, Cotton Purchase Practices, Inventory control, Spin plan, Weave plan, Product costing, Managerial responsibilities. Selection of site for textile mills, Various types of buildings. Upgradation of plant and production equipment, Capital investment proposals and feasibility.

UNIT IV **9 Hours**

UTILITIES

Power requirements for spinning, weaving, Knitting and Garment machinery, Amenities required, Ventilation, Humidification systems, RH and temperature of various departments. Lighting types, Intensity requirements

UNIT V **9 Hours**

PERSONNEL AND MARKETING MANAGEMENT

Planning, Selection, Training, Welfare safety, Factory act, Industrial dispute act, Trade union act, Bonus act, ESI, wage structure in textiles and apparel industry, Categories of operatives in textile mills, HOK, OHS. Labour handling techniques. Marketing channel, Physical distribution, Roles and responsibility of personal department in a textile industry.

Total: 45 Hours

Reference(s)

1. V. D. Dudeja, Management of Textile Industry, Textile Trade Press, Ahmedabad 1990.
2. A. Ormerod, Textile Product Management, The Textile Institute, Manchester 1992.
3. Handbook of Import and Export Procedures, Textile Commissioner Office Reports, Government of India, Ministry of Textiles, Government of India Publications (2005, 2010).

21TT010 UTILITIES ENGINEERING 3 0 0 3

Course Objectives

- To familiarize with fundamentals of utilities engineering.
- To understand the operational aspects of utilities in textile mills.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO11.Project Management and Finance: 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.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Appraise elements and operations of Air Engineering in a Textile Industry context.
2. Analyse electrical layout design, selection of cables, power billing and power management.
3. Assess the requirements of back-up power, size DG Sets and prepare maintenance schedules.
4. Assess water quality needs of industries, understand the methods of Primary, Secondary and Tertiary effluent treatment.
5. Select boilers, air compressors and safety equipment for a factory environment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1		2								2	3	1	2
2	1	1	2								2	3	1	2
3	1	1	2									2	1	2
4	1	1	2								1	2	1	2
5	1	1	2	2		1						3		2

UNIT I **9 Hours**

ELECTRICAL POWER

Transformers: Types - Indoor - Outdoor - Dry - Oil filled. OLTC (on load tap changer). Sizing the capacity of transformers. Power Distribution and wiring. Stabilizers. Power factor management. Power Back Up systems. Solar energy. Electrical Safety. Lightning arrestors.

UNIT II **9 Hours**

MOTORS, GENSETS AND COMPRESSORS

Electrical Motors: Types- Characteristics- Selection. Electrical Generators: Types, Selection- Change over systems. Typical Spinning mill Power bill analysis. Compressors & pneumatic systems: Types of compressors: Reciprocating - Screw- Oil free - Centrifugal - Efficiency of each type. Storage and distribution: Air vessels - air lines - valves and controls - Leakage. Driers: Dew Point. Types; Air requirements. Pneumatic Circuits. Compressors and additional devices for modern machines: MVS and air jet looms. Sizing of Compressors and cost of compressed air in spinning mills

UNIT III **9 Hours**

AIR ENGINEERING

Humidification: Need for Humidification - Supply air - measurement of required Air changes - Motor Power - CFM output. Air washer plants: Nozzles system- Fog system- Eliminators and Louvers- Exhaust Air- measurement of required air changes - Water quality - Diffuser material - Duct material - Air filters. Sizing of Humidification plant and heat load. Operational aspects of Humidification plants in a textile mill

UNIT IV **9 Hours**

WATER TREATMENT SYSTEMS

Water Quality: Standards. Water Softening plants: Need for softening the water - methods of softening -cost of softening. Effluent Treatment: Primary, Secondary and Tertiary treatment. Filters: Sand filter - Activated Carbon - Ultra-filtration. Reverse Osmosis Plants: RO membranes - pH neutralizer - efficiency of RO plants. Categories and usage of water. Cooling water systems.

UNIT V **9 Hours**

OTHER UTILITIES

Boilers: Need for steam - Boiler types- Controls - Sizing. Chilling plants and heat-exchangers. Transport and Material handling. Energy saving measures.

Total: 45 Hours

Reference(s)

1. SITRA norms for spinning mills, The South India Textile Research Association, Coimbatore. 2004.

21TT011/21TTH08 INDUSTRIAL ENGINEERING 3 0 0 3

Course Objectives

- To impart the fundamental principles of Industrial Engineering as applied to textile field
- To make the students familiar with the techniques of work study with practical textile examples

Programme Outcomes (POs)

PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11.Project Management and Finance: 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.

PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

PSO2. Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Suggest remedial actions for low productivity.
2. Analyse work assignments by work and method study.
3. Deduce measures to improve labour productivity by conducting motion study and time study.
4. Develop alternative layouts by studying existing layout and constraints.
5. Analyse difficulties in existing material handling methods and ambience; suggest modifications to improve labour productivity.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1			2	2		2		1		2	2	3	3	1
2			2	3		2		1		2	2	3	3	2
3			2	3		2		1		2	2	2	3	2
4		2	2	2							1	3	3	
5		2	2			3	1				1	3	3	1

UNIT I **9 Hours**

PRODUCTIVITY

Scope of Industrial Engineering. Industrial engineering concepts. Productivity indices. Workloads: work assignments - Work content - added work content - reduction of work content - ineffective time - improving productivity - causes for low productivity in Spinning, Weaving, Wet Processing and Garment industries.

UNIT II **9 Hours**

WORK AND METHOD STUDY

Work Study: Definition - Purpose - Techniques of work study - Procedure for work study Method Study: Definition - Procedure. Process charts: Symbols - Process Sequence chart - Outline process chart - Flow process charts (man type, material type, equipment type) - Charts using time scale - multiple activity charts. Diagrams: string diagram - cycle graph - chrono-cycle graph - travel chart. Textile and Garment industry examples

UNIT III **9 Hours**

MOTION AND TIME STUDY

Motion Study: Operation analysis - motion analysis - motion economy - two handed process chart - micro motion study - Therbligs - SIMO chart. Textile and Garment industry examples. Time Study: Procedure - Equipment. Techniques of time study - Stop watch method. Predetermined Motion Time Standards (PMTS) - Rating. Allowances: Standard Time - Standard data. Textile and Garment industry case studies.

UNIT IV **9 Hours**

FACTORY LAYOUTS

Layout: Layout planning. Types of layouts: Process, Product, Combination and Fixed. Line Balancing: Line Balancing Objectives - Procedure - Techniques. Applications in Textile and Garment units.

UNIT V **9 Hours**

MATERIAL HANDLING AND WORK ENVIRONMENT

Material Handling: Objectives - principles of material handling - relationship of material handling to plant lay-out material handling equipment - Descriptions and characteristics - Specialized material handling equipment for Textile and garment units. Work Environment and Services: Lighting - Ventilation - Temperature Control and Humidity Control - Noise Control - Safety - Ergonomics.

Total: 45 Hours

Reference(s)

1. O. P. Khanna, Industrial Engineering and Management, Dhanpat Rai Publications (P) Ltd., New Delhi, 2004.
2. Johnson Maurice, Introduction to Work Study, International Labour Organization, Geneva, 1995.
3. Jacob Solinger, Apparel Manufacturing Hand Book-Analysis, Principles and Practice, Boblin Media Corp, Columbia, 1991.
4. James M. Apple, Plant Layout and Materials Handling, John Wiley & Sons, 1997.
5. Ralph M. Barnes, Motion and Time Study Design and Measurement of Work, John Wiley & Sons, New York, 1992.
6. A. J. Chuter, Introduction to Clothing Production Management, Blackwell Publishing, Oxford, 2004.

21TT012 PROCESS CONTROL IN SPINNING AND WEAVING

3 0 0 3

Course Objectives

- Select suitable raw material and machinery set-up for the manufacturing of the yarn and fabrics with required quality.
- Outline the parameters for the satisfactory performance of various intermediate processes involved in spinning and weaving.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

1. Select suitable raw materials for the manufacturing of the yarn with required quality.
2. Choose the machinery and process parameters for manufacturing of yarn with required quality and propose measures for trouble shooting in spinning process.
3. Select the machinery and process parameters for the manufacturing of fabrics with required quality.
4. Choose the parameters for manufacturing of fabric with required quality and remedial measures for trouble shooting in weaving process.
5. Identify parameters for satisfactory performance of intermediate processes in spinning and weaving.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2			2								2	
2	1	2			3								3	
3	1	2			1								3	
4	1	2			2								2	
5	1	2			2								3	

UNIT I **9 Hours**

RAW MATERIALS AND SPINNING PREPARATORY PROCESSES

Cotton Mixing quality - Fibre Quality Index (FQI) and its applications - prediction of spinnability and yarn quality - Selection of manufactured fibres (polyester, viscose rayon, acrylic and nylon): Fibre parameters according to end-use requirements including blended yarn production. Bale Management Techniques - blending irregularity. Causes of nep generation - nep removal in carding and combing machines. Use of HVI and AFIS for process control operations.

UNIT II **9 Hours**

YARN QUALITY CONTROL

Cleaning and control of wastes - yarn realisation. Within and between bobbin count variations, control of count variations in preparatory machines and ring frame, yarn unevenness and imperfections, causes for unevenness and imperfections, Analysis and interpretation spectrograms. Yarn faults, causes and methods to reduce faults. Causes and remedial measures for variability in strength. Measures for control of hairiness. Control end breaks in spinning.

UNIT III **9 Hours**

PROCESS CONTROL IN WEAVING PREPARATION

Yarn quality requirements for shuttle and shuttleless looms, Quality and performance in winding, warping, pirn winding, sizing and beam gaiting, weaving package defects, causes and remedies, choice of size recipe, selection of weaving accessories.

UNIT IV **9 Hours**

PROCESS CONTROL IN WEAVING

Fabric defects, causes, control measures. Inspection standards, cloth realization, value loss. Snap study in loom shed, Process performance studies and norms (including preparatory sections).

UNIT V **9 Hours**

PRODUCTIVITY IN SPINNING AND WEAVING

Factors affecting productivity in spinning and weaving, productivity indices, Loom efficiency: factors influencing loom efficiency, maximizing production and productivity in spinning and weaving.

Total: 45 Hours

Reference(s)

1. T. V. Ratnam and K. P. Chellamani, Quality Control in Spinning, SITRA, Coimbatore, 1999.
2. A. R. Garde and T. A. Subramaniam, Process Control in Spinning, ATIRA, Ahmedabad, 1989.
3. A System of Process Control in Weaving, ATIRA, Ahmedabad, 1983.
4. A. J. Chuter, Quality Management in the Clothing and Textile Industry, Woodhead Publishing, UK, 2011.
5. M. C. Paliwal and P. D. Kimothi, Process Control in Weaving, ATIRA Publication, Ahmedabad, 1983.
6. W. Klein, Manmade Fiber and their Processing, The Textile Institute, Manchester, U.K.1994.

21TT013 ADVANCES IN CHEMICAL PROCESSING TECHNOLOGY

3 0 0 3

Course Objectives

- To understand the advancements in the chemical processing of textile materials.
- To evaluate the alternative processes using enzymes in preparation and finishing.
- To acquire knowledge on energy conservation and pollution control measures.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Analyse process parameters involved in fabric preparatory processes.
2. Suggest dye recipes for textile materials for different depths employing latest developments.
3. Evaluate the concepts involved in textile finishes.
4. Appraise the issues involved in the operation and maintenance of effluent treatment plants.
5. Select suitable printing machines and techniques.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1											3
2	3	2	2											3
3	3	1	3											3
4	3	1	3											3
5	3	2	2											3

UNIT I **9 Hours**

ADVANCES IN PREPARATORY PROCESSES

Combined preparatory processes - Single bath desizing, scouring and bleaching - Bio-scouring and its limitations - Bio-bleaching and combined enzyme assisted processes - Solvent scouring Process - Preparatory process for blends, application of enzymes in textile processing.

UNIT II **9 Hours**

DYEING

Developments in the application of direct, reactive, disperse dyes to textile materials using batch wise and continuous methods - Salt free dyeing of reactive dyes - Dyeing of wool blends - Concept of Right First-Time dyeing - Developments in E-control dyeing machines - Low liquor and Low wet pickup techniques, super critical carbon dioxide dyeing.

UNIT III **9 Hours**

FINISHING

Micro and Nano encapsulation and its application in finishing of textile materials - Finishing of technical textiles - Formaldehyde-free crease recovery finishing. Problems and remedies in the flame-retardant finishing of polyester and its blends. Bio-polishing - Influence of biopolishing on dyeability and physical properties of fibres and fabrics - developments of new fibres using Bio technology.

UNIT IV **9 Hours**

ENERGY CONSERVATION AND POLLUTION CONTROL

Energy conservation steps in chemical processing - causes and remedies for water and air pollution - Detailed study about characteristic of textile effluent and its norms - Developments in membrane techniques in the effluent treatment. Bio-technology in textile effluent treatment.

UNIT V **9 Hours**

PRINTING

Developments in rotary printing machine, Developments in pigment printing: foam, plastic, foil, rubber, glitter and transparent print. Synthetic thickeners for latest printing techniques - Digital printing - 3D printing- Transfer printing.

Total: 45 Hours

Reference(s)

1. V. A. Shenai, Technology of Printing, Vol. IV, Sevak Publication, Bombay, 1996.
2. John Shore, Cellulosic Dyeing, Society of Dyers and Colourists, 1995.
3. P. W. Harrison, Low-Liquor Dyeing and Finishing, Textile Progress, UK, 1986.
4. R B Chavan, Environmental Issues: Technology Options for Textile Industry, Special Issue, Indian Journal of Fibre and Textile Research, New Delhi, 2001.
5. A C Paulo, Enzymes in Textile Processing, Woodhead Publication, UK, 2002.

21TT014 PROCESS AND QUALITY CONTROL IN TEXTILE CHEMICAL PROCESSING

3 0 0 3

Course Objectives

- To acquire knowledge on quality and process control in chemical processing.
- To apply and use norms and standards applied to chemical processing.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Organize process control measures in preparatory process.
2. Develop process control measures in dyeing.
3. Appraise process control measures in printing.
4. Analyse process control measures in mechanical finishing process.
5. Develop process control measures in chemical finishing process.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3		2									2
2	3	3	3		2									2
3	3	3	3		2									2
4	3	3	3		2									2
5	3	3	3		2									2

UNIT I **9 Hours**

PROCESS CONTROL IN PREPARATORY

Overview of process and quality control in textile chemical processing. Machine and process parameters influencing the process performance and quality of preparatory processes. Desizing - Scouring - Bleaching - Souring - Mercerization. Quality evaluation of preparatory processed material.

UNIT II **9 Hours**

PROCESS AND QUALITY CONTROL IN DYEING

Machine and process parameters influencing dyeing of fibre, yarn and fabrics made from various fibres with different dyeing techniques. Quality evaluation of dyed material.

UNIT III **9 Hours**

PROCESS AND QUALITY CONTROL IN PRINTING

Machine and process parameters influencing the printing of fabrics made from various fibres with different printing techniques. Quality evaluation of printed material.

UNIT IV **9 Hours**

PROCESS AND QUALITY CONTROL IN FINISHING

Machine and process parameters influencing the Mechanical finishing of fabrics made from various fibres with different finishing techniques. Quality evaluation of mechanically finished textile material.

UNIT V **9 Hours**

PROCESS AND QUALITY CONTROL IN FINISHING

Machine and process parameters influencing the chemical finishing of fabrics made from various fibres with different finishing techniques. Quality evaluation of chemically finished textile material.

Total: 45 Hours

Reference(s)

1. B.P. Saville, Physical Testing of Textiles, The Textile Institute, Woodhead Publishing Limited, Cambridge, 1999.
2. R. Ed Postle, S. Kawabata and M. Niwa, Objective Evaluation of Fabrics, Textile Machinery Society, Japan, Osaka, 1993.
3. S. R. Karmakar, Chemical Technology in the Pretreatment Process of Textiles, Elsevier Publications, 1999.
4. P.C. Mehta, Process and Quality Control, BTRA, 1995.
5. Process control and safety in chemical processing of Textile, Prof Y M India, 2012.

21TT015 COLOUR SCIENCE 3 0 0 3

Course Objectives

- To understand the fundamental knowledge of colour science and colour measurement.
- To understand the basics of kinetics and thermodynamics related to dyeing.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Use the principles of colour and colour vision for textile applications.
2. Apply colour order systems in textile finishing operations.
3. Use colour measurement systems.
4. Apply principles of kinetics and thermodynamics in the dyeing of textiles.
5. Select software tools for quality control in colouration.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2		2									2
2	2		2											2
3	2		2											2
4	2		2											2
5	2		2											2

UNIT I **9 Hours**

COLOUR AND COLOUR VISION

Fundamentals of colour science: Eye and colour perception - Colour blindness - colour theory - Tests for defective colour vision. Metamerism, Dichroism, warm and cool colours.

UNIT II **9 Hours**

COLOUR ORDER SYSTEM

Munsell system - Ostwald system - CIE matching functions - Determination of Tri-stimulus value - Linear and non-linear transformation - industrial colour tolerance limit and calculations - Concept of K-M theory for colour matching - Derivation of KM equation and its application.

UNIT III **9 Hours**

COMPUTER COLOUR MATCHING

Sample preparation for colour matching: Determination of optical data of dyes - Recipe formulation and correction - Detailed study about colour measuring instruments - Spectro photometer - limitations of CCM technique - Sequence of colour matching in industry - invariant and conditional matching. 555 Shade sorting technique.

UNIT IV **9 Hours**

KINETICS AND THERMODYNAMICS OF DYEING

Dyeing properties related to the inherent physical structure of the fibre - Interaction between dyes and fibre forming polymers - Study about types of adsorption isotherms - Absorption and desorption technique to determine the dyeing equilibrium - Derivation of affinity equation - determination of dyeing rate - theory of dyeing for different fibres.

UNIT V **9 Hours**

QUALITY CONTROL OF COLOUR

Colour difference equation - factors responsible for colour difference - yellowness and whiteness measurement with AATCC and ASTM standards - online colour measurement for textiles - database preparation for colour matching - colour control system and development of colour software.

Total: 45 Hours

Reference(s)

1. H.S. Shah and R.S. Gandhi, Instrumental Colour Measurements and Computer aided Colour Matching for Textiles, Mahajan Book Distributors, Ahmedabad, 1990.
2. A.T. Peters and H.S. Freeman, Physico-chemical Principles of Colour Chemistry, Blackie,1995.
3. Ashim Kumar Chaudry, Colour Science, Mahajan Book Distributors, Ahmedabad, 1990.
4. D. Sule, Computer Colour Analysis, New Age Internationals (P) Ltd, New Delhi, 2002.
5. Narendra S. Gangakhedkar, Science and Technology of Colour, Rutu Prakashan, 2003.

21TT016 TEXTILE EFFLUENT TREATMENT 3 0 0 3

Course Objectives

- To understand the need to control the effluents arising from wet processing.
- To suggest different methods of treating the textile effluents.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PSO2. Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Characterize textile effluents.
2. Characterize colour and turbidity of textile effluents.
3. Assess the water quality using standard procedures.
4. Propose inputs for the design of an effluent treatment plant.
5. Suggest suitable methods to reduce the effluent load in textile processing.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	1											3
2	3	3	2											3
3	3	3	3											3
4	3	3	2											3
5	3	3	-											3

UNIT I **9 Hours**

SOURCES AND CHARACTERISTICS OF POLLUTION

Characteristics and treatment of effluents: Preparatory process - Colouration - Finishing - Combined effluents. Problem of colours. Synthetic and woollen textile processing effluents: Spin bath components - Wool scouring wastes: Solids - Liquids.

UNIT II **9 Hours**

COLOUR AND TURBIDITY

Primary treatment: Screening - sedimentation - Equalisation - Neutralisation - Coagulation - Floatation. Secondary biological treatments: Activated sludge - Trickling filtration - Aerated lagoons - Secondary sedimentation - Oxidation ponds - Anaerobic digestion - Sludge disposal. Tertiary treatment: Multimedia filtration - chemical coagulation - chemical precipitation - hyper filtration: Ultra filtration - Nano filtration - Reverse osmosis. Dialysis – Chlorination.

UNIT III **9 Hours**

WATER AND EFFLUENT ANALYSIS

Water analysis - Colour - Acidity - Alkalinity - Dissolved solids - Suspended solids - Total hardness (Calcium Magnesium). Methods: EDTA Titrimetric - Total iron-thiocyanate - Determination of Alkalinity - Chlorides - Dissolved oxygen - Surfactants - Methylene blue - Corrosivity - BOD-COD - TDS Toxicity.

UNIT IV **9 Hours**

EFFLUENT TREATMENT PLANTS

Design of effluent treatment plant: Individual Unit - Common effluent treatment - Collection of samples - Quality assurance programmes in ETP: Audit - Assessment - Recording - Monitor - Re-evaluation. Sludge Management: Source reduction - Bio-elimination - Solid separation - Government Regulations - Norms for treated water.

UNIT V **9 Hours**

REDUCTION OF POLLUTION AND WATER REQUIREMENT

Waste segregation - recovery - reuse - substitution of low polluting chemicals - process modification - economy in water use. Quality requirement of water for processing: Cotton - Synthetics - Wool - Silk - Boiler - Humidification.

Total: 45 Hours

Reference(s)

1. C. S. Rao, Environment Pollution Control Engineering, New Age International Ltd., 1994.
2. P. Cooper, Colour in Dyehouse Effluent, Society of Dyers and Colourists, UK, 1995.
3. N. Manivasakam, Treatment of Textile Processing Effluents, Sakhi Publications, 1995.
4. P. Vankar, Textile Effluent, NCUTE Publication, New Delhi, 2002.

21TT017 ADVANCED KNITTING TECHNOLOGY 3 0 0 3

Course Objectives

- To acquire the knowledge of advanced technologies in knitting.
- To understand the mechanisms involved in advanced knitting machines.
- To analyse the latest developments in knitted fabric structures.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

1. Compare the contrast warp and weft knitted structures.
2. Select tricot and raschel knitting machines for production of knitted fabrics.
3. Analyse features of flat knitting machine to produce flat knit structures.
4. Explain the loop geometry and loop formation in a knitted fabric
5. Select yarn preparation machines and methods for warp knitting.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2		2									2	
2	2	2		2									2	
3	2	2		2									2	
4	2	2		2									2	
5	2	2		2									2	

UNIT I **9 Hours**

WARP KNITTING - TRICOT KNITTING TECHNOLOGY

Fabrics produced with two fully threaded guide bars - Fabrics produced with two partly threaded guide bars - fabrics produced with three or more guide bars - multi - guide bar Tricot - The use of electronics and computers in Tricot - tricot knitting with weft insertion - terry fabric production - sinker pile fabrics - cut press and miss press techniques - double needle bar Tricot.

UNIT II **9 Hours**

WARP KNITTING - RASCHEL KNITTING TECHNOLOGY

Introduction - standard Raschel machines - multi guide bar Raschel machines - jacquard knitting – multi-guide bar and jacquard Raschel machines - electronic patterning equipment - double needle bar Raschel machines - Raschel machines for the production of corsetry nets, shoe spacer fabrics, plush lingerie

UNIT III **9 Hours**

FLAT KNITTING MACHINES

Double system flat machines: Cam plate description - yarn carrier sequences - the products of double system machinery - multiple feed machines - stripes - long and short needles eight system flat knitting machines. colour effects on eight system machines - knitted fabrics with fancy stitch effects - special devices on flat knitting machines: Widening on V bed knitting machines - The application of loop transfer. Seamless Knitting; Production of fully-fashioned knitted items

UNIT IV **9 Hours**

SCIENCE OF WARP KNITTING

Yarn count and its relation to machine gauge - warp knitted fabric geometry - Loop models - the machine state loop model - yarn to fabric ratio - the machine of loop formation in warp knitting.

UNIT V **9 Hours**

YARN PREPARATION

Methods of yarn preparation - Indirect /mill warping - Direct Warping - Direct warping equipment for filament yarns -Warping machines - yarn creel - attachments.

Total: 45 Hours

Reference(s)

1. S. Raz, Warp Knitting Production, Verlag Melliand Textilberichte GMBH, Heidelberg, 1987
2. Samuel Raz, Flat Knitting Technology, C.F. Rees GmbH, Druck-Repro-Verlag, Heidenheim, Germany, 1993.
3. Chris Wilkens, Warp Knit Machine Elements, U. Wilkens Verlag, 1997.
4. Henry Johnson, Introduction to Knitting Technology, Abhishek Publications, Chandigarh, 2006.
5. Chandrasekhar Iyer, Bernd Mammal and Wolfgang Schach, Circular Knitting, Meisenbach GmbH, Bamberg, 1995.
6. D. B. Ajgaonkar, Knitting Technology, Universal Publication Corporation, Mumbai, 1998.

21TT018 ADVANCES IN TECHNICAL TEXTILES 3 0 0 3

Course Objectives

- To provide an overview on the application of advanced technical textiles.
- To teach the manufacturing processes of a few important advanced technical textiles.
- To educate on the physical and chemical properties of advanced technical textiles.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, andan engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverseteams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Characterize the different sectors of advanced technical textiles and their role in the economy.
2. Assess contribution of value addition to conventional textiles various sectors of textile industry to nation's economy.
3. Summarize the production processes of Nonwovens and Agro-tech their applications.
4. Resolve the production processes of Carbon fibres & Glass fibres their applications.
5. Outline the manufacturing processes of advances in Sports technology.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3	1			1		2			3	2	
2	3	2	3	1			2		1	2		3	2	
3	3	2	3	1			1		2			3	2	
4	3	2	3	1			2		2			3	2	
5	2	2	3	1			2		2	1		3	2	3

UNIT I **9 Hours**

TECHNICAL TEXTILES

Advanced/modified textile materials. Sustainability- Trends followed and aspects to be followed for sustainable development. Durability- Maximum and minimum expire ability as end use. Functionality- vast and varied end uses with different technical specification. Parameters required to be modified for advanced level applications.

UNIT II **9 Hours**

VALUE ADDITION TO CONVENTIONAL TEXTILES

Value addition by various techniques of functionality, coating, coloration. Technical felts-method of production, structure, properties and applications. Phase change materials-their structural characteristics and varied applications through technical textiles. Additional features by blending of yarn, chemical modification of synthetic fibres. Fibre structure variation and properties implied.

UNIT III **9 Hours**

NON WOVENS & AGROTECH

Types of fibres used for nonwovens. Manufacturing techniques - Wet laid, spun lacing. Structural difference and varied end use. Modified nonwovens- by mixing and blending-properties acquired. Structure analysis and predicting field of end uses. Agro-tech- materials used- structure and properties- applications in agriculture, horticulture, aquaculture. Structural modifications for enhanced technical features-type of modification-techniques followed- Possible advancement scope.

UNIT IV **9 Hours**

CARBON FIBRES & GLASS FIBRES

Carbon fibres- Structural modifications and properties gained. Detailed structural analysis. Comparison with other high performance or specialty fibres. Various field of applications-existing and possible advanced uses.

Glass fibres- Structural modifications and properties attained. Structural analysis and comparison with carbon fibres. Properties and varied area of applications. Advanced uses in fibre optics and future scopes.

UNIT V **9 Hours**

SPORTS TECHNOLOGY

Designing factors, structure and methods- external conditions, functional requirement, protection and maintenance. Clothing comfort. Stretch ability. Lightweight. Water repellant. Knitting structure-technicalaspect. Fibres used. Yarn development-hollowness, channelized. Clothing comfort- factors affecting clothing comfort and characteristics.

Total: 45 Hours

Reference(s)

1. A. R. Horrocks and S. C. Anand, Handbook of Technical Textiles, Woodhead Publishing Limited and The Textile Institute, 2000.
2. Alagirusamy and A. Das, Technical Textile Yarns, CRC press, 2010.
3. Pushpa Bajaj and A. K. Sengupta, Industrial Applications of Textiles for Filtration and Coated Fabrics, Textile Progress Vol.14, 1992.

21TT019/21TTH12 APPAREL PRODUCTION PLANNING AND CONTROL **3 0 0 3**

Course Objectives

- To understand the concepts in production planning and control.
- To understand the material management and their movement in the production.
- To apply the various techniques in production planning and control.
- To understand the material management and their movement in the production.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO9.Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11.Project Management and Finance: 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.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Evaluate the benefits of planning and controlling of different production systems adopted in apparel industry.
2. Prepare product and process planning with respect to different levels of apparel industry.
3. Prepare schedules for material loading, production flow in order to control various processes.
4. Analyse the stocks in different inventory with integrated planning systems.
5. Prepare aggregate planning and related issues and strategies for an apparel industry

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1							2	2	2	2	3	
2	1	2							2	1	2	1	3	2
3	1	1							2	2	2	2	3	2
4	1	3									3			2
5	1	3									3			2

UNIT I **9 Hours**

INTRODUCTION

Objectives and benefits of planning and control-Functions of production control-Types of production systems -job- batch and continuous-Product development and design-Marketing aspect - Functional Aspects-Operational Aspect-Durability and dependability aspect- aesthetic aspect. Profit consideration-Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

UNIT II **9 Hours**

PRODUCT PLANNING AND PROCESS PLANNING

Product planning - Process planning and routing-Pre requisite information needed for process planning-Steps in process planning-Quantity determination in batch production-Machine capacity, balancing-Analysis of process capabilities in a multi-product system.

UNIT III **9 Hours**

PRODUCTION SCHEDULING

Production Control Systems- Loading and scheduling-Master Scheduling-Scheduling rules-Gantt Charts-Perpetual Loading-Basic scheduling problems - Line of balance - Flow production scheduling-Batch production scheduling- Product sequencing - Production Control systems- Periodic batch control-Material requirement planning kanban - Dispatching-Progress reporting and expediting-Manufacturing lead time-Techniques for aligning completion times and due dates.

UNIT IV **9 Hours**

INVENTORY CONTROL AND RECENT TRENDS IN PPC

Inventory control - Purpose of holding stock - Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system - Determination of Economic order quantity and economic lot size - ABC analysis - Recorder Procedure-Introduction to computer integrated production planning systems - elements of JIT - Fundamentals of MRP II and ERP.

UNIT V **9 Hours**

AGGREGATE PLANNING

Aggregate Units of production, Issues of aggregation- smoothing, bottle neck problem, planning horizon, treatment of demand; Cost in aggregate planning; Aggregate in chase strategy, constant workforce, and mixed strategies and additional strategies; Disaggregating aggregate plans.

Total: 45 Hours

Reference(s)

1. Steven Nahmias, "Production and Operations Analysis", 6th edition; Tata McGraw-Hill, 2009.
2. S. K. Mukhopadhyay, "Production Planning & Control: Text and Cases", PHI Learning Pvt. Ltd., 2007.
3. Martand Telsang, "Industrial Engineering and Production Management", S. Chand and Company, First edition, 2000.
4. Stephen N. Chapman, "The fundamentals of Production Planning and Control.", Pearson Education, 2009.
5. K. C. Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management", Khanna Publishers, 1990.
6. Upendra Kachru, "Production and operations management Text and cases" Excel books 1st edition 2007.

21TT020/21TTH10 PATTERN ENGINEERING 3 0 0 3

Course Objectives

- To impart knowledge on human body measurements and creating pattern from the measurements.
- To develop commercial pattern with design aspect by manipulating the basic pattern.
- To fabricate patterns of different sizes by grading the basic pattern.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Design and develop patterns based on figure analysis and by choosing suitable measurement technique.
2. Design and develop patterns for the basic blocks of garment.
3. Draw and prepare patterns for the body components of sleeve, cuff and collars.
4. Draw and prepare patterns for the body components of yokes and pockets.
5. Develop pattern grading for basic body components to various sizes.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		3											3
2	2		3											2
3	2		2											3
4	2		2											2
5	2		2											3

UNIT I **9 Hours**

HUMAN ANTHROPOMETRICS AND SIZING SYSTEMS

Garment manufacturing process flow chart, Measurements and its importance, land mark terms, sequence of taking body measurements - vertical measurements and horizontal measurements. Sizing system: size categories in men's wear, women's wear and children's wear, international sizing, ASTM standard size chart. Proportion and disproportion of human figure.

UNIT II **9 Hours**

PATTERN MAKING

Pattern making tools, pattern making terms, basic blocks, pattern details, dart, notches, grain line, drill hole marks, ease allowance, seam allowance, style lines, types of patterns, techniques of pattern making - drafting, draping and flat pattern, blending and trueing, Interpretation of design and specification sheet, tolerance, different types of patterns produced during sampling and production.

UNIT III **9 Hours**

DRAFTING

Principles of pattern drafting, Drafting patterns for basic bodice, sleeve, skirt, types of sleeves, collars, yokes, cuffs. shirt and trouser. Skirts - length variation, skirt foundations, styles pleated, tiers, godets, gored, circular, cowl, pegged, skirts with yoke, uneven hem lines, peplums, wrap skirt, cascade wrap, Pants: foundations, culottes, jean, hip hugger, jump suits, Bermudas, pedal pushers, capri.

UNIT IV **9 Hours**

FLAT PATTERN TECHNIQUES AND FIT

Dart manipulation methods - pivot, slash & spread and measurement method. Single and double dart series, conversion of dart into style lines, yokes, gathers and multiple darts. Pattern alterations: Fit-importance, standards, influence of clothing fit, importance of altering patterns, principles of pattern alterations, common pattern alterations in various garments, alteration of patterns for irregular figures.

UNIT V **9 Hours**

PATTERN GRADING

3D body scanning, principles, operations and advantages of body scanning technologies. Principles of pattern grading, types draft grading and track grading, two dimensional and three-dimensional grading, grading of bodice, sleeve, skirt, trouser, and collar, computerized pattern grading. Types of layouts, laying patterns on different types of fabric, marker planning for different types of garments.

Total: 45 Hours

Reference(s)

1. Helen Joseph Armstrong, Pattern Making for Fashion Designers 4th Edition, Prentice-Hall, New Jersy, 2006.
2. Le Pechoux B and Ghosh T K, Apparel Sizing and Fit, Textile Progress, Volume 32, The Textile Institute, Manchester, 2002.
3. Ashdow S P Sizing in clothing Developing effective sizing systems for ready to wear clothing, CRC press, Textile Institute & Wood Head publishers, England, 2007.
4. Connie Amaden Crawford, The Art of Fashion Draping, Fair child Publications, New York, 2005.
5. Harold Carr and Barbara Lathom, The Technology of Clothing Manufacture, Blackwell Sciences, Oxford, 1996.

21TT021 GARMENT PRODUCTION MACHINERY AND EQUIPMENT

3 0 0 3

Course Objectives

- To acquire knowledge on the design, construction and operational features of garment production machinery and equipment.
- To understand the details of garment machinery and equipment with focus on the means of exploiting the features built in the garment machinery and equipment.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Prepare the operational parameters of spreading, cutting machines and evaluate the performance.
2. Assess sewing machine and its components for their use in apparel manufacture.
3. Evaluate single needle lock stitch machine for apparel manufacture.
4. select appropriate overlock sewing machines for apparel manufacture.
5. Select appropriate work aids in apparel manufacture.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3		2		2								3	1
2	3		2		2								3	1
3	3		2		1								3	1
4	3		2		2								3	1
5	3		2		2								3	1

UNIT I **9 Hours**

SPREADING AND CUTTING MACHINES

Spreading machines: Spreading table - stationary-portable -fixed machines - travelling spreaders - manual - semi-automatic - automatic. Cutting machines: Vertical blade reciprocating - rotary blade - band knife - die cutter - clickers and presses - shears - hand knives - short knives - table sword knives - notches - drills - computer-controlled cutting knives - machines using laser, water, plasma and ultrasonic waves.

UNIT II **9 Hours**

SEWING MACHINE

History of sewing machines - classification according to bed types - major parts of sewing machinery and functions. Adjustment of major parts of single needle lock stitch machine: Non-UBT: stand height, pedal, presser foot, height of needle bar, needle to hook relationship, height of feed dog, normal and reverse feed stitch length, feed timing, presser foot pressure, needle and bobbin thread tension, bobbin winding assembly, belt tension.

UNIT III **9 Hours**

SEWING MACHINE ADJUSTMENT (SNLS)

Sewing needle and sewing thread, thread consumption, thread routing. Adjustment on SNLS-UBT: Needle stop position, wiper, thread timing sequence, timing of thread trimmer cam, positioning the moving knife, installation, sharpening, replacing moving knives

UNIT IV **9 Hours**

SEWING MACHINE ADJUSTMENT (OVERLOCK)

Parts, functions and adjustments of over lock: Needle height, feed dog height, differential feed ratio, tilt of the feed dog, position of the upper and lower knives, sharpening of knife and looper

UNIT V **9 Hours**

WORK AIDS

Work-aids and attachments, functions of pullers, guides and folders compensating presser foots left, right, double; feller, hemmer, etc. Collar turning machines, folding machinery, fusing and pressing machinery.

Total: 45 Hours

Reference(s)

1. Jacob Solinger, Apparel Manufacturing Handbook, Van Nostrand Reinhold Company, 1988.
2. Peyton B. Hudson, Guide to Apparel Manufacturing, Medi Apparel Inc. 1989.
3. H. Carr and B. Latham, The Technology of Clothing Manufacture, Blackwell Scientific Publications, 1988.

21TT022 MANAGEMENT OF APPAREL UNITS 3 0 0 3

Course Objectives

- To understand the managing aspects the apparel industry.
- To understand the basics of managing a garment production factory.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO11.Project Management and Finance: 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.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Construct organization charts for various sizes of woven, knitted or leather apparel industry.
2. Prepare appropriate layout for optimum utilization of resources.
3. Evaluate apparel market structure and market operations.
4. Prepare project report for an apparel start-up.
5. Prepare export documentation according to rules and regulations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2									3	1	3	2
2	1	2									3	1	3	2
3	1	2									3	1	1	3
4	1	2									3	1	3	2
5	1	2									3	1	1	2

UNIT I **9 Hours**

ORGANIZATION

Apparel industry: Organization of the apparel industry -concept of small-scale industry - advantages of SSI units. Classification of Garment Units: Woven - knitted - lingerie - leather garment - sportswear - outer wear - under garments - hospital wear.

UNIT II **9 Hours**

PRODUCTION MANAGEMENT

Production planning and control - production systems - material flow control - optimization of work place arrangement for higher productivity. Types of production layouts: Process oriented - Product oriented. Case study.

UNIT III **9 Hours**

MARKETING

Market structure: Domestic - International-Wholesale - Retail. Buying seasons: Spring - Summer - Autumn -Winter - Holiday. Advertising - different media - trade fare - display - exhibition - buyer - seller meet.

UNIT IV **9 Hours**

SETTING UP A GARMENT UNIT AND LABOUR LAWS

Study of land - Norms of SA-8000 - capital - labour - market demand - preparing a project - large scale industry - advantages over SSI - Bank assistance. Government Schemes. Costing: Garment cost elements - cost calculations (numerical problems). Labour - Study of labour laws - factory act - labour laws - welfare measures - safety act.

UNIT V **9 Hours**

EXPORTS

Exports policy - trade documentation and quota policy - AEPC and its role in the garments industry. Export Documentation. Payment terms.

Total: 45 Hours

Reference(s)

1. Ruth E Glock, Grace I Kunz, Apparel Manufacturing - Sewn Product Analysis - 3rd Edition, Prentice Hall Inc., 2000. Jacob Solinger, Apparel Manufacturing Handbook - Analysis Principles and Practice, Bobbin Blenheim Media Corp; 2nd edition (December 1988).
2. Jacob Solinger, Apparel Manufacturing Handbook - Analysis Principles and Practice, Bobbin Blenheim Media Corp; 2nd edition (December 1988).

21TT023/21TTH11 APPAREL MARKETING AND MERCHANDISING

3 0 0 3

Course Objectives

- To teach the activities of marketing and merchandising in the apparel industry.
- To teach the commercial and sourcing aspects of the garment industry.
- To teach the commercial and sourcing aspects of the garment industry.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11.Project Management and Finance: 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.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Construct organization charts for industrial units of varying sizes; plan for realizing export incentives.
2. Organize and implement marketing strategies and goals.
3. Organize production, visual merchandising, product development and line presentation.
4. Prepare materials requirement plan for a given order and identify sourcing resources.
5. Prepare export documentation.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3									1	2	3	2
2	1								2	2	3		2	1
3	1								2		3		3	2
4	1					2			2		3		3	1
5	1								2		3		3	2

UNIT I **9 Hours**

ORGANIZATION OF THE APPAREL BUSINESS

Introduction to apparel industry - Organization of the apparel industry - Types of exporters - Business concepts applied to the apparel industry - International trade. WTO: Functions and objective. GSP. Export incentives: Duty drawback - DEPB - Import - Export.

UNIT II **9 Hours**

MARKETING

Functional organization of an apparel firm. Responsibilities of a marketing division - Marketing objectives and strategies - Marketing research - Types of markets: Retails and wholesale strategies for merchandise distribution - Retailers- sourcing flows and practices - Marketing plan.

UNIT III **9 Hours**

MERCHANDISING

Definition - functions. Role and responsibilities of merchandiser - Visual merchandizing, different types of buyers - communications with the buyers - awareness of current market trends - product development line planning - line presentation

UNIT IV **9 Hours**

SOURCING

Need for sourcing - sourcing materials - manufacturing resources planning - principles of MRP - Overseas sourcing - sourcing strategies. Supply chain and demand chain analysis - Materials management for quick response - Buying houses.

UNIT V **9 Hours**

DOCUMENTATION

Order confirmation, various types of export documents, pre-shipment post-shipment documentation - terms of sale - payment - shipment

Total: 45 Hours

Reference(s)

1. Ruth E Glock, Grace I Kunz, Apparel Manufacturing - Sewn Product Analysis - 3rd Edition, Prentice Hall Inc., 2000
2. V. R. Sampath, P. Perumalraj and M. Vijayan, Apparel Marketing and Merchandising, Kalaiselvam Pathippakam, Coimbatore, 2007.
3. J. A. Jarnow, M. Guerreiro and B. Judelle, Inside the Fashion Business, Macmillan Publishing Company, 1990.
4. Grace I. Kunz, Merchandising: Theory, Principles and Practice, Fairchild Books, 2005.
5. Elaine Stone and A. Jean, Fashion Merchandising - An Introduction, McGraw-Hill Book Company, 1990.

21TT024 COSTING AND FINANCIAL MANAGEMENT

3 0 0 3

Course Objectives

- To offer the students a broad overview of costing of textile products and teach principles of financial management

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9.Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11.Project Management and Finance: 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.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

1. Understand the cost accounting, and financial management.
2. Explain the concept of process costing, marginal costing and cost accounting.
3. Apply the principles and evaluation of capital budgeting techniques.
4. Analyse the cost of capital, capital structure and financial leverage in capital budgeting.
5. Apply the principles and determinants involved in working capital management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3			3			2	1	2	1		2	
2	2	3			3			2	2	2	2		2	
3	2	3			3			2	1	2	1		2	
4	2	3			3			2	2	2	2		2	
5	2	3			3			2	2	2	1		2	

UNIT I **8 Hours**

BASICS OF COSTING AND FINANCIAL MANAGEMENT

Introduction to cost accounting-Cost ledgers: Reconciliation between cost and financial accounting - Costing methods -Product Costing, Job, order, Batch and Contract costing- Cost Sheet. Introduction Financial Management: Functions, Goals, Organization of Finance Function, Time Value of Money, Future Value and Present Value of Money. Real and Nominal Interest Rate

UNIT II **8 Hours**

PROCESS COSTING AND ACCOUNTING

Process costing-operation costing -operating costing -unit costing, multiple costing -Marginal costing - Throughput accounting -ABC -integration of standard costing with marginal cost -Transfer Pricing- Treatment of special expenses -Accounting and control of waste, scrap, spoilage, defective etc.

UNIT III **10 Hours**

PRINCIPLES OF CAPITAL BUDGETING

Principles and Nature of Capital Budgeting, Evaluation Techniques: Payback Period, Accounting Rate of Return, Net Present Value, Internal Rate of Return, Profitability Index. Project selection under Capital Rationing

UNIT IV **10 Hours**

CAPITAL BUDGETING

Cost of Capital and Capital Structure Concept of Cost of Capital, Measurement of Specific Costs and Overall Cost of Capital, Factors Determining Capital Structure, Operating and Financial Leverage.

UNIT V **9 Hours**

WORKING CAPITAL MANAGEMENT

Principles of Working Capital, Principles and Determinants of Working Capital, Operating Cycle, Estimation of Working Capital, Policies for Financing Current Assets, GWC vs. NWC.

Total: 45 Hours

Reference(s)

1. M.N. Arora, Cost Accounting: Principles and practice, New Delhi: Vikas publishing Pvt. Ltd., 2011.
2. Horngreen, Foster &Datar, Cost Accounting-A Managerial Emphasis, New Delhi: Prentice Hall India, 2010.
3. Dr. Ashish K. Bhattacharyya, Principles and Practice of Cost Accounting, New Delhi: Prentice Hall (PHI), 2012.
4. I.M. Pandey, Financial Management, New Delhi: Vikas Publishing House Pvt. Ltd., 2012.
5. Brigham and Houston, Fundamentals of Financial Management, New Delhi: Thomson Learning.
6. Prasanna Chandra, Financial Management-Theory and Practice, New Delhi: Tata McGraw-Hill Publishing Company Ltd, 2012.

21TT025/21TTM/H05 COATED AND LAMINATED TEXTILES

3 0 0 3

Course Objectives

- To acquire knowledge on the science and technology of coating and lamination of textile materials.
- To understand the applications of coated and laminated textiles.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO11.Project Management and Finance: 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.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Select polymers and resins for coating applications.
2. Appraise textile fibres and structures for coating applications.
3. Select construction parameters for manufacturing coated fabrics.
4. Select coated textile-structure-based materials for specific end-uses.
5. Characterize coated and laminated textile materials.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2		2		2				1	3	1	2
2	3	3	2		2		2				1	3	2	2
3	3	3	2		2		2				1	3	1	2
4	3	3	2		2		2				1	3	2	2
5	3	3	2		2		2				1	3	1	2

UNIT I **9 Hours**

MATERIALS

Commercial and technical scope of coated and laminated textiles. Materials for coating: Plastic materials -natural and synthetic rubbers, Polyvinyl Chloride, Acrylic polymers. Materials for lamination: Films - Polyurethane foam -Polyolefin foam.

UNIT II **9 Hours**

MATERIALS AND RHEOLOGY

Adhesives: solvent-based and water-based. Textile Substrate: Requirements of textile substrates for coating, Selection of textile fibres and fabric structure. Rheological behaviour of fluids, Rheology of Plastisols: Apparent viscosity of plastisols, Polymer size and size distribution, Plasticizer and Additives, Viscosity change during fusion.

UNIT III **9 Hours**

COATING AND LAMINATION METHODS

Coating and Lamination Methods: Calendaring coating - Knife coating - Roller coating - Nip and Dip coating - Spray coating - Foam coating - Powder coating-Slot die extruder-Flame lamination - Hot melt lamination.

UNIT IV **9 Hours**

PRODUCTS

Protective Clothing - the spacesuit - garment interlinings - Tarpaulins - Conveyor belts - PTFE coated belts - Hot air balloons - Exhibition board coverings - Labels -Tyres and hoses -Applications: Automotive - Marine - Buildings and architecture -Household products.

UNIT V **9 Hours**

QUALITY EVALUATION

Adhesion test -Flexing Test -Abrasion resistance - Fabric handle, drape and stiffness - Fabric strength -Bursting Strength-Dimensional Stability-Thermal comfort -Flammability testing.

Total: 45 Hours

Reference(s)

1. W. Fung, Coated and Laminated Textiles, Woodhead Publishing, England, 2002.
2. A. K. Sen, Coated Textiles, Principles and Applications, Technomic Publication, Lancaster, 2001.
3. S. C. Anand and W. Horrocks, Technical Textiles, Woodhead limited, Cambridge England, 2000.
4. R. S. Lenk, Polymer Rheology, Applied Science Publishers, London, 2000.
5. W. C. Smith, Smart Textile Coatings and Laminates, Woodhead Publishing, Cambridge England, 2010.

21TT026/21TTM/H06 NANO TEXTILES 3 0 0 3

Course Objectives

- To understand the concept of nanotechnology and its application in textiles.
- To evaluate the production methods of nanofibres.
- To acquire knowledge on nano-composites and their properties.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Appraise nanofibres produced by electrospinning technique.
2. Develop and characterize carbon nanotubes and nano composites.
3. Develop polymer layered silicate nano-composites.
4. Assess surface modification of textile materials for functional application.
5. Analyse hybrid polymer nano-layers for smart textiles.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		3										3	1
2	1		3										2	3
3	1		3										1	3
4	2		3										2	3
5	1		3										1	3

UNIT I **9 Hours**

NANO FIBRES

Process: Electro spinning - properties -improvement - fibre morphology - fibre alignment.

UNIT II **9 Hours**

NANO TUBES AND NANO COMPOSITES

Carbon nano tubes: synthesis - characterization techniques - nano tubes - Polymer fibres - structures - production process - properties - fibre morphology.

UNIT III **9 Hours**

NNANOFILLER POLYPROPYLENE FIBRES

Polymer layered silicate nano composites: structure and properties - Nano composites Dyeing of Polypropylene - Modified propylene for improved dyeability.

UNIT IV **9 Hours**

NANO COATING OF TEXTILES

Surface modification techniques - anti- adhesive nano coating of fibre and textiles - water and oil repellent coating - self-cleaning. Functional textiles: protection - applications

UNIT V **9 Hours**

HYBRID POLYMER NANOLAYERS

Thin hybrid film - smart textiles - polymer to polymer hybrid layers - polymer to particles hybrid layers. Nano fabrication of thin polymer fibre - "Grafting from" and "Grafting to" techniques for synthesis of polymer films, synthesis of smart switchable coatings

Total: 45 Hours

Reference(s)

1. P. J. Brown and K. Stevens, Nanofibers and Nanotechnology in Textiles, Woodhead Publishing Limited, England, 2007.
2. Bharath Bhushan, Springer Handbook of Nanotechnology, Springer, 2004.
3. H. Zeng, L. Zhu, G. Hao and R. Sheng, Synthesis of various forms of Carbon Nanotubes by AC Arc Discharge, Carbon Vol. 36, pp. 259-261, 1998.
4. K. Yamamoto, S. Akiya and Y. Nakayama, Orientation and Purification of Carbon Nanotubes using AC Electrophoresis, Applied Physics, Vol. 31, L 34-L 36, 1999.
5. E. Hammel, X. Tang, M. Trampert, T. Schmitt, K. Mauthner, A. Eder and P. Potschke, Carbon Nanofibers for Composites Applications, Carbon, Vol. 42, pp.1153-1158, 2004.

21TT027/21TTM/H03 TEXTILE COMPOSITES 3 0 0 3

Course Objectives

- To acquire the knowledge of various manufacturing and processing technologies for composite materials.
- To understand mechanical characterization and applications of textile composites.
- To acquire knowledge of ASTM, ISO, BSI standards used in composite materials.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9.Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11.Project Management and Finance: 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.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Classify the composite materials and evaluate the role of reinforcement and matrix in a composite.
2. Analyse physical and chemical properties of high-performance reinforcements and matrix materials and the methods to improve inter facial bonding.
3. Outline methods of manufacturing advanced composite preforms for designing composite materials.
4. Analyse composite manufacturing techniques for selective end-use applications.
5. Evaluate the mechanical properties of composite materials employing standard test methods.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3	1			1		2	2		3	1	1
2	3	2		2			2	2	1			3	2	
3	3	2	3	1			1		2			3	1	2
4	3	2	3	2	2		2		1			3	2	2
5	3	2	3	1	2		1		2		2	3	2	2

UNIT I **9 Hours**

INTRODUCTION TO COMPOSITE MATERIALS

Classification: fibre - particulate -laminar composites. Constituents of composite materials- functions of fibre and matrix - Properties of fibres and matrix materials- Critical fibre length - Aligned and random fibre composites - property prediction - rule of mixtures- simple problems.

UNIT II **9 Hours**

COMPOSITE MATERIALS

Types of high-performance fibres - properties- types of matrix materials - Thermoset and Thermo plastics properties fibre matrix interface coupling agents - coupling of interfaces and interfacial reaction in fibre composites.

UNIT III **9 Hours**

TEXTILE STRUCTURAL COMPOSITE REINFORCEMENTS

Introduction to manufacturing techniques - property requirements Textile preforms - weaving, knitting braiding, filament winding, pultrusion. Prepregs - Introduction, manufacturing techniques, property requirements, compaction and applications - Advantages and disadvantages of prepreg materials.

UNIT IV **9 Hours**

COMPOSITES PROCESSING TECHNIQUES

Vacuum bagging - compression moulding - injection moulding - pultrusion - thermoforming - resin transfer moulding (RTM), VARTM, SMC, BMC.

UNIT V **9 Hours**

MECHANICAL CHARACTERISATION OF COMPOSITES

Introduction to structural material characterisation standards- ASTM, ISO, BSI. Testing of composites materials- Fibre volume fraction - tensile- shear - compression - Impact-Fatigue - flexural properties - Damage Tolerance assessment -Non-Destructive testing of composites.

FOR FURTHER READING

Applications of textile composites in various fields, Short fibre composites, modelling of internal geometry of textile performs, Filament winding, Inter laminar fracture/failure modes in composites.

Total: 45 Hours

Reference(s)

1. L. Gupta Advanced Composite Materials, Himalayan Books, New Delhi, 1998.
2. An introduction to composite materials Cambridge University Press, Cambridge, 1998.
3. C. Long, Design and manufacture of Textile composites, Woodhead Publishing Limited, 2005.
4. A. C. Long, Mechanical testing of advanced fibre composites, Woodhead Publishing Limited, 2005.
5. F. L. Mathews and R. D. Rawlings, Composite Materials Engineering Science, Chapman & Hall, London, 1994.

21TT028/21TTM/H01 HOME TEXTILES 3 0 0 3

Course Objectives

- To analyse textiles-based products used in homes and their selection.
- To acquire knowledge on manufacture of home textiles.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PSO2. Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Appraise the characteristics of home furnishing textile materials
2. Select floor coverings according to specific needs
3. Assess suitability of curtains and draperies according to customer needs
4. Analyse bed linen requirements in technical terms
5. Select technical parameters for bath towel applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		2										2
2	2	3	2											1
3	3	2	2											3
4	3	3	3											2
5	2		3	2										3

UNIT I **9 Hours**

HOME FURNISHING

Textile Furnishing: Woven and non-woven. Selection of: Fibers, Colours, Designs. Kitchen Textiles: Apron-Dish cloth, Bread Bag, Pot Holders. Table textiles: Mats - Table cloths, Types - Materials. Upholstery: Materials - Fixed upholstery, non-stretch loose covers, stretch covers - Cushion covers.

UNIT II **9 Hours**

FLOOR COVERINGS

Floor covering: Resilient - Soft Rugs - Pads. Types: Tufted - Needle felt - Woven- Hand tufted. Carpet manufacture: Wilton - Axminister - Knitted, Stitch bonding – Flocking.

UNIT III **9 Hours**

CURTAINS AND DRAPERIES

Choice of Fabrics, Curtains, Draperies - Tucks and pleats - Drapery Rods, Hooks, Tape Rings, Pins. Textile wall hanging.

UNIT IV **9 Hours**

BED LINEN

Bed Linen: Types: Sheets, Blankets, Blanket Covers, Comforters, Comforter Covers, Bed Spreads, Mattress - Mattress Covers, Pads, Pillows. Made-ups in hospitals, Textiles care labelling. Testing of home textiles: Colour fastness, Shrinkage, Abrasion - Flammability.

UNIT V **9 Hours**

TOWELS

Types: Bath robes, Bead towels, Napkins. Construction: Weave, Pile height - Pattern - Dyeing and Finishing, Absorption tests. Velour, Types of Velvet, Construction.

Total: 45 Hours

Reference(s)

1. Subrata Das., Performance of Home Textiles, Woodhead Publishing India PVT. LTD, 2010.
2. Alexander N.G., Designing Interior Environment, Mass Court Brace Covanorich, New York, 1972.
3. Wingate I.B., & Mohler J.E., Textile Fabrics & Their Selection, Prentice Hall Inc, New York, 1984.

21TT029/21TTM/H04 SPECIALITY TEXTILES 3 0 0 3

Course Objectives

- To understand the technological aspects of specialty textiles
- To acquire knowledge on the applications of specialty textiles
- To innovate specialty textiles based on the requirements

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

1. Select fancy yarns for a given application.
2. Outline the manufacturing processes and applications of narrow fabrics.
3. Summarise the processes, techniques and applications of industrial webbings.
4. Outline the production processes of braided materials, machines and their applications.
5. Choose appropriate machines and processes for the production of carpets with the given specifications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2											3	
2	1	1											2	
3	2	2											3	
4	1	2											2	
5	1	2											2	

UNIT I **9 Hours**

FANCY YARNS

Slub Yarns - Crimp Yarn - Diamond Yarn - Boucle Yarn - Loop Yarn - Snarl Yarn - Mock Chenille Yarn - Knop Yarn - Stripe Yarn - Grandrelle yarn - Neppy yarn or Flaggy yarn - Button Yarn - Fascinated yarn - melange yarn. Methods for the production of fancy yarns in Ring spinning, Rotor spinning and Air Jet spinning. Applications of fancy yarns.

UNIT II **9 Hours**

NARROW FABRICS

Fibre and Yarn types, Fabrics. Preparation process for narrow fabric production-Winding, Warping, Sizing, Drawing-in, Denting-in. Woven narrow fabrics and their construction-structure of narrow fabrics woven on shuttleless looms. Conventional shuttle loom, unconventional shuttle looms and shuttleless looms for narrow fabrics production. End use. Industrial tapes: Slide fastener tapes - Insulating tapes -Book binders tapes - Labelling Tapes - Border Tapes, Elastic, Pleated lingerie ribbing.

UNIT III **9 Hours**

INDUSTRIAL WEBBINGS

Manufacture of spindle drive webbing- Print webbings - Webbings for automobile safety belts. Industrial nets: Knotted netting and applications.

UNIT IV **9 Hours**

INDUSTRIAL BRAIDS

Classification of braids - Trimmed braids, Flat braids and Circular Braids, Hollow braids. Production techniques. Properties and Application.

UNIT V **9 Hours**

CARPETS

Non-pile carpet weaves and their looms. Pile surfaced carpet weaves and their looms. Needle felt floor coverings.

Total: 45 Hours

Reference(s)

1. R. H. Gong and R. M. Wright, Fancy yarns Their manufactures and applications, Wood head Publishing Limited, 2002.
2. Turner J P, " The production and properties of narrow fabrics, Textile Progress, Vol.8 No.4, The Textile Institute, Manchester, 2002.
3. Sabit Adanur, "Wellington Series Handbook of Industrial Textiles, Technomic publishing company Inc., USA, 1995.
4. Jarmila Shvedova," Industrial Textiles", Elsevier Science Publishing Co in, ISBN -0444-98754-1, New York, 1990.
5. Alexander N G. Designing Interior Environment, Mas court Brace Covanorich Inc, New York, 1996.
6. Crew AH and Arahamsen H Carpets: Back to Front", Textile Progress, ol.19 No.3, The Textile Institute, Manchester, 1987.

21TT030/21TTM/H02 NONWOVEN TECHNOLOGY 3 0 0 3

Course Objectives

- To understand the fundamentals of various production processes in the manufacture of nonwovens.
- To acquire knowledge on the different methods of finishing nonwoven products.
- To understand the various applications of nonwovens.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2.Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Explain the nonwoven manufacturing processes using natural and chemical fibres.
2. Differentiate different bonding methods used in nonwoven manufacturing process.
3. Suggest suitable finishing methods of nonwoven meant for different applications.
4. Evaluate the nonwovens in terms of physical properties.
5. Outline the applications of nonwovens for hygiene and household products.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	1			1						3	3	3
2	2	3	2			2						3	3	3
3	2	3	2			3						3	3	3
4	2	3	1			3						3	3	3
5	2	3	2			3						1	3	3

UNIT I **9 Hours**

WEB FORMATION

Definition of Nonwoven - nonwoven manufacturing processes - nonwoven properties and applications including environmental considerations. Raw materials for the production of nonwoven: natural fibres -animal fibres -chemical fibres. Web forming - Lay process - spun laying. Spun bonding web formation

UNIT II **12 Hours**

BONDING

Needling: principle - needle characteristics - process variables- fabric properties. Loop formation processes: types - Process variables -fabric properties. Hydro-entanglement process: principle - process variables -Fabric properties. Bonding: Hot air - Heat setting - Thermal Calendar-Ultrasound - Chemical - saturation - print. Foam and spray bonding.

UNIT III **9 Hours**

FINISHING

Mechanical finishing: splitting and winding - perforating -drying - compressive finishes, Surface finishes: singeing - shearing - flocking - raising - polishing -softening, Wet finishes: washing - colouration -printing - Application of chemical finishes: types - antistatic agents - antimicrobial or biocidal finishes -flameproof finishes - waterproof finishes - softeners- stiffeners. UV stabilisers.

UNIT IV **8 Hours**

TESTING

Sampling and statistics - Testing conditions -Standards and specifications. Testing of raw materials - finished fabrics. Testing process related to end use: hygiene and medical products - household textiles. Protective clothing and filter fabrics.

UNIT V **7 Hours**

APPLICATIONS

Hygiene - medical-safety -cleaning - household products - home textiles - apparels - technical. Re- utilization of nonwovens - recycling of nonwovens. Techno economic in nonwovens.

Total: 45 Hours

Reference(s)

1. Wilhelm Albrecht, Nonwoven Fabrics, WILEY-VCH Verlag GMBH & Company, Germany, 2003.
2. S. Russell, Handbook of Nonwovens, The Textile Institute Publication, 2007.
3. O. Irsak, Nonwoven Textiles, Textile Institute, Manchester, 1999.
4. R. Krcma, Manual of Nonwovens, Textile Trade Press, Manchester, 1993.

18TT0XA COTTON FIBERS: OPTIONS AND ALTERNATIVES

1 0 0 1

Course Objectives

- To evaluate organic cotton and genetically modified cotton.
- To understand the alternatives available for cotton.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Apply the different types of cotton and cultivation process used for organic cotton.
2. Apply appropriate fibre for a specific end use.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2												
2	2	3												

Cotton Fibres: Morphology - Properties. Organic Cotton: Definition - Cultivation Methods - GOTS Certification system. Genetically Modified Cotton: Need for modification - Methods - Advantages - Properties of GM Cotton. Coloured Cotton: Types - Natural Colorants. Alternative Fibres: Bamboo fibres - Natural and Regenerated fibres - Regeneration process - Cultivation and extraction of natural bamboo fibres - Properties. Modal Fibres -Comparison of process sequence with conventional viscose rayon - Advantages – Properties.

Total: 15 Hours

Reference(s)

1. Journal of Natural Fibres.
2. http://www.cicr.org.in/.

18TT0XB FANCY YARNS **1 0 0 1**

Course Objectives

- To classify various types of fancy yarns, their structure and characteristics.
- To understand the working principles of various machines used for production of fancy yarns
- To understand the various effects of fancy yarns on fabric appearance

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Evaluate various production methods of fancy yarns.
2. Apply the process parameters that affect the quality and performance of fancy yarns.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3												
2	2	3												

Characteristics features, technology of production and end uses of: Slub Yarns - Crimp Yarn - Diamond Yarn - Boucle Yarn - Loop Yarn - Snarl Yarn - Mock Chenille Yarn - Knop Yarn - Stripe Yarn - Grandrelle yarn - Neppy yarn or Flaggy yarn - Button Yarn - Fascinated yarn - melange yarn. Production Methods for the manufacturing of fancy yarns in Ring spinning, Rotor spinning and Air Jet spinning - Production of Fancy yarns in short staple spinning systems - Factors influencing the fancy effects. Applications: Manufacturing of apparel fabric & home furnishing using fancy yarns.

Total: 15 Hours

Reference(s)

1. R. H. Gong and R. M. Wright, Fancy yarns "Their manufactures and applications", Wood head Publishing Limited, 2002.

18TT0XC DENIM FABRICS AND GARMENTS 1 0 0 1

Course Objectives

- To understand the key aspects of denim fabric production.
- To understand the various finishing treatments available for denim fabrics.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Analyse the key properties, structure and production of denim fabrics.
2. Apply the various finishing treatments for denim fabrics.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2				1							
2	2	2	2				2							

Yarn Requirements and Characteristics for Denim - Weaving of Denim Fabrics - Physical properties of denim fabrics. Dyeing of Warp Yarn - Indigo dyeing - Indigo & Sulphur dye combinations. Garments: Design and construction - production process of denim garments. Finishing of Denim fabrics and Garments - Stone and Stoneless Washing of Denim Garments. Bleaching of Denim Garments using Oxidative and Enzyme Treatments – Back staining of Garments and Remedies.

Total: 15 Hours

Reference(s)

1. M. S. Parmar, S. S. Satsanji and Jai Prakash, Denim: A Fabric for All, NITRA Publications, 1996.
2. J. V. Rao, Denim Washing, Northern India Textile Research Association, Ghaziabad, 2006.

18TT0XD TESTING OF DYES 1 0 0 1

Course Objectives

- To understand the working principle of various testing instruments meant for measuring the properties of dyes.
- To develop the operating procedures for different testing instruments used for analysis of dyes.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Analyse the strength and purity of textile dyes.
2. Analyse the toxicity of textile dyes.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	2	2												

Testing of dyes: Need for testing. Purity and strength: chemical - colorimetric methods - laboratory dyeing trials. Properties characteristics to a dye class: Direct - Vat - Disperse - Basic - Reactive dyes. Testing of dyeing auxiliaries: dye fixing agent - dispersing agent - leveling agent - carrier. Identification of dyes on fibres. Environmental and toxicological effects of dyes.

Total: 15 Hours

Reference(s)

1. Zollinger H, Colour Chemistry, Wiley - VCH, Switzerland, 2003.
2. Orientation Programme in Wet Processing - Quality and Process Control, ATIRA Publications, 2000.
3. Clayton E, Identification of Dyes on Textile Fibres, Society of Dyers and Colourists, UK, 2000.

18TT0XE TESTING OF AUXILIARIES 1 0 0 1

Course Objectives

- To analyse various auxiliaries used in textile chemical processing.
- To develop the operating procedures for different testing instruments used for testing auxiliaries.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Assess the testing instruments meant for measuring the properties of auxiliaries used in textile chemical processing.
2. Create procedures for testing auxiliaries used in textile chemical processing.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2		2										
2	3	3		2										

Assessment of Auxiliaries used in Fabric Preparation. Surfactant: Ionic Nature - Active Content – Performance of Strength of sodium hydroxide - Hydrogen Peroxide - Sodium hypochlorite. Assessment of Auxiliaries used in Dyeing and Printing. Assessment of Dispersing Agents -Detergents – Rongalite. Assessment of auxiliaries used in Finishing. Assessment of FBA for Active Strength - Softening Agents.

Total: 15 Hours

Reference(s)

1. Wet Processing Quality and Process Control, ATIRA Publications, Latest version.
2. J. W. Weaver, AATCC Technical Manual, American Association of Textile Chemists and Colourists, North Carolina, 1984

18TT0XF ECO PROCESSING 1 0 0 1

Course Objectives

- To understand ecology related issues connected with the Textile Industry and their consequences.
- To acquire knowledge on the technologies that are in line with preservation of ecology in the area of textile chemical processing.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11.Project Management and Finance: 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.

Course Outcomes (COs)

1. Evaluate the eco-friendly methods of processing of textiles.
2. Analyse the effect of toxicity on environment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3					2	2			2			
2	2	3					3	3		2	2			

Environmental Issues - Eco Standards. Environmentally friendly fibres - Harmful substances in natural fibres - Eco standards. Banned amines and toxic substances - Sources of contaminations – Approaches for Eco-processing: Reduce - Recycle - Reuse. Eco-friendly Preparation, Dyeing, Printing and Finishing: Eco-friendly fabric preparation methods - Solvent assisted preparation - ozone bleaching - peracetic acid. Hazardous nature of synthetic dyes - types of hazards - alternative dyes. Eco-friendly chemicals and auxiliaries in dyeing and finishing: Reducing agents - oxidizing chemical thickeners - sequestering agents - bio-surfactants. Eco-friendly finishing chemicals: Cross-linking treatment - formaldehyde-free chemicals - softeners - biopolishing.

Total: 15 Hours

Reference(s)

1. R. Asokan, Eco-Friendly Textile Wet Processing, NCUTE Publications, New Delhi, 2001.
2. Eco Textiles ’98: Sustainable Development, Bolton Institute, 1998.
3. Eco Textiles, Book of Papers, BITRA, 1996.

18TT0XG ERECTION AND COMMISSIONING OF TEXTILE MACHINES

1 0 0 1

Course Objectives

- To acquire knowledge on the basic steps to be followed during erection and commissioning of textile machinery.
- To select the appropriate tools and equipment for erection.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Analyse the fundamentals of machinery erection.
2. Apply the relevant tools and equipment for erection and commissioning of textile machines.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	3	3												

Floor levelling using U tube water level - Machine case handling while shifting machines - packing list and physical stock verification - arranging components for erection - storing sensitive and expensive components - work table arrangement - special tools - provisions for power and pneumatic lines - manpower: skilled and un-skilled manpower requirement - machine layout line marking - positioning the base machine - machine levelling - erection sequence - - training to operators & maintenance personnel - reports and sign off.

Total:15 Hours

Reference(s)

1. LMW erection manuals and handouts.

18TT0XH WORKLOAD AND WORK ASSIGNMENTS

1 0 0 1

Course Objectives

- To analyse key principles by which workloads are assigned in the textile industry.
- To understand the standards available on work assignments recommended in various sections of a textile mill.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Analyse the various factors concerning work load assignment.
2. Create a work load plan based on the machinery and production pattern of a spinning mill.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	3	3												

Definitions of Workload and Work assignment - multi-machine work assignment - interference. Workloads and assignments in Spinning, Weaving, Chemical Processing, Knitting and Garment industries - Factors influencing work assignments - measures for increasing productivity. Calculation of Productivity Measures in Spinning, Weaving and Chemical Processing. Productivity Indices.

Total: 15 Hours

Reference(s)

1. T. V. Ratnam et al, SITRA Norms for Spinning Mills, The South India Textile Research Association, Coimbatore, 2004.

18TT0XI AIR ENGINEERING IN TEXTILE INDUSTRY

1 0 0 1

Course Objectives

- To understand the significance of maintaining humidity and temperature in textile manufacture.
- To identify design and operational aspects of humidification plants.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Analyse the controls and parameters for maintaining the humidity level
2. Create a layout of the humidification system for the given level of machinery.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3												
2	2	3												

Humidity, Relative Humidity - Need for Maintaining Humidity - Types of Humidifiers: Steam - Evaporator Pan - Water Spray. Localized Humidification Control - Air Curtains - Air Handling Units- Concept of Total Air Control - Humidity and Health. Air Conditioning Units- Dehumidification - HVAC Systems.

Total: 15 Hours

Reference(s)

1. B. Purushothama, Humidity and Ventilation Management in Textile Industry, Wood head Publishing Limited, New Delhi, 2009.

18TT0XJ PRODUCT CERTIFICATION 1 0 0 1

Course Objectives

- To understand the importance and necessity for product certification.
- To examine the criteria to be fulfilled to obtain the certification for textile products.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Analyse the importance and necessity for product certification.
2. Evaluate the criteria to be fulfilled to obtain certification for textile products.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2				2		2						
2	3	3				2		3						

Necessity for certification - GOTS -Introduction - Certification - Licensing and labelling: Intertek - Chemical certification - Eco certification - Green leaf mark certification for customer goods - WRAP certification - Oeko-Tex R Standard 100 - Oeko-Tex R Standard 1000 - Oeko-Tex R Standard 100 plus - Product certification schemes of BIS - BRC - USDA organic - Organic exchange certification - Eco labels in Textiles - Wool mark - Silk mark - Handloom mark.

Total: 15 Hours

Reference(s)

1. www.global-standard.org/the-standard/general-description.html.
2. www.oeko-tex.com/oekotex100_public/content5.asp?area.
3. www.intertek.com/textiles/certification/.

18TT0XK ENERGY CONSERVATION IN THE TEXTILE INDUSTRY

1 0 0 1

Course Objectives

- To understand the energy conservation techniques applicable to textile industry.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Analyse the energy consumption of various machines in textile industry.
2. Execute the factors that influence the energy consumption in various processes in textile industry.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2				1	2							
2	3	3				2	3							

Need for energy conservation. Energy consumption: Spinning - Weaving - Knitting - Processing - Garmenting. Auxiliary machineries - Component wise consumption - Specific energy consumption (UKG). Energy Audit: Concept - Types of audits - Instrumentation - methodology - analysis. Electrical and Thermal audit. Techniques of energy saving: Energy efficient equipment's for various processing machines and ancillaries - Preparatory - Spinning - Post Spinning - Weaving Wet Processing - Humidification/Air conditioning - Lighting - Compressors - Boilers - Generators.

Total: 15 Hours

Reference(s)

1. Energy Conservation in Textile Industry, SITRA, 2005.
2. Palaniappan C et al, Renewable Energy Applications to Industries, Narose Publishing House, 1998.
3. Proceedings of International Seminar cum Exhibition ASIA Energy Vision 2020 - sustainable energy supply, November 15-17, 1996.

18TT0XL INDUSTRIAL ENGINEERING IN APPAREL MANUFACTURING **1 0 0 1**

Course Objectives

- To understand the need for industrial engineering in apparel industry.
- To familiarize the procedures and practices followed in the implementation of industrial engineering in apparel production.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Analyse work assignments by work and method study.
2. Deduce measures to improve labour productivity by conducting motion study and time study.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2			2									
2	3	3			3									

Basic needs and expectation of industry from the new engineers, Overall Process – Order flow from customer-Brand-Factory Factory process flow - Fabric receive to dispatch, Merchandising – sampling and costing. Fabric stores – Type of fabric, Fabric inspection process and type of inspection Pattern – Pattern making, Digitizing and Grading, CAD - Marker making and Marker planning, Spreading-Lay planning and type of spreading Cutting –Type of machines and cut process, Stickering, Bundling and checking, Sewing - Production process and machineries - Industrial Engineering - Time study, Method study, Capacity study, Target setting, Line balancing and material handling (Ergonomics)

Total: 15 Hours

Reference(s)

1. O. P. Khanna, Industrial Engineering and Management, Dhanpat Rai Publications (P) Ltd., New Delhi, 2004.
2. A. J. Chuter, Introduction to Clothing Production Management, Blackwell Publishing, Oxford, 2004.

18TT0XM INDUSTRIAL EXPORT MERCHANDISING **1 0 0 1**

Course Objectives

- To provide an overview on the process and procedure followed in the export merchandising in industry.
- To familiarize the documentation procedure adopted in the export merchandising.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO9.Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Organize production, visual merchandising, product development and line presentation.
2. Prepare material requirement plan for a given order and identify sourcing resources.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2							2					
2	3	3							3					

Introduction to export merchandising – Organisation of exports – Scope in exports – Marketing strategies – Types of customers. Forecast – Market study – Scope for new products – Trends and Developments – Trends sampling – Market observation – customer review and suggestions - new product and new design development. Product terms and types – product analysis – feasibility analysis – time study on products –sourcing and sampling process – Communication. Bulk planning – line planning – execution flow – programming – fabric forecast – fabric production – sewing trims and packing trims – sourcing of trims and in-housing - production planning and control – Export shipmentprocess.

Total: 15 Hours

Reference(s)

1. V. R. Sampath, P. Perumalraj and M. Vijayan, Apparel Marketing and Merchandising, Kalaiselvam Pathippakam, Coimbatore, 2007.
2. Ruth E Glock, Grace I Kunz, Apparel Manufacturing - Sewn Product Analysis - 3rd Edition, Prentice Hall Inc., 2000.

18TT0XN YARN COSTING **1 0 0 1**

Course Objectives

- To enable the students to learn about preparation of cost sheet.
- To enable the students to learn about preparation of costing of different yarn counts.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member andleader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Evaluate the various cost accountings with the basic knowledge on principles of costing for textile industry.
2. Estimate the yarn cost through accounting various cost elements in a spinning mill.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2									2			
2	3	3									3			

Raw material cost – Trash in Cotton – Clean Cotton Cost - Yarn Realisation%. Conversion Cost – Calculation of labour cost – machinery allocation – Category of worker – Direct labourcost – Indirect labour cost. Power cost – production rate – power consumption – humidificationpower consumption – compressor power consumption – captive power consumption – units per kg. Packing cost – Types of packing – cost per kg of packing. Selling expenses – commission – marketing – advertisement.

Total: 15 Hours

Reference(s)

1. Richard D. Irwin, Principles of Cost Accounting: Managerial Applications, 2003.
2. P. V. Bhave and V. Srinivasan, Cost Accounting in Textile Mills, ATIRA Publication, 2000.

18TT0XO FABRIC COSTING **1 0 0 1**

Course Objectives

- To enable the students to learn about preparation of cost sheet.
- To enable the students to learn about preparation of costing of different fabrics.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member andleader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Calculate the various elements of fabrics costing.
2. Understand the concepts of preparation of cost sheet, budget and fabric types.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2									2			
2	3	3									3			

Calculation of raw material consumption and its cost - Fabric construction assessment – weave – EPI – PPI – Yarn Count – Crimp% - weight of warp and weft. Cost of Warping. Cost of Sizing –Cost of size ingredients – Size add-on determination - cooking cost for different types of recipes. Weaving cost – speed of loom – calculation of cost per pick – Inspection. Packing cost – types of packing and cost of packing. Humidification power consumption.

Total: 15 Hours

Reference(s)

1. Richard D. Irwin, Principles of Cost Accounting: Managerial Applications, 2003.
2. P. V. Bhave and V. Srinivasan, Cost Accounting in Textile Mills, ATIRA Publication, 2000.

18TT0XP GARMENT COSTING **1 0 0 1**

Course Objectives

- To enable the students to learn about preparation of cost sheet.
- To enable the students to learn about preparation of costing of garments.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member andleader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Calculate the various elements of garment costing.
2. Understand the concepts of preparation of cost sheet, budget and garment sizes.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2									2			
2	3	3									3			

Direct cost Material labour. Over heads: factory office selling and distribution. Variances: material labour over heads. Preparation of the cost sheet in fabric production. Material labour direct expenses (trimmings)over heads factory: office selling and distribution. Variance: material labour overheads. Effects of width, designs and lot size on cost shipment cost preparation of cost sheet in garment production.

Total: 15 Hours

Reference(s)

1. Richard D. Irwin, Principles of Cost Accounting: Managerial Applications, 2003.
2. P. V. Bhave and V. Srinivasan, Cost Accounting in Textile Mills, ATIRA Publication, 2000.

18TT0XQ MEDICAL TEXTILES 1 0 0 1

Course Objectives

- To enable the students to learn about implantable and non- implantable materials.
- To enable the students to learn about healthcare and hygienic products.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.
PO7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Evaluate the functional requirements of wound dressings and bandages.
2. Evaluate the textile material used for hygiene and health care applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2				2							
2	3	3	3				3							

Metals, ceramics, polymers used for bio medical applications – manufacture, features and limitations; cell-biomaterial interaction. Non-implantable materials: Wound dressing- requirements of wound dressing, types, properties and applications; bandages - types, evaluation and applications. Implantable biomedical devices: vascular grafts, sutures - types, properties and applications; extra-corporeal materials; scaffolds for tissue engineering. Healthcare and hygiene products: surgical gowns, masks, respirators, wipes, antibacterial textiles, super absorbent polymers Safety, Legal and ethical issues involved in using medicaltextile materials

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Total: 15 Hours

Reference(s)

1. A. R. Horrocks and S. C. Anand, Handbook of Technical Textiles, Wood head Publishing Limited and The Textile Institute, 2000.
2. Alagirusamy and A. Das, Technical Textile Yarns, CRC press, 2010.

18TT0XR GARMENT PRINTING **1 0 0 1**

Course Objectives

- To analyse various special printing techniques used in textile chemical processing.
- To develop the application process for special printing techniques.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO4. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PSO1. Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

1. Evaluate the special printing techniques used in textile chemical processing.
2. Prepare the textile material and develop procedures for special printing techniques used in textile chemical processing.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2		2									3	
2	3	3		3									3	

Screen printing, Transfer printing: Inkjet/Laser Printer, Sublimation printing, Transfer Paper & Heat Press, Direct to garment printing, Vinyl printing, flock printing, Plastisol Transfers, Puff Print technique, Gel printing, Glow printing, metallic printing: gold, silver and bronze, UV glow printing, Suede printing, Glitter printing, Stencil Printing, Marble printing.

Total: 15 Hours

Reference(s)

1. https://sewguide.com/best-t-shirt-printing-methods/
2. https://www.seamwork.com/magazine/2015/02/the-art-of-marbled-fabric.
3. J. W. Weaver, AATCC Technical Manual, American Association of Textile Chemists and Colonists, North Carolina, 1984.

18TT0XS ADVANCEMENT IN GARMENT MANUFACTURING **1 0 0 1**

Course Objectives

- To understand the working principles of various automated machines.
- To understand the benefits of automated machines in garment manufacturing.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

1. Understand the importance of garment automated machines.
2. Summarise the economical benefits of automation in garment manufacturing.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2											3	
2	3	3											3	

Automated elements in clothing production – spreading- cutting of fabric - cutting by water jet, laser, plasma - automated sewing machines. Types of driving mechanism of sewing machines – single needle lock stitch machine, over lock and flat lock machine. Automation in special machines – bar tack, pocket making and patterning machines, button holing and sewing machines.

Total: 15 Hours

Reference(s)

1. Berkstresser, G.A. & Buchanan, E.M., Automation and Robotics in the Textile and Apparel Industries, Noyes Publications, 1986/
2. M.G.Mahadevan, “Textile Robotics and Automation”, Abhishek Publications, Chandigarh, 2001.
3. A.Gordan, et al., “Automation and Robotics in the Textile and Apparel Industries (Textile series)”, Noyes Publication, UK, 1986.
4. G.A.Berkstresser, “Automation in the Textile Industry: From Fibers to Apparel”, 1st Edition, Technomic Publishing Co., Inc, UK, 1995.
5. M.Acar, “Mechatronic Design in Textile Engineering”, NATO Science Series, 1st edition, Springer, USA, 1994.
6. Carr H., and Latham B., “The Technology of Clothing Manufacture”, Blackwell Science Ltd., Oxford,1994.

18TT0XT SMART TEXTILES **1 0 0 1**

Course Objectives

- To understand the working principles of various smart textiles.
- To understand the various applications of smart textile products.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

1. Evaluate various production methods of smart textiles.
2. Summarise the parameters that affect the quality and performance of smart textiles.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3											3	
2	3	3											2	

Intelligent fibres-Phase change materials, Heat balance and thermo-physiological comfort, intelligent textiles with PCMs - intelligent polymers for biomedical applications, shape memory materials - wearable technology for snow clothing – Textile scaffolds in tissue engineering – ideal scaffold system, scaffold materials, textile scaffolds.

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Total: 15 Hours

Reference(s)

1. Smart fibres, fabrics and clothing, By Xiaoming Tao., Woodhead Publishing Limited, Cambridge, England.
2. Intelligent textiles and clothing, by H.R.Mattila, Woodhead Publishing Limited, Cambridge, England.
3. Wearable electronics and photonics, by Xiaoming Tao, Woodhead Publishing Limited, Cambridge, England.
4. New fibres, By Tatsuya Hongu and Glyn O Phillips, Ellis Horwood, New York, London, Toronto, Sydney, Singapore.

18TT0XU GARMENT FINISHING 1 0 0 1

Course Objectives

- To understand the finishing importance on garment materials.
- To analyse the design, functional features of garment finishing techniques.

Programme Outcomes (POs)

PO2. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

PO3. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.

PO4. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments.

PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

PSO2. Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Evaluate the finishing operations on garments.
2. Assess the functional finishers quality on textiles.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2	2	1									2	2
2		2	2	2									2	2

Overview of textile colouration and finishing machinery and processes: Scouring, bleaching, mercerizing, dyeing, printing, finishing. Fabric pretreatment methods and its precautions-Need of garment dyeing-garment dyeing machines-garment dyeing methods-garment dyeing parameters- - garment dyeing dyestuff selection-quality assurance and control in garment dyeing-advantages and disadvantages in garment dyeing-recent trends and brands. Flame retardant finish, Soil release finish, Antistatic finish - UV Protection finish- Antimicrobial finish- Anti odour finish- enzymatic treatment (biopolishing): Methods & mechanism. Sustainable process methods and chemicals in denim processing and washing. Evaluation and testing methods. Quality evaluation of mechanically finished textile material.

Total: 15 Hours

Reference(s)

1. S. P. Mishra, A Textbook of Fibre Science and Technology, New Age publication, 2000.
2. V. A. Shenai, Evaluation of Textile Chemicals, Sevak publications, Mumbai, 1995.
3. John Shore, Cellulosic Dyeing, Society of Dyers and Colorists, 1995.
4. P. W. Harrison, Low-Liquor Dyeing and Finishing, Textile Progress, UK, 1986.

18TT0XV QUALITY AUDITS FOR EXPORT MERCHANDISING

1 0 0 1

Course Objectives

- To teach the activities of marketing and merchandising in the apparel industry.
- To teach the commercial and sourcing aspects of the garment industry.

Programme Outcomes (POs)

PO2. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

PO3. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.

PO4. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments.

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PSO1.Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

PSO2. Develop new designs (woven / printed / dyed) and products (knitted / woven / nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Construct organization charts for industrial units of varying sizes; plan for realizing export incentives.
2. Organize production, visual merchandising, product development and line presentation.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		1	2	1	2								2	2
2		2	2	2	1								2	2

Introduction to apparel industry - Organization of the apparel industry - Types of exporters - Business concepts applied to the apparel industry - International trade- Merchandiser functions on export orders, communications with the buyers - awareness of current market trends, different standards and certifications required for Export orders. WTO: Functions and objectives. GSP. Export incentives: Duty drawback - DEPB - Import - Export.

Total: 15 Hours

Reference(s)

1. J. E. Booth, Principles of Textile Testing, CBS Publishers & Distributors, New Delhi,1996.
2. Pradip V. Metha, An Introduction to Quality Control for the Apparel Industry, ASQC Quality Press, Marcel Dekker Inc New York, 1992.
3. R. Ed Postle, S. Kawabata and M. Niwa, Objective Evaluation of Fabrics, Textile Machinery Society, Japan, Osaka, 1983.
4. Dale H. Basterfield, Total Quality Management, Pearson Education Inc., 2004.
5. James R. Evans and William M. Lidsay, The Management and Control of Quality, South Western (Thomson Learning), 2002.

18GE0XA ETYMOLOGY 1 0 0 1

Course Objectives

- To increase vocabulary and enhance use, knowledge, and understanding of the English language.
- To stimulate an appreciation for the English language, including how it developed, how new words enter the language, and how it continues to be dynamic.
- To demonstrate the importance of a broad-based vocabulary for effective oral and written communication.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Examine prefixes, roots, and suffixes of Latin, Greek, Germanic, and Anglo-Saxon origin.
2. Explore the historical aspects of language, including the infusion of Indo-European languages, semantic changes, and the influence of world events.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	2	2												

UNIT I **7 Hours**

CONVENTIONS

Acronyms, Abbreviations, Initializes, Jargon Neologisms - Idiomatic Expressions, Euphemisms Spoonerisms Malapropisms; Mondegreens - Words Derived from Latin - Words Derived from Greek - Words Derived from - Germanic/Anglo-Saxon - Abstract word Acronym - Affix Analogy - Antonym Apheresis - Blend word Assimilation - Colloquial language Clipped word

UNIT II **8 Hours**

WORD ANALYSIS

Concrete word Derivative - Dialect Diminutive suffix - Dissimilation Doublet - Etymology Euphemism - Figurative word Homonym - Hybrid word Inflection - Informal language Infusion - Jargon Linguistics - Loan words Metathesis; Modify - Philology Onomatopoeia - Romance language Prefix - Semantics - Root-base word - Suffix Slang - Word component Synonym

Total: 15 Hours

Reference(s)

1. Norman, Lewis. Word Power Made Easy, Goyal Publisher. Edition 2. 2014.
2. C T Onions. The Oxford Dictionary of English Etymology, Volume 11, Issue 1.70, Wynford Drive, Don Mills, Oxford University Press.1965.
3. Nurnberg W, Maxwell and Rosenblum, Morris, How to build a better Vocabulary, Completely Revised and Updated, Popular Library. 1961.

18GE0XB GENERAL PSYCHOLOGY 1 0 0 1

Course Objectives

- To provide a basic understanding of psychology.
- Defining Psychology and the subject matter of psychology.
- To provide an awareness of various methods and branches of psychology.
- To explain social and work psychology of people and the need for mental health.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Understand the basics of human behaviour in the workplace and society at large.
2. Understand the different fields of psychology and its uses.
3. Deal people effectively in their personal and social life.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	2	2												
3	2	2												

UNIT I **15 Hours**

GENERAL PSYCOLOGY

Psychology - Introduction - Mind body relationship - Methods and Scope of Psychology -Motivation- Types of Needs- Motivational Cycle- Intelligence: Concept of Intelligence and IQ- measurement - Social psychology: individual behaviour and group behaviour - Group dynamics- group formation- social influence-social cognition, stereotypes- prejudice- discrimination - Definitions, formation of attitude, factors of attitude formation-change of attitude.

Total: 15 Hours

Reference(s)

1. Atkinson & Atkinson, Introduction to Psychology, 6th Ed McGraw-Hill Publications. 1975.
2. Mishra, B. K, Psychology: The study of human behaviour, 2nd Ed New Delhi: Prentice Hall of India Learning Pvt. Ltd. 2016.
3. Baron, R.A., Branscombe. N.R, Social Psychology, 14th Ed. New Delhi; Pearson Education. 2016.
4. Morgan, C.T., King, R.A., Weisz, J.R., & Schopler, J. Introduction to Psychology, 7th Ed. New Delhi: Tata McGraw Hill. 1993.

18GE0XC NEURO BEHAVIORAL SCIENCE 1 0 0 1

Course Objectives

- To provide an introduction to the Cognitive Neuro Science of languages.
- To provide an understanding of the Cognitive processes.

Programme Outcomes (POs)

PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Identify the psychological problems that will impact mental health.
2. Value ethical conduct in professional and personal life.
3. Recognize the need for rationale and evidence in decision-making.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									1					
2									2					
3									3					

UNIT I **15 Hours**

NEURO BEHAVIOURAL SCIENCE

Introduction to physiology - Anatomy - Neuro Biology - Psycho Neuro Science Behaviour and Hormones - Behaviour Modifications - Relaxation Therapy - Psycho Education for minds.

Total: 15 Hours

Reference(s)

1. Beck, Robert. Handbook of Physiology. Vol I. Oxford University Press March 15,1996.
2. Horon C Philip. Sexology and Mind. Academic Press. 1993.
3. Blatteis M.Clark and Melvin J. Fregly. Handbook of Physiology Sect 4, Oxford University Press. March 15, 1996.

18GE0XD VISUAL MEDIA AND FILM MAKING 1 0 0 1

Course Objectives

- To acquire fundamental knowledge on development of filmmaking as an art.
- To provide students a basic understanding of the techniques and nuances of visual medium.
- To inculcate an ability to plan and produce a short film.

Programme Outcomes (POs)

PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Understand the significance and techniques of visual medium
2. Analyse and produce visual clippings

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		1				2								
2		1				2								

UNIT I **15 Hours**

ART OF FILMMAKING

History of Cinema (Origin and Narrative) Cinema as a visual medium -Significance of Editing, Styles of Editing, Editing as a methodology (Hollywood s Invisible Editing) Technical Aspects of Editing (Final Cut Pro (FCP), AVID and Premire Pro) - Basics of video production (pre-production to post-production) Different types of shots and angles - Film style and Narrative (Italian Neo-realism, Avant Garde, Russian Formalism, Alternative Cinema etc.,) Regional Cinema to National Cinema Basics of Script Writing (Double and Single Column) Basics of Video Production (script to screen) Final submission of a script for five minutes short film

Total: 15 Hours

Reference(s)

1. Monaco, James, How to Read a Film: Movies, Media, and Beyond. Auckland: OUP, 2009.
2. Belavadi, Vasuki, Video Production. India: OUP, 2013.

18GE0XE YOGA FOR HUMAN EXCELLENCE 1 0 0 1

Course Objectives

- To know about the history and schools of yoga.
- To know the difference between supreme consciousness and individual consciousness.
- To apply the knowledge by the way of practice and introspection.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Understand the historical aspects and schools of yoga
2. Ensure their physical & mental wellness through yoga practice
3. Develop the power to concentrate and have stress free mind

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3												
2	2	2												
3	2	2												

UNIT I **15 Hours**

YOGA FOR HUMAN EXCELLENCE

What is Yoga, History of Yoga - Yoga in today's scenario- Schools of Yoga - Eight Limbs of Yoga - Sathvic, Rajasic, Tamasic Foods and Thoughts - Science of Yoga Loosening Exercises - Yogasanas & Benefits - Super Brain Yoga - Surya Namaskar Standing Asanas - Sitting Asanas - Prone Asanas - Supine Asanas – Mudras Relaxation - Pranayama - Meditation

Total: 15 Hours

Reference(s)

1. Vethathiri Publications, Yoga Practices-2, Erode, 2012.
2. Iyengar B.K.S. Yoga: Wisdom & Practice, B.K.S. Iyengar, 2009.
3. Ramesh Partani, The Complete Secret, Ru Education, 2013.
4. http://www.sarvyoga.com/.
5. http://www.wikihow.com/Do-Superbrain-Yoga.

18GE0XF VEDIC MATHEMATICS 1 0 0 1

Course Objectives

- To improve their calculation speed, analytical thinking and numerical skills.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Solve problems creatively in mathematics and its applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2												

UNIT I **15 Hours**

VEDIC MATHEMATICS

Addition- Subtraction- System of Multiplication- Squaring numbers- Cube roots- Square roots- Solution of simultaneous equations- Solutions of Quadratic equations.

Total: 15 Hours

Reference(s)

1. Dhaval Bathia, Vedic Mathematics, JAICO Publishing House, 29th Edition, Mumbai, 2014.
2. Jagadguru Swami Sri Bharathi Krsna Tirthaji Maharaja, Vedic Mathematics, Motilal Banarsidass Publishers Private Limited, New Delhi, 1997.

18GE0XG HEALTH AND FITNESS 1 0 0 1

Course Objectives

- To understand the fundamental concepts about physical fitness & its types, training and assessment of physical fitness.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Acquire the knowledge and training of the individual physical, mental and social concepts.
2. Understand the fundamental concepts of yogic practice and physical fitness.
3. To acquire the knowledge about nutrition and health consciousness.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2												
2	2	3												
3	3	3												

UNIT I **5 Hours**

FITNESS

Meaning & Definition, Need & importance of Physical fitness, Types Physical fitness - Exercise, Training and Conditioning and it is important.

UNIT II **5 Hours**

YOGA AND MEDITATION

Meaning and definition; Principles of practicing; Basic Asana and it important; Pranayama and Meditation - Relaxation Techniques.

UNIT III **5 Hours**

NUTRITION AND BALANCE DIET

Nutrition and Balance Diet: Needs and Important, Significant of Nutritional Food - Tips for balance diet. Common Diseases for IT professionals: Common diseases - cause prevention-First aid for common sports injuries.

Total: 15 Hours

Reference(s)

1. Anderson, Bob., Pearl, Bill. &Burke, Edmund R., (2001). Getting in Shape Workout Programs for Men &Women. Mumbai: Jaico Publishing House.
2. Baechle, Thomas. R, & Earle, Roger. W., (2000). Essentials of Strength Training and Conditioning. Champaign: Human Kinetics.
3. Iyengar, BKS., (2003). The Art of Yoga. New Delhi: Harper Collins Publishers.
4. Singh, Hardayal, (1995). Science of Sports training. New Delhi: D.V.S. Publications.
5. Begum, Raheena. M., (2002). A Textbook of Foods, Nutrition and Dietetics. New Delhi: Sterling Publishers Private Limited.

18GE0XH CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMICOMPOSTING

1 0 0 1

Course Objectives

- To understand the importance of safe methods of treating solid wastes generated through various human activities.
- To appreciate the skills / devices / practices associated with the compact procedures of biodegradation of unwanted solid residues.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Understand the role of recycling of garbage leading to the sustenance of our health and environment.
2. Recognize the organic farming practices and production of healthy food products.
3. Prepare and maintain tips for small scale compost units and thereby becoming more environmentally conscious.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3												
2	2	2												
3	2	3												

UNIT I **15 Hours**

VERMICOMPOSTING TECHNOLOGY

Ecological roles and economic importance of earthworms - need for earthworm culture, scope and importance of vermiculture , limiting factors - types of worm culturing and the relative benefits Small scale and commercial methods: process & advantages , Vermicomposting equipment's, devices, Design and maintenance of vermi bed - Products from vermiculture (matter & humus cycle), vermi castings in organic farming/horticulture - Marketing the products of vermiculture quality control, market research, marketing techniques , Applied vermiculture: use of urban solids & farm/ industrial residues for vermicomposting - Constraints of vermiculture and its future perspectives Artificial Earthworm as a standalone biodegradation assembly.

Total: 15 Hours

Reference(s)

1. Sultan Ahmed Ismail, 2005. The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.
2. Vermiculture Technology; Earthworms, Organic Wastes and Environmental Management, 2011, Edited by Clive A Edwards, Norman Q Arancon & Rhonda Sherman, CRC Press.
3. www.organicgrowingwithworms.com.au.
4. New York Times, Scientists Hope to Cultivate and Immune System for Crops.

18GE0XI BLOG WRITING **1 0 0 1**

Course Objectives

- To sharpen and improve writing skills, including draft writing, voice, and format.
- To develop general and global knowledge.
- To experiment with non-written forms of online communications, including images, audio and video.
- To be able to add content to your website without the assistance of a web designer.

Programme Outcomes (POs)

PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Understand the flow of language in natural manner.
2. Understand the elements of a blog and be able to use them effectively.
3. Find a niche for a long-term blog.
4. Gain insight into the strategies, methods and writing of successful bloggers.
5. Develop their creative thinking.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						1	1			1				
2						2	1			1				
3						2	1			1				
4						1	2			1				
5						2	1			1				

UNIT I **7 Hours**

Concept: What is blog writing? Types of blog posts -personal experience, opinion, reviews, advice, news/updates. Focusing your blog - concept, audience, uniqueness, posts. Company blogs. Structure: Types of structure - inverted pyramid, feature article, list, story, other options. Creating effective openings. Planning a post.

UNIT II **8 Hours**

Voice: Defining and achieving voice. Exploring various voices. Stylistic tips, rhythm, verbs, interesting words, senses, emphasis. Smartness and sarcasm. Reliability - accuracy, provability, specificity. Transparency about payments. Sample Blogs and Activities

Total: 15 Hours

Reference(s)

1. The Elements of Blogging: Expanding the Conversation of Journalism, by Mark Leccese and Jerry Lanson. (Taylor & Francis, 2015) ISBN: 978-1-13-802154-9. $29.95 paperback.
2. Blogging Heroes, by Michael Banks. Choose 15 of the 30 interviews/profile segments to read, be sure to include the segments on Chris Anderson and Brian Lam.
3. Complete Guide to Blogging, Huffington Post.

18GE0XJ INTERPERSONAL SKILLS 1 0 0 1

Course Objectives

- To communicate and work effectively, both individually and in groups.
- To be able to understand and manage one's own and others' emotions.
- To define and solve problems by making decisions about the best course of action.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Express themselves clearly and confidently
2. Listen to others completely and with empathy
3. Assert an opinion without diminishing other's opinion
4. Be responsible and timely with a willingness to collaborate
5. Develop innate personality traits to handle certain social situations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	1	2												
3	2	1												
4	1	2												
5	2	1												

UNIT I **7 Hours**

INTRODUCTION

Conversational Skills - Active Listening - Team working Empathy - Emotional Intelligence.

UNIT II **8 Hours**

SKILLS

Conflict Resolution and Mediation skills - Decision making and Problem Solving - Negotiation and Persuasion skills.

Total: 15 Hours

Reference(s)

1. Stephen P. Robbins, Phillip L. Hunsaker, Training in Interpersonal Skills, Pearson, 2015.
2. Robert B. Cialdini, Influence: The Psychology of Persuasion, Harper Business; Revised Edition, 2006.
3. Suzanne C De Janasz, Karen O Dowo & Beth Z Schneder, Interpersonal Skills in Organizations, McGraw-Hill Education; 5th Edition, 2014.

18GE0XK NEW AGE INNOVATION AND ENTREPRENEURSHIP

1 0 0 1

Course Objectives

- Understand the role of National Service Scheme in community.
- Identify the needs and problems of the community and involve in problem solving.
- Develop competence required for group living and acquire leadership qualities.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Understand the community in which they work and render their service.
2. Develop among themselves a sense of social and civic responsibility.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	2	2												

UNIT I **15 Hours**

COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT

Introduction and Basic Concepts of NSS: History-philosophy-aims & objectives of NSS- Emblem, flag, motto, song, badge- Organizational structure, roles and responsibilities functionaries. NSS Programmes and Activities: Concept of regular activities, special camping, Day Camps-Basis of adoption of village/slums-Methodology of conducting Survey -Financial pattern of the scheme -Coordination with different agencies-Maintenance of the Diary. Community Mobilization: Mapping of community stakeholders-Designing the message in the context of the problem and the culture of the community-Identifying methods of mobilization-Youth-adult partnership. Health, Hygiene & Sanitation: Definition, needs and scope of health education- Food and Nutrition - Safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan). Entrepreneurship Development: Definition & Meaning - Qualities of good entrepreneur - Steps/ways in opening an enterprise -Role of financial and support service Institutions.

Total: 15 Hours

Reference(s)

1. A Hand book on National Service Scheme, Anna University, Chennai, 2012.
2. http://nss.nic.in/intro.asp.
3. Delgado-Gaitn and Concha, The Power of Community: Mobilizing for Family and SchoolingNew York: Rowman & Littlefield Publishing, Inc. 2001.
4. James Bailey,Guide to Hygiene and Sanitation in Aviation, World health organization, 2nd edition. 1980.
5. AnuradhaBasu, Mark Casson, Nigel wadeson and Bernard Yeung, The oxford hand book of entrepreneurship, Oxford Press. 2009.

18GE0XL NATIONAL CADET CORPS 1 0 0 1

Course Objectives

- To understand the importance of NCC and its organization.
- To realize the skills in the applications of drill and weapon training.
- To analyze the factors in National unity.
- To identify the utility of smart materials in engineering applications.

Programme Outcomes (POs)

PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO9.Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Recall the motto and aim of NCC.
2. Implement synergy in disaster management.
3. Execute an example patriotic leader to serve nation.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1							2		2					
2							1		2					
3							1		2					

UNIT I **7 Hours**

NCC STRUCTURE AND TRAINING

NCC Organization: National Cadet Corps: Aim and Objectives - Administrative and Organizational pattern - NCC flag and NCC song - Duties, Responsibilities and Conduct by NCC Cadets - Badges of ranks in NCC and Armed forces- Types of NCC camps - Eligibility conditions for writing B and C certificate examinations. Cadet welfare society and Career opportunities for NCC cadets. Drill and Weapon Training: Drill: Aims of drill - Types of drill - Foot drill, Arms drill and Ceremonial drill. Word of commands, Guard of honour. Weapon training - Rifles used in NCC: Parts and Characteristics of 0.22 and INSAS - Stripping, Assembling and Cleaning of weapons. National Integration and Social Awareness: National Integration: Introduction - Constitution of India- Importance and Necessity - Factors affecting National integration - Role of NCC in National integration. Social service and its need - Rural development programs - NGOs role and Contribution - Social Security schemes.

UNIT II **8 Hours**

PERSONALITY DEVELOPMENT AND LEADERSHIP

Personality Development and Leadership: Personality Development: Introduction - Factor influences in personality development. Leadership: Leadership traits and Skills - Indicator of good leader - Honour code concept - Type of leaders - Case studies of effective leader. Disaster Management and First Aid: Disaster types - Natural and Manmade disasters. Role of NCC cadets in disaster management. Civil defence: Civil defence measures - Civil defence services. First aid: First aid kits and Equipment's - Firstaid for snake bite, Sun stroke and Drowning - Respiration -Types of respiration.

Total: 15 Hours

Reference(s)

1. Cadets Hand book Common subject, DG NCC, New Delhi.
2. Cadets Hand book Special subject, DG NCC, New Delhi.
3. Misra R.C and Sanjaykumar Mishra, A HAND BOOK OF NCC(English), Kanti Prakashan, 2016.
4. Gupta R. K, NCC: Handbook of NCC Cadets for A, B and C Certificate Examinations (English) RPH Editorial Board, 2018.

18GE0XM COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT

1 0 0 1

Course Objectives

- To make the participants understand as to how to get along with the task of setting independent business units and on the various facets of running a business.
- To get the budding young entrepreneurs to appreciate the structured knowledge of the dynamics of operationalizing a business opportunity.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Understanding entrepreneurship as an important career option.
2. Concept and methodology of idea translation to viable start-ups.
3. Events to occur in the building of a technology-based venture for students or working professionals or women.
4. Overview of Indian trends in the start-up scene.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1								2				
2	2	2								2				
3	1	2								2				
4	1	2								2				

UNIT I **15 Hours**

NEW AGE INNOVATION AND ENTREPRENEURSHIP

Introduction to Entrepreneurship - Opportunity Identification ideation -MVP Positioning as an Entrepreneur Starting own Business - Developing Effective Business Model - Industry and Competitor Analysis - Building Business Plan Mentoring Session with Investors- Legal and Ethical Foundation for Startup. Types of startups and licensing systems - MSME -Evaluating the Financial Strength of a New Venture/Project - Getting Funding - Types of Sources VCs, Angel funding, PE etc. -Marketing Strategies for New Ventures - IT Systems - IPR - Strategies for New Venture Growth - Talent Acquisition and Management for New Ventures - Valuation Challenge in Entrepreneurship - Intrapreneurship Sustainability - Exit strategies and Start-up trends in India.

Total: 15 Hours

Reference(s)

1. Kathleen R. Allen, Launching New Ventures, South-Western Cengage Learning, 6th Edition, 2012.
2. Alex Osterwalder and Yves Pigneur, Business Model Generation, published by the authors, 2010.
3. Branson. R. Business stripped bare, New York, Penguin books, 2011.
4. Moris MH, Kuratko DF and Covin JG, Corporate entrepreneurship and innovation, 3rd editions,Mason, Oh; CENGAGE/SOUTH WESTERN publisher, 2011.

18GE0XN DISRUPTIVE INNOVATION BASED STARTUP ACTIVITIES

1 0 0 1

Course Objectives

- To make the participants understand as to how to get along with the task disruption led innovations.
- To get the budding young entrepreneurs to appreciate the structured knowledge of the dynamics of operationalizing creativity-based disruption strategy.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO11.Project Management and Finance: 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.

Course Outcomes (COs)

1. Understanding contemporary entrepreneurship as an important career option.
2. Concept and methodology of creative disruption to viable start-ups.
3. Events to occur in the building of a technology-based venture for students or working professionals or women with disruptive technology option.
4. Overview of Indian trends with reference to disruptive innovation-based start-ups.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1									2			
2	1	2									1			
3	2	2									2			
4	1	1									2			

UNIT I **15 Hours**

DISRUPTIVE INNOVATION

Creativity linked innovation- Differences between Disruptive & incremental Innovations - Historical, theoretical, and practical evolution of disruptive innovation (DI). - Idea generation & communication of creativity leading to DI. Innovation management concepts in DI based entrepreneur generation - How do firms bring in new business models and get new products and services to the market? - Investor preferences in core versus new or disruptive business models - disruptors and the disrupted frameworks for assessing company's capabilities and rethinkingproduct, market and strategy - Right customers for DI: strategy in a world that is changing sorapidly- Application of disruptive theories to complex problems and opportunities.

Total: 15 Hours

Reference(s)

1. https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1540-5885.2005.00177.x.
2. http://www.brinq.com/workshop/archives/2005/01/08/what-is-disruptive-innovation.
3. https://hbr.org/2006/12/disruptive-innovation-for-social-change.

18GE0XO SOCIAL PSYCHOLOGY 1 0 0 1

Course Objectives

- To provide a basic understanding of social psychology.
- Defining psychological & physical changes during puberty age.
- To provide an awareness of various psychological problems and social problems.
- To explain social and work psychology of people and the need for mental health.

Programme Outcomes (POs)

PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Understand the basics of human behaviour in the workplace and society at large.
2. Understand the various psychological, physical, social problems and management skills.
3. Deal people effectively in their personal and social life.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									2					
2									2					
3									3					

UNIT I **7 Hours**

INTRODUCTION

Introduction - Ice breaker - Time Line - Tasks and Challenges of the age (Erik Erikson) Physical changes - Introduction to Reproductive Health - Reproductive Organs - Menstruation - Changes during Puberty - Abortions - Contraception - Difference between Sex and Gender - Introduction to the origins of Patriarchy - Gender.

UNIT II **8 Hours**

PSYCHOLOGY

Developmental changes - Attraction - Friendship - Differences and Similarities - Images of Beauty and Body Image -Introduction to Media-Feedback - Sexuality - Boundaries Relationships - Marriage - Love - Emotional Health - Sexual Abuse and Safety - Role of Media - Abortions, Contraception, Wrapping up the Course.

Total: 15 Hours

Reference(s)

1. Baron, R. A., Branscombe.N.R.(2016). Social Psychology, 14th Edition. New Delhi; Pearson Education
2. Morgan,C.T., King,R.A.,Weisz,J.R.,& Schopler,J.(1993). Introduction to Psychology, 7thEdition. New Delhi: Tata McGraw Hill.

21OCE01 ENERGY CONSERVATION AND MANAGEMENT

3 0 0 3

Course Objectives

- To develop an understanding and analyze the energy data of industries.
- To carryout energy accounting and balancing.
- To conduct energy audit and suggest methodologies for energy savings.
- To utilize the available resources in optimal ways.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO11.Project Management and Finance: 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.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Classify and characterize the various energy utilization techniques.
2. Identify suitable technique to provide an energy efficient system.
3. Identify the need for thermal systems with latest technologies.
4. Choose suitable techniques doe conserving energy with respect to emerging trends.
5. Assess the impact economics on the conservation of energy.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1										1	3
2	1	3									1	3
3	1	3									2	3
4	1	3	2								3	3
5	1	2	2								1	3

UNIT I **9 Hours**

INTRODUCTION

Energy - Power – Past & Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

UNIT II **9 Hours**

ELECTRICAL SYSTEMS

Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT III **9 Hours**

THERMAL SYSTEMS

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and Encon measures. Steam: Distribution & Usage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories.

UNIT IV **9 Hours**

ENERGY CONSERVATION IN MAJOR UTILITIES

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets

UNIT V **9 Hours**

ECONIMICS

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept .

Total: 45 Hours

Reference(s)

1. Energy Manager Training Manual (4 Volumes) available at www.energymanager training.com,a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.
2. Witte. L.C., P.S. Schmidt, D.R. Brown, “Industrial Energy Management and Utilization” Hemisphere Publication, Washington, 1988.
3. Callaghn, P.W. “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981.
4. Dryden. I.G.C., “The Efficient Use of Energy” Butterworths, London, 1982.
5. Turner. W.C., “Energy Management Hand book”, Wiley, New York, 1982.
6. Murphy. W.R. and G. Mc KAY, “Energy Management”, Butterworths, London 1987.

21OCS01 OBJECT ORIENTED PROGRAMMING 3 0 0 3

Course Objectives

- To understand the concepts of Object-Oriented Programming.
- To study the concepts of objects and classes.
- To familiarize in the types of constructors.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Identify the characteristics and data types of C++ language.
2. Develop programs using objects and classes for real world applications.
3. Construct programs to implement operator overloading and inheritance techniques.
4. Apply Polymorphism and File streams concepts to develop C++ program.
5. Design applications using templates and apply exception handling mechanisms.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2			3									
2	1	2	3		3									
3	1	2	2		3									
4	1	2	3		3									
5	1	2	3		3									

UNIT I **8 Hours**

INTRODUCTION

Need for object-oriented programming - Procedural Languages vs. Object oriented approach - Characteristics Object oriented programming - C++ Programming Basics: Basic Program Construction - Output Using Cout - Input with Cin - Data types- Variables and Constants - Operators - Control Statements-Manipulators - Type conversion. Function Prototyping- call by reference, return by reference- Inline function- Default arguments - Function overloading.(Sona).

UNIT II **8 Hours**

OBJECTS AND CLASSES

Objects and Classes Simple Class - C++ Objects as Physical Objects - C++ Object as Data types- CONSTRUCTORS: Parameterized Constructors - Multiple Constructors in a Class - Constructors with Default Arguments - Dynamic Initialization of Objects - Copy and Dynamic Constructors - Destructors(PSG) - Structures and Classes - Arrays and Strings.

UNIT III **9 Hours**

OPERATOR OVERLOADING AND INHERITANCE

Operator Overloading and Inheritance Need of operator overloading- Overloading Unary Operators- Overloading binary Operators - Overloading Special Operators - Data Conversion Inheritance: Derived Class and Base Class - Derived Class Constructors-Overriding Member Functions-Class Hierarchies- Public and Private Inheritance-Levels of Inheritance-Multiple Inheritance.

UNIT IV

POLYMORPHISM AND FILE STREAMS **10 Hours**

Polymorphism and File Streams Virtual Function - Friend Function - Static Function-Assignment and Copy Initialization- Memory Management: new and delete Pointers to Objects, this Pointer- Streams - String I/O - Character I/O - Object I/O - I/O with Multiple Objects - File Pointers - Disk I/O with Member Functions- Error Handling in File I/O.

UNIT V **10 Hours**

TEMPLATES AND EXCEPTION HANDLING

Templates: Introduction - Function Templates - Overloading Function Templates-, user defined template arguments(Sona) - Class Templates - Exception Handling - Syntax, multiple exceptions, exceptions with arguments.

Total: 45 Hours

Reference(s)

1. Deitel & Deitel, C++ How to program, Prentice Hall, 2005.
2. Robert Lafore, Object Oriented Programming in-C++, Galgotia Publication.
3. D.S.Malik, C++ Programming, Thomson, 2007.
4. K.R. Venugopal, Rajkumar and T.Ravishankar, Mastering C++, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2006.
5. E.Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill Publishing.

21OCS02 JAVA FUNDAMENTALS 3 0 0 3

Course Objectives

- Implement applications based on core Java Concepts with examples.
- Construct application using inheritance, packages and exception handling for real time problems.
- Integrate the Java I/O concepts to handle input and output operations.
- Develop programs to perform string manipulation in java.
- Design GUI with Java for event handling and database applications.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Demonstrate applications based on core Java Concepts with examples.
2. Construct application using inheritance, packages and exception handling for real time problem.
3. Explain the Java I/O concepts to handle input and output operations.
4. Develop programs to perform string manipulation in Java.
5. Design GUI with Java for event handling and database applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2		2									
2	2	3	2		2									
3	3	3	3		3									
4	2	2	2		2									
5	2	2	2		2									

UNIT I **9 Hours**

BASICS OF JAVA

The Genesis of Java - Overview of Java - Data Types, Variables, and Arrays - Operators – Control Statements - Introducing Classes - Methods and Classes.

UNIT II **9 Hours**

INHERITANCE, PACKAGES AND EXCEPTIONS

Inheritance: Basics - Using Super - Creating a Multilevel Hierarchy - Method overriding - Using Abstract Classes - Packages and Interfaces: Packages - Access Protection - Importing Packages- Interfaces Definitions and Implementations - Exception Handling: Types - Try and Catch - Throw.

UNIT III **9 Hours**

EXPLORING JAVA I/O

I/O Basics - Reading Console Input -Writing Console output - Native Methods - I/ O Classes and Interfaces - File - The Byte Streams - The Character Streams - Using Stream I/ O - Serialization.

UNIT IV **9 Hours**

JAVA STRINGS

String Handling: Special String operations and Methods - String Buffer - Exploring java. Lang: Simple type Wrappers - System - Math - Collections Framework: Collections Interfaces and Classes – Utility Classes: String Tokenizer - Date and Time.

UNIT V **9 Hours**

GUI WITH JAVA

Applet Basics - Applet Architecture - Applet Display Methods - Parameter Passing - Event Handling Mechanisms - Event Classes - Event Listener - Working with Windows, Graphics, Colors and Fonts - AWT Controls - Layout Managers and Menus – JDBC.

Total: 45 Hours

Reference(s)

1. Herbert Schildt, Java 2-Complete Reference, Tata Mc Graw Hill, 2015.
2. Deitel & Deitel, Java How to Program, Prentice Hall of India, 2010.
3. Gary Cornell and Cay S. Horstmann, Core Java Vol.1 and Vol.2, Sun Microsystems Press, 2008.

21OCS03 KNOWLEDGE DISCOVERY IN DATABASES

3 0 0 3

Course Objectives

- Introduce the basic concepts of data warehousing.
- Impart knowledge about the data mining functionalities.
- Assess the strengths and weaknesses of association mining and cluster analysis.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Explain the concepts of Data Warehousing architecture and business analysis process.
2. Illustrate the process of Data Mining and preprocessing techniques for data cleansing.
3. Apply the association rules for mining the various kinds of data.
4. Analyse Classification and Clustering algorithms for various problems with high dimensional data.
5. Illustrate the various data mining techniques on complex data objects.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2													
2	2	3	2											
3	2	2	2											
4	3	2	2	2										
5	2	2	2	2										

UNIT I **9 Hours**

DATA WAREHOUSING AND BUSINESS ANALYSIS

Data warehousing Components -Building a Data warehouse -Data Warehouse and DBMS- Metadata-Multidimensional data model - Data Extraction, Cleanup and Transformation Tools - Reporting, Query tools and Applications - OLAP vs OLTP - OLAP operations - Data Warehouse Schemas: Stars, Snowflakes and Fact constellations.

UNIT II **8 Hours**

INTRODUCTION TO DATA MINING

Introduction - Steps in knowledge discovery from databases process - Architecture of a Typical Data Mining Systems - Data Mining Functionalities - Classification of Data Mining Systems - Data mining on different kinds of data - Different kinds of pattern - Task Primitives - Integration of a Data Mining System with a Data Warehouse - Major issues in Data mining.

UNIT III **9 Hours**

ASSOCIATION RULE MINING

Market Basket Analysis- Frequent Item Set Mining methods: Apriori algorithm - Generating Association Rules - A Pattern Growth Approach- Pattern mining in multilevel and multidimensional space - Mining Various Kinds Of Association Rules - Association Analysis to Correlation Analysis - Constraint Based Association Mining.

UNIT IV **9 Hours**

CLASSIFICATION AND CLUSTERING

Decision Tree Induction - Bayesian Classification - Rule Based Classification - Classification by Back propagation - Support Vector Machines - Clustering: Types of data - Partitioning methods: k-means, k- medoid - Hierarchical Methods: distance based agglomerative and divisible clustering, BIRCH – Density Based Method: DBSCAN - Grid Based Method: STING.

UNIT V **10 Hours**

DATA MINING APPLICATIONS

Mining complex data objects - Text Mining - Graph mining - Web mining - Spatial Data mining -Application and trends in data mining - Social impacts of Data mining.

Total: 45 Hours

Reference(s)

1 Jiawei Han, Micheline Kamber and Jian Pai , Data Mining: Concepts and Techniques, Morgan Kauffman, 3rd Edition, 2013.

2 Alex Berson and Stephen J Smith, Data Warehousing, Data Mining, and OLAP, Tata McGraw- Hill, 1997.

3 David Hand, Heikki Manila, Padhraic Symth, Principles of Data Mining, MIT Press, 2001.

4 Margaret H.Dunham, Data Mining: Introductory and Advanced Topics, Pearson Education 2003.

21OCS04 E-LEARNING TECHNIQUES 3 0 0 3

Course Objectives

- Understand the technologies involved in e-learning.
- Gain the fundamentals of e-learning techniques.
- Determine the characteristics of Teaching-Learning Process.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Acquire knowledge about the basic concepts of e-learning.
2. Explain the technology mediated communication in e-learning.
3. Exemplify of e-learning and content the process management.
4. Analyse the teaching and learning processes in e-learning environment.
5. Assess the various applications of e-learning.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	2	2	3											
3	3	3	3											
4	2	2	2											
5	2	2	2											

UNIT I **9 Hours**

INTRODUCTION

Evolution of Education - Generations of Distance Educational Technology - Role of E-Learning - Components of e-learning: CBT, WBT, Virtual Classroom - Barriers to e-Learning Roles and Responsibilities: Subject Matter Expert - Instructional Designer - Graphic Designer - Multimedia Author - Programmer - System Administrator - Web Master.

UNIT II **9 Hours**

TECHNOLOGIES

Satellite Broadcasting - Interactive Television - Call Centers - Whiteboard Environment - Teleconferencing: Audio Conferencing - Video Conferencing -Computer Conferencing. Internet: E-mail, Instant Messaging, Chat, Discussion Forums, Bulletin Boards, Voice Mail, File Sharing, Streaming Audio and Video.

UNIT III **9 Hours**

MANAGEMENT

Content: E-Content, Dynamic Content, Trends - Technology: Authoring, Delivery, Collaboration - Services: Expert Service, Information Search Service, Knowledge Creation Service - Learning Objects and E-Learning Standards. Process of E-Learning: Knowledge acquisition and creation, Sharing of knowledge, Utilization of knowledge - Knowledge Management in E-Learning.

UNIT IV **9 Hours**

TEACHING-LEARNING PROCESS

Interactions: Teacher-Student - Student-Student - Student-Content - Teacher- Content - Teacher-Teacher - Content-Content Role of Teachers in E-Learning - Blended Learning -Cooperative Learning - Collaborative Learning - Multi Channel learning -Virtual University - Virtual Library.

UNIT V **9 Hours**

APPLICATIONS

Customer service training - Sales training - Customer training - Safety training - IT training – Product training - Healthcare training.

Total: 45 Hours

Reference(s)

1. E-Learning: An Expression of the Knowledge Economy, Gaurav Chadha, S.M. Nafay Kumail, Tata McGraw-Hill Publication, 2002.
2. E-Learning: New Trends and Innovations, P.P. Singh, Sandhir Sharma, Deep & Deep Publications, 2005. 4. 4. Michael Allen's Guide to E-Learning, Michael W. Allen, Michael Allen, Wiley Publication, 2002.
3. E-Learning: Concepts, Trends and Applications, Epignosis LLC, LLC publications, 2014.
4. Michael Allen's Guide to E-Learning, Michael W. Allen, Michael Allen, Wiley Publication, 2002.

21OCS05 SOCIAL TEXT AND MEDIA ANALYTICS 3 0 0 3

Course Objectives

- Understand the basic ideas of Text mining.
- Analyse the methods and approaches used in analytics.
- Gain knowledge on various types of analytics like web, social network, and social media.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Demonstrate the concepts and applications of text mining.
2. Explain Content analysis and Sentiment analysis.
3. Illustrate web analytics with a suitable model.
4. Illustrate social network analytics with suitable example.
5. Illustrate social media analytics with suitable example.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3		2	3									
2	2	3		2	2									
3	2	3		3	3									
4	2	2	2	3	2									
5	2	3		2	3									

UNIT I **7 Hours**

TEXT MINING

Introduction, Core text mining operations, Preprocessing techniques, Categorization, Clustering, Information extraction, Probabilistic models for information extraction, Text mining applications.

UNIT II **9 Hours**

METHODS

Content Analysis-Natural Language Processing-Clustering & Topic Detection-Simple Predictive Modeling-Sentiment Analysis; Sentiment Prediction.

UNIT III **9 Hours**

WEB ANALYTICS

Web analytics tools-Clickstream analysis-A/B testing, online surveys-Web search and retrieval-Search engine optimization-Web crawling and Indexing-Ranking algorithms-Web traffic models.

UNIT IV **10 Hours**

SOCIAL NETWORK ANALYTICS

Social contexts: Affiliation and identity - Social network analysis - Social network and web data and methods. Graphs and Matrices - Basic measures for individuals and networks.

UNIT V **10 Hours**

SOCIAL MEDIA ANALYTICS

Information visualization - Making connections: Link analysis - Random graphs and network evolution.

Total: 45 Hours

Reference(s)

1. Ronen Feldman and James Sanger, The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data, Cambridge University Press, 2006.
2. Hansen, Derek, Ben Sheiderman, Marc Smith. Analyzing Social Media Networks with NodeXL: Insights from a Connected World, Morgan Kaufmann, 2011.
3. Avinash Kaushik. Web Analytics 2.0: The Art of Online Accountability, 2009.
4. Hanneman, Robert and Mark Riddle. Introduction to Social Network Method, 2005.
5. Wasserman, S. & Faust, K. Social network analysis: Methods and applications. New York: Cambridge University Press, 1994.
6. Monge, P. R. & Contractor, N. S. Theories of communication networks. New York: Oxford University, 2003.

21OME01 DIGITAL MANUFACTURING 3 0 0 3

Course Objectives

- To understand the process of generating 3D Computer Aided Design (CAD) model by different method.
- To explain the constructional features and develop simple program for CNC lathe and Milling machines.
- To provide an exhaustive knowledge on various generic process and benefits of Additive Manufacturing.
- To familiarize about materials and process parameters of liquid and solid based AM techniques.
- To educate powder-based methodology and emerging trends with case studies, applications of AM techniques.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PSO1. Design, analyse and evaluate the performance of mechanical systems.
PSO2. Choose the appropriate methodology, materials, tools and machinery to manufacture quality products at economical cost.

Course Outcomes (COs)

1. Design a 3D model from the 2D data.
2. Develop a CNC program for simple components.
3. Generate still file and manipulate parameters of AM machine.
4. Select appropriate liquid or solid materials-based AM process to the respective application.
5. Select appropriate process to fabricate a functional/prototype for aerospace, automotive, electronics, manufacturing and medical applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2		2								1	2	
2	2	2	2		2								1	2	
3	2	2	2		2								1	2	
4	2	2	2		2								1	3	
5	2	2	2		2								1	2	

UNIT I **9 Hours**

CAD MODELING

Introduction - Design process - Stages. CAD - Input and Output devices, Modelling methods - Wire frame modelling, Surface modelling, Solid modelling - Constructive Solid Geometry and Boundary Representation Techniques. CAD/CAM data exchange - IGES, STEP. Product Life cycle management (PLM).

UNIT II **10 Hours**

AUTOMATION AND CNC MACHINES

Introduction to Automation - Definition, types, reasons for automating. CNC Machines - Principles, types, features, advantages, applications. CNC Machine structure - Linear motion bearings, Recirculating ball bearings, drive system, and control system. CNC Lathe and Milling programming - Linear and circular interpolation, threading and drilling programs.

UNIT III **7 Hours**

ADDITIVE MANUFACTURING

Introduction - Impact of Additive Manufacturing (AM) and Tooling on Product Development - Distinction between AM and CNC Machining - The Generalized AM Process chain - CAD Model - Input file formats - Generation and Conversion of STL file - File Verification and Repair - Build File Creation - Part Construction - Part Cleaning and finishing - AM Benefits - Classification of AM process

UNIT IV **8 Hours**

LIQUID AND SOLID MATERIAL BASED SYSTEMS

Stereo lithography Apparatus (SLA), Digital Light Processing (DLP), Fused Deposition Modelling (FDM) and Laminated Object Manufacturing (LOM) - Working Principle, Construction, Process, Materials and Applications

UNIT V **11 Hours**

POWDER BASED PROCESSES AND APPLICATIONS OF ADDITIVE MANUFACTURING

Selective Laser Sintering (SLS), Colour Jet Printing (CJP), Electron Beam Melting (EBM) and Laser Engineered Net Shaping (LENS) - Working Principle, Construction, Process Variables, Materials and Applications. Reverse Engineering using 3D scanner. Application of Additive Manufacturing in Medical field, Manufacturing, Automotive industries, Aerospace and Electronics and Retail industries.

Total: 45 Hours

Reference(s)

1. Ibrahim Zeid, R. Sivasubramanian, CAD/CAM Theory and Practice, Tata McGraw Hill, 2010.
2. M. Aditan, B.S. Pabala, CNC Machines, New age International, 2012.
3. C. K. Chua, K. F. Leong and C. S. Lim, Rapid prototyping: Principles and applications, Cambridge University Press, 2010.
4. D. T.Pham, S. S.Dimov, Rapid manufacturing, Springer-Verlag, London, 2001.
5. I. Gibson, D. W. Rosen, and B. Stucker, Additive Manufacturing Technologies 3D Printing, Rapid Prototyping and Direct Digital Manufacturing, Springer, 2015 http://www.springer.com/978-1-4939-2112-6.
6. www.grabcad.com, www.all3dp.com.

21OME02 INDUSTRIAL PROCESS ENGINEERING 3 0 0 3

Course Objectives

- To impart the knowledge on production planning methodologies and layout design.
- To learn about production planning and its control methods.
- To provide the knowledge of work study, process charts and ergonomic condition.
- To impart the knowledge on inventory control and material handling.
- To learn about system analysis and different types of maintenance processes.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO11.Project Management and Finance: 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.
PSO2. Choose the appropriate methodology, materials, tools and machinery to manufacture quality products at economical cost.

Course Outcomes (COs)

1. Select proper plant layout for the required production system.
2. Plan the resources required for the production and to perform the control methods.
3. Apply work study method, prepare charts to outline the process and develop ergonomic condition suitable for the processes.
4. Analyse the inventory required based on production needs and material handling.
5. Perform system analysis and use different types of maintenance process for smooth operations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	1		1									2	
2	3	3	1		2						2			2	
3	1	3	3		2									2	
4	2	3	1		2									2	
5	2	3	1		2									2	

UNIT I **9 Hours**

INDUSTRIAL ENGINEERING AND PRODUCTION SYSTEM

Industrial engineering - Concept, History and development, Applications, Roles of Industrial engineer- Production management, Industrial engineering versus production management, operations management. Plant layout, Criteria for good layout, Types of layouts - Process layout, Product layout, Combination layout and fixed position layout, Flow (material movement) pattern, Workstation Selection and design.

UNIT II **10 Hours**

PROCESS PLANNING AND PRODUCTION CONTROL

Introduction to Process Planning-Definition, Procedure, Process selection, Machine capacity, Process sheet. Process analysis - Group technology, classification and coding system, formation of component family - Production planning, loading, scheduling. Production control -dispatching, routing - Progress control bar, curve, Gantt chart, route and schedule chart.

UNIT III **8 Hours**

WORK STUDY AND ERGONOMICS

Work study - Definition, Need, Advantages, objectives of method study and work measurement, method study procedure, Process chart - symbols, outline process chart, flow process chart, principles of motion economy, ergonomics- applications of ergonomic principles in the shop floor- work benches- seating arrangement, Industrial physiology.

UNIT IV **10 Hours**

INVENTORY MANAGEMENT

Inventory control, classification, management, objectives, functions. Economic order quantity, Economic batch quantity, inventory models, ABC analysis, Material Requirement Planning(MRPI), Manufacturing Resource Planning (MRPII), Operating cycle, lean manufacturing, Supply chain management - Material handling.

UNIT V **8 Hours**

SYSTEM ANALYSIS AND MAINTENANCE

System concept - system analysis, systems engineering, value engineering, value control, types of values. Plant maintenance - objectives, importance. Maintenance engineer - duties, functions and responsibilities. Types - breakdown, scheduled, preventive and predictive - Plant maintenance schedule, Condition monitoring.

Total: 45 Hours

Reference(s)

1. Khanna O.P., Industrial Engineering and management, Dhanpat Rai Publications., 2010.
2. Martand T. Telsang, Industrial Engineering and Production Management, S Chand Publishers, 2006.
3. Panneerselvam R., Production and operations management, Heritage Publishers, 2006.
4. Ravi Shankar, Industrial Engineering and Management, Golgotia Publications Pvt. Ltd., New Delhi, 2009.

21OME03 MAINTENANCE ENGINEERING 3 0 0 3

Course Objectives

- To understand the principles, objectives and importance of maintenance adopted in industry for successful progress.
- To introduce different maintenance categories, its merits and types of lubrication.
- To expose the idea of condition monitoring, methods and instruments used for allied measurements.
- To learn about failure analysis and repair methods for few mechanical elements.
- To promote computerization in maintenance and inventory management.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PSO2. Choose the appropriate methodology, materials, tools and machinery to manufacture quality products at economical cost.

Course Outcomes (COs)

1. Explain the principles, objectives and importance of maintenance adopted in industry.
2. Select the suitable maintenance category and lubrication type.
3. Apply the appropriate methods and instruments for condition monitoring.
4. Analyze the failures of mechanical systems and select suitable repair methods.
5. Utilize computers in maintenance and inventory management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2												2	
2	2	2												2	
3					2	2	1							2	
4	1	2	1		2	2	2							2	
5	2	2	2		1	1	1							2	

UNIT I **9 Hours**

PRINCIPLES OF MAINTENANCE PLANNING

Basic principles of maintenance planning - Objectives and principles of planned maintenance activity - Importance and benefits of sound maintenance systems - Maintenance organization - Maintenance economics.

UNIT II **9 Hours**

MAINTENANCE CATEGORIES AND LUBRICATION

Maintenance categories - Comparative merits of each category - Preventive maintenance, Maintenance schedules, Repair cycle - Total Productive Maintenance - Principles and methods of lubrication.

UNIT III **9 Hours**

CONDITION MONITORING

Condition based maintenance - Cost comparison with and without Condition Monitoring - Methods and instruments for condition monitoring - Noise, vibration, wear and temperature measurement.

UNIT IV **9 Hours**

FAILURE ANALYSIS AND REPAIR METHODS

Failure analysis - Failures and their development - Role of Non-Destructive Testing in failure analysis - Repair methods for bearings, cylinder block, fuel pump, shaft.

UNIT V **9 Hours**

COMPUTER AIDED MAINTENANCE MANAGEMENT

Approach towards Computerization in maintenance - computer-aided maintenance management system (CAMMS) - Advantages of CAMMS - spare parts and inventory centre performance reporting.

FURTHER READING

Retrofitting, objectives, classification of retrofitting, cost effectiveness through retrofitting (economical aspects), circumstances leading to retrofitting, features and selection for retrofitting.

Total: 45 Hours

Reference(s)

1. Srivastava S.K, Maintenance Engineering, S Chand and Company, 2010.
2. Mishra R.C, Pathak K, Maintenance Engineering and Management, Second edition, Prentice Hall India Learning Pvt. Ltd., 2012.
3. Keith Mobley R, Lindley R. Higgins and Darrin J. Wikoff, Maintenance Engineering Handbook, Seventh edition, McGraw-Hill Professional, 2008.
4. Davies A, Handbook of Condition Monitoring: Techniques and Methodology, Springer, 2012.
5. Otegui Jose Luis, Failure Analysis, Fundamentals and Applications in Mechanical Components, Nineteenth edition, Springer, 2014.

21OME04 SAFETY ENGINEERING 3 0 0 3

Course Objectives

- To study the principles of safety management system.
- To introduce the provisions contained in the industrial laws.
- To provide knowledge on safety requirements for engineering industry.
- To learn safety requirement for chemical industry.
- To study the various safety measures adopted in construction industries.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1. Design, analyse and evaluate the performance of mechanical systems.
PSO2. Choose the appropriate methodology, materials, tools and machinery to manufacture quality products at economical cost.
PSO3. Address all the fluid flow and heat transfer related problems of mechanical systems.

Course Outcomes (COs)

1. Explain safety management system of an industry.
2. Implement the provisions of acts and rules in industries.
3. Implement and review the safety performance followed in various industries.
4. Evaluate safety appraisal in chemical industries.
5. Generate safety reports on construction industries.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1					2	1		1						2	2
2					1			3					2	1	
3	2											3	1		2
4	2	3							2				2		1
5					2					3				3	

UNIT I **8 Hours**

SAFETY MANAGEMENT

Concepts - Evolution, International Labour Organization (ILO), National Safety Council, Techniques - Job Safety Analysis (JSA), Safety survey, Safety inspection, Safety Sampling, Accident Reporting and Investigation - Concept of an accident, Accident causation models, cost of accident, investigation, Safety Performance Monitoring - Safety indices.

UNIT II **10 Hours**

SAFETY AND LAW

Factory Act 1948-Safety and Health chapters, Tamil Nadu Factories Rules- Safety and Health chapters, Environment and Pollution Laws, Building and other construction works act 1996, Electricity Rules.

UNIT III **10 Hours**

SAFETY IN ENGINEERING INDUSTRIES

Safety in machine shop - Principles of machine guarding - Personal protective equipment- Safety in handling industrial gases - Safety in cold forming and hot working of metals- Safety in finishing, inspection and testing, heat treatment, electro plating, leak test, radiography.

UNIT IV **9 Hours**

SAFETY IN CHEMICAL INDUSTRIES

Safety in process design, unit operations, pressure vessel, heat exchanger, safety valves -Plant commissioning and inspection, pressure vessel, Plant maintenance and emergency planning, management of maintenance HAZOP study.

UNIT V **8 Hours**

SAFETY IN CONSTRUCTION INDUSTRY

Construction regulations, contractual clauses, permit to work, - Education and training-Hazards of construction and prevention- excavation, scaffolding, dismantling, road works, construction of high-rise buildings - Working at heights, -Working on fragile roofs, work permit systems-Construction machinery, cranes, chain pulley blocks, earth moving equipment, conveyors- Manual handling, Safety in demolition work, - Safety in confined spaces

FOR FURTHER READING

Case Studies- Major accidents at Flixborough, UK, Seveso, Italy, Victoria Dock, India, Bhopal, India.

Total: 45 Hours

Reference(s)

1. Blake R.B., Industrial Safety, Prentice Hall, Incorporated, New Jersey, 1973.
2. National Safety Council, Accident Prevention Manual for Industrial Operations, Chicago,1988. Subramanian V., The Factories Act, 1948, with Tamil Nadu Factories Rules, 1950, Madras.
3. Environmental Pollution Control Act, 1986.
4. BOCW Act,1996, Madras Book agency, Chennai-1.
5. Explosive Act, 1884, Eastern Book Company, Lucknow -266 001.

21OBT01 BIOFUELS 3 0 0 3

Course Objectives

- To understand and explore the scope of biofuels the most efficient renewable source of energy.
- To develop the expertise in the technology pertaining to their generation and employment in order to surrogate the existing conventional fuels and hence strives towards sustainable development
- To give way to the bolster green technology and incline towards more eco-friendly options.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PSO3. Conceive Plan and Deploy bio-resources for the benefit of society and environment.

Course Outcomes (COs)

1. Apply the bioresources that can be used for the production of biofuels.
2. Analyze the physical and chemical properties of the biodiesel.
3. Analyze the mechanisms of improvising the quality and performance of engines using biofuels.
4. Analyze the bio-fuel conversion technologies and their environmental attributes.
5. Evaluate the designing aspects of major unit processes/operations of an integrated bio- refinery.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1		2				3								1
2	2						1								3
3	1						3								2
4	2						3								3
5	1						1								

UNIT I **9 Hours**

CLASSIFICATION AND RESOURCES

Introduction, biofuel as a renewable energy, classification of biofuels - First, second, third and fourth generation biofuels, different plant sources as biofuel feedstocks, Biogases, physical and chemical characteristics of vegetable oils - iodine number, hydroxyl, acid values, rancidity, hydrogenolysis and hydrolysis, Food vs energy.

UNIT II **9 Hours**

BIODIESEL

Definition, basics and chemistry of biodiesel, vegetable oils in biodiesel production, Trans esterification: Chemical methods, enzymatic methods and types of catalysts, separation and purification, physical properties and characterization of biodiesel - Cloud point, pour point, cold filter plugging point, flash point, viscosity and cetane number.

UNIT III **9 Hours**

QUALITY BIODIESEL AND ENVIRONMENT

Producing Quality Biodiesel, quality control, test methods, ASTM specifications. Oxidative andthermal stability, estimation of mono, di, triglycerides and free glycerol, engine performance test, blending of ethanol with biodiesel, blending of biodiesel with high-speed diesel (HSD) and their combustion properties.

UNIT IV **9 Hours**

BIOETHANOL AND BIOGASES

Ethanol as a fuel, microbial and enzymatic production of ethanol from biomass - lignocellulose, sugarcane, sugar beet, corn, wheat starch, purification - wet and dry milling processes, saccharification-chemical and enzymatic. Production of bio methane and bio hydrogen.

UNIT V **9 Hours**

BIOREFINERIES

Definition and types of biorefineries, co-products of biorefineries-oil cake and glycerol, purification of glycerol obtained in biodiesel plant; anaerobic and thermal gasification of biomass, economics of biorefineries.

Total: 45 Hours

Reference(s)

1. Caye Drapcho, John Nghiem and Terry Walker, Biofuels Engineering process technology, McGraw Hill Professional, 2008.
2. Mousdale, Biofuels, CRC Press, 2008.
3. Ahindra Nag, Biofuels Refining and Performance, McGraw-Hill Professional, 2007.
4. Lisbeth Olsson, Biofuels (Advances in Biochemical Engineering/ Biotechnology), Springer, 2007.

21OFD01 TRADITIONAL FOODS 3 0 0 3

Course Objectives

- Understand the importance of traditional foods and food habits.
- Know the traditional processing of snack, sweet and dairy food products.
- Infer the wide diversity and common features of traditional Indian foods and meal patterns.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Justify the processing methods of traditional foods in terms of its health benefits.
2. Assess the production methods of traditional sweets, snacks and dairy products.
3. Differentiate Traditional fermented foods products based on its raw material.
4. Implement a large-scale production of tradition foods for its increased consumption.
5. Compare the health aspects of traditional foods with modern foods.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1													
2		1												
3	2	1	1											
4								2						
5								2						

UNIT I **9 Hours**

TRADITIONAL METHODS OF FOOD PROCESSING

Introduction - food culture -geographical features and food. Traditional methods of milling grains - rice, wheat and corn - equipment and processes as compared to modern methods. Equipment and processes for edible oil extraction- comparison of traditional and modern methods. Energy costs, efficiency, yield, shelf life and nutrient content comparisons. Traditional methods of food preservation - sun-drying, osmotic drying, brining, pickling and smoking.

UNIT II **9 Hours**

TRADITIONAL SWEETS, SNACKS AND DAIRY PRODUCTS

Production, formulation, preparation and processing of Indian traditional sweet and snack food products: -Rasgolla, Gulab jamun; formulation and preparation of namkeen, potato chips, banana chips. Acid coagulated and fermented dairy products- paneer, dahi, shrikhand, lassi - processing conditions, defects etc. Fat rich products- Butter, ghee and its processing.

UNIT III **9 Hours**

TRADITIONAL FERMENTED FOOD PRODUCTS

Idli, Soya sauce, fish pickle, dry fish, meat and vegetable fermented products. Various alcohol-based products. Ways to increase nutritional quality of food such as enrichment, fortification, fermentation and mutual supplementation. Best cooking and processing methods to retain nutrients.

UNIT IV **10 Hours**

COMMERCIAL PRODUCTION OF TRADITIONAL FOODS

Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods -types marketed, turnover; role of SHGs, SMES industries, national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi. Commercial production of intermediate foods - ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idly and dosa batters

UNIT V **8 Hours**

HEALTH ASPECTS OF TRADIONAL FOODS

Comparison of traditional foods with typical fast foods / junk foods - cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments /illnesses.

Total: 45 Hours

Reference(s)

1. Sen and Colleen Taylor, Food Culture in India, Greenwood Press, 2005.
2. Davidar, Ruth N. "Indian Food Science: A Health and Nutrition Guide to Traditional Recipes:" East West Books, 2001.
3. Steinkrus.K.H. Handbook of Indigenous Fermented Foods, CRC press, 1995.
4. Aneja. R.P, Mathur.BN, R.C. Chandan,and Banerjee.A.K. Technology of Indian Milk Products. Dairy India Year Book, 2009.

21OFD02 FOOD LAWS AND REGULATIONS

3 0 0 3

Course Objectives

- Introduce the concept of food hygiene, importance of safe food and laws governing it.
- Learn common causes of food borne illness - viz. physical, chemical and biological and identification through food analysis.
- Understand food inspection procedures employed in maintaining food quality.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Analyse the food safety strategies and nutritional quality of the food.
2. Check the food regulatory mechanism and mandatory laws for food products.
3. Determine the national and international regulatory agencies.
4. Understand and apply the voluntary regulatory standards.
5. Assess the implementation of food safety for a food processing industry.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1											
2		1				1	2	1						
3		1												
4	1	2												
5	1	2												

UNIT I **10 Hours**

INTRODUCTION

Introduction, concept of food safety and standards, food safety strategies. Food hazards and contaminations - biological (bacteria, viruses and parasites), chemical (toxic constituents / hazardous materials) pesticides residues / environmental pollution / chemicals) and physical hazards. Preventive food safety systems - monitoring of safety, wholesomeness and nutritional quality of food. Prevention and control of physical, chemical and microbiological hazards. Principles of food safety - Establishment: design and facilities - emergency preparedness - Maintenance cleaning and sanitation - personal hygiene - packaging and labelling - transportation - traceability - recall procedure - visitor policy. Adulteration: Intentional and unintentional - Preservatives - antioxidants, sweeteners, flavours, colours, vitamins, stabilizers - indirect additives - organic resides - inorganic residues and contaminants.

UNIT II **10 Hours**

FOOD LAWS

Indian and Food Regulatory Regime (Existing and new), PFA Act and Rules, Food Safety and Quality Requirements, Additives, Contaminants and Pesticide Residue. Food Safety and Standards Act, 2006, FSSAI roles and responsibilities, Essential Commodities Act, 1955, Global Scenario, Codex Alimentarius, WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR) WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR). Food safety inspection services (FSIS) and their utilization.

UNIT III **10 Hours**

REGULATIONS

Introduction to OIE & IPPC, Other International Food Standards (e.g. European Commission, USFDA etc). WTO: Introduction to WTO Agreements: SPS and TBT Agreement, Export & Import Laws and Regulations, Export (Quality Control and Inspection) Act, 1963. Role of Agricultural and Processed Food Products Export Development Authority (APEDA), Customs Act and Import Control Regulations, Other Voluntary and mandatory product specific regulations, Other Voluntary National Food Standards: BIS Other product specific standards; AGMARK. Nutritional Labelling, Health claims.

UNIT IV **10 Hours**

STANDARDS

Voluntary Quality Standards and Certification GMP, GHP, HACCP, GAP, Good Animal Husbandry Practices, Good Aquaculture Practices ISO 9000, ISO 22000, ISO 14000, ISO 17025, PAS 22000, FSSC 22000, BRC, BRCIOP, IFS, SQF 1000, SQF 2000. Role of NABL, CFLS.

UNIT V **5 Hours**

IMPLEMENTATION AND RISK ASSESSMENT

Implementation of food safety for a desired food processing industry. Risk assessment studies: Risk management, risk characterization and communication.

Total: 45 Hours

Reference(s)

1. Singal RS (1997). Handbook of indices of food quality and authenticity. Woodhead Publ. Cambridge, UK.
2. Shapton DA (1994). Principles and practices of safe processing of foods. Butterworth Publication, London. Winton AL (1999) Techniques of food analysis, Allied Science Publications New Delhi.
3. Pomeranze Y (2004). Food analysis - Theory and Practice CBS Publications, New Delhi.
4. Jacob MB (1999). The chemical analysis of foods and food products. CBS Publ. New Delhi.

21OFD03 POST HARVEST TECHNOLOGY OF FRUITS AND VEGETABLES

3 0 0 3

Course Objectives

- To understand the importance and different methods of post-harvest handling and storage of fruits and vegetables.
- To gain knowledge on different preservation methods of fruits and vegetables.
- To familiarize with the value-added products from fruits and vegetables.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Implement the different post-harvest handling practices for the storage of fruits and vegetables.
2. Analyse the suitable preservation method (sugar, salt or dehydration) to produce value added products from fruits and vegetables.
3. Evaluate the requirement of low temperature and irradiation methods to preserve specific fruits and vegetables.
4. Apply the concentration and fermentation methods to preserve fruits and vegetables.
5. Implement the canning method to preserve fruits and vegetables.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	2	1			1							
2	1	1												
3	1	2												
4	1		1											
5	2	1	1											

UNIT I **9 Hours**

POST-HARVEST PRACTICES AND PROCESSING

Maturity indices for harvesting; pathological spoilage's during storage, ripening and control measures, post-harvest handling, sorting & grading, packaging, storage, transportation, Methods of pre-cooling, post-harvest treatments to hasten and delay ripening; Methods of storage at farm level - cold storage, controlled/modified atmosphere storage, Quality management, export requirements, Nutritive value, nutraceutical properties.

UNIT II **9 Hours**

PRESERVATION AND VALUE ADDITION

General principles and methods of fruit and vegetable preservation. Preservation using sugar: Principle and Preparation of jam, jelly, marmalade, squash, RTS, carbonated beverages, crush, nectar, cordial, fruit bar, preserves, candies and carbonated fruit beverages. Processing using salt: Principle - Brining - Preparation of pickles, chutney and sauces, ketchup.

UNIT III **9 Hours**

PRESERVATION BY LOW TEMPERATURE AND IRRADIATION

Preservation by low temperature: definition, principle, methods - Refrigeration, freezing. Methods of freezing- changes during freezing. Preparation of frozen foods. Minimal Processing of Fruits and Vegetables - techniques involved - Preservation by irradiation: definition- principle, application, irradiation unit.

UNIT IV **9 Hours**

PRESERVATION BY DRYING

Machineries involved in processing of fruits and vegetables products. Drying and dehydration: definition, principle, Types of driers: Solar, cabinet, spray drier, drum drier, fluidized bed drier. Preparation of product for dehydration. Dehydration principles and equipment. Preparation of fruits - powder production. Problems related to storage of dehydrated products.

UNIT V **9 Hours**

PRESERVATION BY CANNING

Canning: principles, Types of cans, packing of canned products-preparation of canned products - general considerations in establishing a commercial fruit and vegetable cannery, machineries involved in canning and bottling unit- spoilage of canned foods. Bottling of fruit and vegetable. Precautions in canning operations.

Total: 45 Hours

Reference(s)

1. S. Ranganna, Hand Book of Analysis and Quality Control for Fruit and Vegetable Products, McGraw Hill Education (India) Private Limited, Chennai, 2017.
2. N.W. Desrosier, the Technology of Food Preservation, CBS Publisher & Distributions, New Delhi, 1987.
3. R.P. Srivastava and S. Kumar, Fruit and Vegetable Preservation: Principles and Practices, Second Edition, International Book Distribution Co., Lucknow, 1998.
4. G. Lal, G. Siddappa and G.L. Tondon, Preservation of Fruits and Vegetables, Indian Council of Agricultural Research, New Delhi, 1986.
5. Chakraverty, A.S. Mujumdar, G.S.V. Raghavan and H.S. Ramaswamy, Handbook of Post-harvest Technology, Marcel Dekker Press, USA, 2001.
6. D.K. Salunkhe, and S.S. Kadam, Handbook of Fruit Science and Technology: Production, Composition and Processing, Marcel Dekker, New York, 1995.

21OFD04 CEREAL, PULSES AND OIL SEED TECHNOLOGY

3 0 0 3

Course Objectives

- Understand the application of scientific principles in the processing technologies specific to the materials.
- Understand the storage methods and handling techniques followed for cereals, pulses and oil seeds.
- Develop the knowledge in the area of Cereals, pulses and oil seed processing and technology.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PSO2. Practical and research training imparted to the students will pave the way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Identify the specific processing technologies employed for cereals.
2. Analyse the composition of millets and their nutritional importance.
3. Relate the compositional changes and processing methods of pulses and legumes.
4. Create the competence in processing of oilseeds technology.
5. Relate the storage processing of food grains with quality aspects.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		2		2								
2	1	2		2		1								
3	2	2		1		2								
4	2	3		2		2								2
5	2	2		2		3								

UNIT I **9 Hours**

CEREALS

Cereal Grains- Basic agricultural aspects, structure and composition; Storage, Insect control; Processing: Wheat- milling, (Atta and Maida), quality aspects of flour, wheat proteins and their function, rheology of flour; wheat based baked products - Bread, Biscuit, Cakes, Extruded products, Pizza, Chapatis, malting and malt products; Rice-Milling, Parboiling, Quick cooking rice, Traditional Indian Products- Puffed Rice, flaked rice, Idli/Dosa/vada mixes and other savouries; Corn- Wet and dry milling, Corn Products - Corn flakes, Corn starch, canned corn products, puffed product; Oats-Milling, Oat Products - Steel cut, rolled oats, quick cooking; Traditional and Fermented cereal products.

UNIT II **9 Hours**

OTHER CEREALS AND MILLETS

Sorghum, Pearl Millet, Finger millet, Foxtail Kodo Millet - Basic agricultural millet, aspects, structure and composition; storage, insect control; processing - pearling, Milling, Malting, Malt based foods, flaked and fermented products; Traditional and Nutritional products based on finger millet.

UNIT III **9 Hours**

PULSES AND LEGUMES

Basic agricultural aspects, structure, composition, storage, insect control, processing Milling/splitting, dhal milling, products - puffed, flakes, flour, legume-based traditional products, flour based Indian sweets and savouries, soya milk, soy protein Isolate, soya paneer

UNIT IV **9 Hours**

OIL SEEDS AND NUTS

Basic agricultural aspects structure, composition, Storage, Insect control; processing: traditional and modern methods of oil extraction, refining, bleaching, deodorizing, hydrogenation; oil blends; applications of different oils and fats in food processing & products.

UNIT V **9 Hours**

STORAGE AND HANDLING

Bag Storage - Advantages and Disadvantages, Cover Plinth Storage Structures, CAP storage (Cover and Plinth Storage). Protection against Rodents, Fungi, Pests and Mites. Fumigation Processes for bag storage piles. Bulk Storage in silos and large Bins. Conveyors and Elevators for feeding and discharging.

Total: 45 Hours

Reference(s)

1. Chakraverty, A.: Post Harvest Technology of Cereals, Pulses and Oilseeds. Oxford and IBH Publishing Co, Calcutta, 1995.
2. Delcour, Jan A. and R. Carl Hoseney., Principles of Cereal Science and Technology, 3rd Edition, American Association of Cereal Chemists, 2010.
3. Karl Kulp, Handbook of Cereal Science and Technology, 2nd Rev. Edition, CRC Press, 2000.
4. N.L.Kent and A.D.Evans, Technology of Cereals (4th Edition) Elsevier Science (Pergaman),Oxford, UK, 1994.
5. Matz, Samuel A., The Chemistry and Technology of Cereals as Food and Feed, 2ndEdition, CBS, 1996.
6. Morris, Peter C. and J.H. Bryce., Cereal Biotechnology, CRC/Wood head publishing, 2004.

21OFT01 FASHION CRAFTSMANSHIP 3 0 0 3

Course Objectives

- To impart theoretical and practical knowledge about various handi-craft techniques.
- To enhance innovative skills on hand crafts.
- To build confidence on doing handicrafts.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1. Interpret trends, decipher fashion movements, apply the knowledge of elements of design and Gestalt theory of visual perception; and incorporate sustainable decisions into their design artworks, fashion products and accessories.

Course Outcomes (COs)

1. Outline the classification, techniques and criteria for selecting raw materials for making various handicraft materials and produce textile-based handicrafts. Produce various decorative and appealing products.
2. Design and construct various wall hangings and fashion accessories.
3. Design and construct toys and accessories.
4. Design and construct head accessories, home furnishings and paintings.
5. Design and construct various decorative and appealing products for interiors.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	3				2		2	2		2	2	
2	3	2	3				1		2	3		2	2	
3	3	2	3				2		2	3		2	2	
4	3	2	3				2		2	3		2	2	
5	3	2	3				2		2	3		2	2	

UNIT I **9 Hours**

TECHNIQUES OF HANDICRAFT MATERIALS

Definition of Handicraft, Classification: Reusable, Non reusable, Raw materials used in various craft materials: printed, embroidered, stitched and handmade, Criteria for selection of raw materials: material types and end uses.

UNIT II **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - INTERIORS

Designing and Construction procedures for following various decorative and appealing products: Wall hangings - String Art on plywood, Pressed Flower Art frames.

UNIT III **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - ACCESSORIES

Designing and Construction procedures for following various decorative and appealing products: Handbags, Hats, footwear.

UNIT IV **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - ORNAMENTS

Designing and Construction procedures for following various decorative and appealing products: Stone necklace using Macrame Technique, Tribal Jewellery using woollen threads, Floral Jewellery using Resin Technique, Fabric Jewellery using Tie and Dye Technique.

UNIT V **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - FANCY ITEMS

Designing and Construction procedures for following various decorative and appealing products: Jewellery Box, Utility Holder, Gift items. Lampshade decors from cardboard, Driftwood Frames for pictures and Mirrors.

Total: 45 Hours

Reference(s)

1. Handmade in India: A Geographic Encyclopaedia of India Handicrafts. Abbeville press; 1st edition (October 20,2009).
2. Encyclopaedia of Card making Techniques (Crafts), Search Press Ltd, illustrated edition, 2007.
3. All about Techniques in Illustration, Barron Educational Series, 2001.
4. Printing by Hand: A Modern Guide to printing with Handmade stamps, Stencils and Silk Screens, STC Craft/A Melanie Falick Book, 2008.
5. Materials & Techniques in the Decorative Arts: An Illustrated Dictionary, University of Chicago Press, 2000.
6. https://www.marthastewart.com/274411/fashion-crafts.

21OFT02 INTERIOR DESIGN IN FASHION 3 0 0 3

Course Objectives

- To impart knowledge on interior design.
- To improve the design skills, sustainable with socially-conscious designs.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PSO1. Interpret trends, decipher fashion movements, apply the knowledge of elements of design and Gestalt theory of visual perception; and incorporate sustainable decisions into their design artworks, fashion products and accessories.

Course Outcomes (COs)

1. Interpret the elements of interior design concepts and resolve the personality requirements.
2. Develop graphical representations of interior design concepts.
3. Resolve the space planning requirements of residential home as per CPWD guidelines.
4. Determine the aesthetic requirements of interior design components.
5. Appraise the roles and responsibilities of interior designer.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3			1							2	
2	3	2	3		2	3		2					3	
3	3	3	3		2	2		2					2	
4	3	3	3		2	3		2					2	
5	3	2			2			3					3	

UNIT I **9 Hours**

INTRODUCTION

Interior designing - definition, importance, requirements and types - Structural design, Decorative Design -Designing interiors, Good taste; Design themes, types and application. Personality of the Home - Art elements - Line: types, characteristics and importance; form: size and shape, characteristics; Colour - sources, qualities, emotional effects, colour wheel and schemes.

UNIT II **9 Hours**

GRAPHICAL PRESENTATIONS

3D composition; Isometric and Axonometric- Still life- Furniture Sketching- Object Drawing with colour rendering - Interior elements, Lighting, plants. Perspective, Axonometric Isometric drawing. Orthographic Projection - Lifts and escalators.

UNIT III **9 Hours**

SPACE PLANNING

Space planning concepts- interiors, circulation. Definition, application of ergonomic principals in interiors. Residential house space planning case study- CPWD guidelines. Lighting for different locations and activities, measurement, ventilation and indoor air quality, noise control methods.

UNIT IV **9 Hours**

INTERIOR COMPONENTS

Application of colour in interiors; Texture - types and significance; Pattern: types and effects; Light - importance. Importance of Furniture Design for Interiors- Ancient Age / Middle Age / Contemporary. Doors, Windows, Staircase designs, False Ceiling, Partitions, Wall Panelling, Comics, Mosaic, Cladding- Flooring and Wall Cladding

UNIT V **9 Hours**

ROLES AND RESPONSIBILITIES OF INTERIOR DESIGNER

Role of an Interior Designer- Responsibility towards society and need of an Interior Designer to better the environment- Ethics and Code of Conduct- Responsibility towards client, contractor and supplier, Estimation. Professional Fees- Work of an Interior Designer- Making of portfolio, JD Annual Design Awards.

Total: 45 Hours

Reference(s)

1. Joanna Gaines, Homebody: A guide to creating spaces you never want to leave, Harper design, 2018.
2. Erin gates, Elements of Style: Designing a Home and a life, Simon and Schuster, 2014.
3. Simon Dodsworth, The Fundamentals of Interior Design, AVA publishing, 2009.
4. V. Mary. Knackstedt, The Interior Design Business Handbook: A Complete Guide to Profitability, Wiley, New Jersey; 2006.
5. M. G. Shah, C. M. Kale, and S.Y. Patki, Building Drawing with an Integrated Approach to Build Environment, Tata McGraw Hill, 2002.
6. Https://eclectictrends.com.

21OFT03 SURFACE ORNAMENTATION 3 0 0 3

Course Objectives

- To familiarize the students about the various techniques of surface embellishment with relevance to garment embellishments.
- To aware of various types of embroidery and methods of producing it.
- To make the students confident about doing surface embellishment work.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PSO1. Interpret trends, decipher fashion movements, apply the knowledge of elements of design and Gestalt theory of visual perception; and incorporate sustainable decisions into their design artworks, fashion products and accessories.
PSO2. Articulate design aesthetics, communicate product values, collaborate across disciplines as member and leader; and envision solutions in fashion systems: design, technology, production and management.

Course Outcomes (COs)

1. Analyse the raw material requirements for surface ornamentation and its application.
2. Implement hand embroidery stitches on fabric and show the stitch development procedure in diagrammatic representations.
3. Apply the machine and computerized embroidery stitches.
4. Analyse the surface embellishment techniques and its application.
5. Assess the quality maintenance parameters of all embroidered products and analyse the 6traditional embroidery techniques.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2					1						
2	2	3	2						2				2	2
3	2	3	2		3								2	2
4	2	2	2						2				2	2
5	2	2	2						2					2

UNIT I **9 Hours**

INTRODUCTION TO SURFACE ORNAMENTATION

Introduction, Definition, Need, Types, Raw materials, Importance of surface ornamentation, Selection of needle, thread and fabric for hand embroidery and machine embroidery. various methods of surface embellishment- embroidery and surface ornamentation.

UNIT II **9 Hours**

HAND EMBROIDERY

General rules for hand embroidery. Types of hand embroidery stitches-Running, Couching, Button hole, Satin, Long & Short, Wheat, Chain, Stem, Herringbone, Cross stitch, Knotted stitches, Fish bone, Fly stitch, Braids, Back, Hem, Seed, Needle weaving, Whip stitches.

UNIT III **9 Hours**

MACHINE EMBROIDERY

General rules for machine embroidery. Types of frames and methods of transferring the designs. Attachments to sewing machines for embroidery, Types of machine embroidery stitches- Eyelet work, Cut work, patch work, Mirror work, Applique, Shaded embroidery, Shadow work, Bead and Sequins work, Vermicelli, Zigzag, Granite stitch. Computerized embroidery machine- Concept of design and development, software used in embroidery machines, process of designing, method and types of stitch application, punching and digitizing.

UNIT IV **9 Hours**

EMBELLISHMENT TECHNIQUES

Materials used and Applications. Types of embellishment techniques- fabric painting-hand, Stencil-dabbing and Spraying. Dyeing and printing-advanced tie and dye techniques, batik and block printing. Trimmings and decorations-Laces, Pompons, Fringes, Tassels, Tucks, Show buttons, Crocheting.

UNIT V **9 Hours**

TRADITIONAL EMBROIDERIES OF INDIA AND CARE

Care and maintenance of embroidered articles-care and maintenance methods for embroidered apparel, pressing. Traditional Embroideries of India-Phulkari, Kasuti, Kashmiri embroidery, Kutch work, Chikkankari, Kantha.

Total: 45 Hours

Reference(s)

1. Ruth Chandler, Modern Hand Stitching-Dozens of stitches with creative free-form variations, 2014.
2. Sophie Long, Mastering the Art of Embroidery: Traditional Techniques and Contemporary Applications for Hand and Machine Embroidery, Heritage Publishers, London, 2013.
3. Christen Brown, Embroidered & Embellished, C&T Publishing, 2013.
4. Sheila Paine, Embroidered Textiles, Thames and Hudson Publisher, UK, 1990.
5. Gail Lawther, Inspirational Ideas for Embroidery on Clothes & Accessories, Search Press Ltd, UK, 1993.
6. http://www.needlenthread.com/tag/hand-embroidery-stitches.

21OPH01 NANOMATERIALS SCIENCE **3 0 0 3**

Course Objectives

- Impart knowledge on Nanoscience.
- Explore different techniques of producing nanomaterials.
- Create expertise on the applications of nanomaterials in various fields.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Summarize the origin and advance of nanomaterials and its classification.
2. Compare the different types of methods adopted for synthesizing nanomaterials.
3. Analyse the characterization techniques for analysing nanomaterials.
4. Explain the physical properties exhibited by nanomaterials.
5. Organize the nanomaterials developed for advanced technological applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1												
2	2	2												
3	3	1												
4	1	1												
5	2	3												

UNIT I **9 Hours**

NANO SCALE MATERIALS

Introduction-Feynman's vision-national nanotechnology initiative (NNI) - past, present, future - classification of nanostructures, nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures- effect of nanoscale dimensions on various properties -differences between bulk and nanomaterials and their physical properties.

UNIT II **9 Hours**

NANOMATERIALS SYNTHESIS METHODS

Top-down processes - mechanical milling, nanolithography and types based on radiations - Bottom-up process physical method: physical vapour deposition, RF sputtering, CVD- chemical method: colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self-organization.

UNIT III **9 Hours**

CHARACTERIZATION TECHNIQUES

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

UNIT IV **9 Hours**

SEMICONDUCTOR NANOSTRUCTURES

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nano tubes-structure, synthesis and electrical properties -applications- quantum well laser- quantum efficiency of semiconductor nanomaterials.

UNIT V **9 Hours**

NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits- single electron transistor - - organic photovoltaic cells- spintronics

Total: 45 Hours

Reference(s)

1. Willam A. Goddard, Donald W.Brenner, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, 2012.
2. Charles P. Poole Jr and. Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2007.
3. Guozhong Cao, Y. Wang, "Nanostructures and Nanomaterials-Synthesis, Properties & Applications", Imperials College Press, 2011.
4. T. Pradeep, "NANO: The Essentials Understanding Nanoscience and Nanotechnology", McGraw - Hill Education (India) Ltd, 2012.
5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley and Sons Ltd, 2006.
6. Viswanathan B, AuliceScibioh M, "Fuel cells: Principles and Applications", University Press, 2009.

21OPH02 SEMICONDUCTOR PHYSICS AND DEVICES 3 0 0 3

Course Objectives

- Impart knowledge in physical properties of semiconducting materials.
- Analyse the factors affecting the operation of semiconductor devices.
- Apply the physics of semiconductors to develop semiconductor devices.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Exemplify the band gap, drift and diffusion current densities due to carrier transport in semiconductors.
2. Analyse the energy band diagram in thermal equilibrium and space charge width of PN junction.
3. Illustrate the operation of Bipolar Junction transistor at different modes and different configurations.
4. Illustrate the operation of metal oxide field effect transistor and their memory devices.
5. Represent the working mechanism of opto-electronic devices.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	1												
3	2	1												
4	2	1												
5	2	1												

UNIT I **9 Hours**

ENERGY BANDS AND CARRIER TRANSPORT PROPERTIES

Energy Bands: Formation of energy bands - doping effects - energy levels - electron and hole concept in semiconductor. Carrier transport: Carrier drift-drift current density - conductivity- diffusion current density - total current density

UNIT II **9 Hours**

P-N JUNCTION

Basic structure and fabrication process of p-n junction - current - voltage characteristics - energy band diagram - equilibrium Fermi levels - depletion region - junction breakdown phenomena - Zener - avalanche breakdown.

UNIT III **9 Hours**

BIPOLAR JUNCTION TRANSISTOR

The basic transistor action - operation in the active mode - current gain - static characteristics - carrier distribution in emitter, base and collector region - modes of operation - current - voltage characteristics of common base and emitter configuration - frequency response and switching of bipolar transistor.

UNIT IV **9 Hours**

MOSFET

The ideal MOS diode - basic fundamentals and characteristics - types - CMOS and BiCMOS - CMOS inverter - MOSFET on insulator - thin film transistor (TFT) - silicon on insulators (SOI) devices - MOS Memory structures - DRAM and SRAM

UNIT V **9 Hours**

PHOTONIC DEVICES

Radiative transitions and optical absorption-light emitting diodes-organic LED - infrared LED - semiconductor laser - temperature effect - photo detector - photo diode - silicon and compound semiconductor solar cells - efficiency

Total: 45 Hours

Reference(s)

1. Donald A Neamen, "Semiconductor Physics and Devices", Tata McGraw Hill, 2012.
2. S. M. Sze and M. K. Lee, "Semiconductor Devices, Physics and Technology", John-Wiley & Sons, 2015.
3. Ben. G. Streetman and S. K. Banerjee, "Solid State Electronic Devices", Pearson Education Ltd, 2015.
4. C. Kittel, "Introduction to Solid State Physics", John-Wiley & Sons, 2012.
5. J. Millman and C. Halkias, "Electronic Devices and Circuits", Tata McGraw Hill, 2010.
6. Hagen Klauk, "Organic Electronics: Materials, Manufacturing and Applications", Wiley-VCH, 2006.

21OPH03 APPLIED LASER SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on laser science.
- Explore different strategies for producing lasers.
- Create expertise on the applications of lasers in various fields.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Illustrate the transition mechanisms and the components of a laser system.
2. Compare the different types of lasers based on pumping method, active medium and energy levels.
3. Compute the rotation of earth, velocity and distance using lasers and apply the same for day today applications.
4. Analyse the role of lasers in surgical and endoscopy applications.
5. Apply the laser techniques in industrial applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	1	2												
3	2	1												
4	2	1												
5	1	2												

UNIT I **9 Hours**

LASER FUNDAMENTALS

Introduction - principle - absorption and emission of light - thermal equilibrium - Einstein's prediction - Einstein's relations - A and B coefficients - condition for large stimulated emission - spontaneous and stimulated emission in optical region - light amplification - condition for light amplification - population inversion- Components of lasers - pumping methods - pumping mechanisms - optical resonator.

UNIT II **9 Hours**

LASER BEAM CHARACTERISTICS AND TYPES

Characteristics of laser - Classification of lasers - principle, construction, working, energy level diagram and applications of molecular gas laser (CO2 laser) - liquid laser (dye laser) - excimer laser - Solid state laser (Nd: YAG laser) - semiconductor laser (homojunction laser).

UNIT III **9 Hours**

LASERS IN SCIENCE

Introduction - Harmonic generation (SHG) - Stimulated Raman emission - lasers in chemistry - laser in nuclear energy - lasers and gravitational waves - rotation of the earth - measurement of distance - Light detection And Ranging (LIDER) - velocity measurement – holography.

UNIT IV **9 Hours**

LASERS IN MEDICINE AND SURGERY

Light induced biological hazards: Eye and skin - Eye laser surgery - photocoagulations - homeostasis - dentistry - laser angioplasty - different laser therapies - advantages & disadvantages - laser endoscopy.

UNIT V **9 Hours**

LASERS IN INDUSTRY

Applications in material processing: laser welding - hole drilling - laser cutting - Lasers in electronics industry: information storage - bar code scanner- Lasers in defence: laser based military weapons - laser walls.

Total: 45 Hours

Reference(s)

1. K. Thiyagarajan and A. K. Ghatak, "LASERS: Fundamentals and Applications", Springer, USA, 2015.
2. M. N. Avadhanulu, "An Introduction to Lasers Theory and Applications", S. Chand Publisher, 2013.
3. W. Koechner, M. Bass, "Solid State Lasers: a graduate text", Springer Verlag, New York, 2006.
4. K. P. R. Nair, "Atoms, Molecules and Lasers", Narosa Publishing House, 2009.
5. K. R. Nambiar, "Lasers: Principles Types and Applications", New Age International Publications, 2006.
6. A. Sennaroglu, "Solid-State Lasers and Applications", CRC Press, 2006.

21OPH04 BIO-PHOTONICS 3 0 0 3

Course Objective:

- To understand the light-matter interaction in biological cells or tissues by using the principles of optics and lasers.
- To apply the properties of biological cells or tissues in biomedical applications by various optical imaging, sensing and activation techniques.
- To analyze the concepts of Modern optical measurement techniques and devices in early detection of disease and cure them.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Infer the laws of optics and lasers to interpret the biological cells and tissues.
2. Identify the properties of different optical instruments in biological systems to represent their behavior in structure and design of detection engineering instruments.
3. Use laser tweezers techniques to infer the activities of cells (tissues) and explain the single molecule detection processes in medical diagnosis.
4. Outline the properties of ultra-short laser pulses and tissue engineering to rectify the affecting factors in biological cells.
5. Compare the various types of bio-imaging methods to detect the infected cells and molecules in biological science.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2												
2	3	2												
3	3	2							3					
4	3	2							3					
5	3	2												

UNIT I 9 Hours

INTRODUCTION TO BIOPHOTONICS

Light as Photon Particles – Coherence of light - lasers – classification of lasers – Mechanisms of Non-linear Optics (NLO) processes associated with Biophotonics - Light scattering mechanisms: Rayleigh scattering, Miescattering, Brillouin Scattering, Raman Scattering -Different light sources – Quantitative description of light: Radiometry

UNIT II **9 Hours**

PHOTOBIOLOGY

Interaction of light with cells and tissues – Light – Tissue Interaction Variables – Light –Tissue Interaction Theory: Radiative Transport Theory – Photo process in biopolymers – In Vivo Photoexcitation – photo-induced physical, chemical, thermal and mechanical effects in biological systems – Optical biopsy – Single molecule detection

UNIT III **9 Hours**

BIO-NANO-PHOTONICS

Laser Microtools, Semiconductor quantum dots for bioimaging, Metallic nanoparticles and nanorods for biosensing – Optical biosensors: Fibre-Optic, evanescent wave, surface Plasmon resonance (SPR) based biosensors – biomaterials for photonics – Principle and design of laser tweezers – laser trapping and dissection for biological manipulation.

UNIT IV **9 Hours**

TISSUE ENGINEERING WITH LIGHT

Basics of tissue optics: Light absorption and scattering in tissues, Wavelength effects and spectra– the therapeutic window, Light penetration in tissues – Absorbing agents in tissues and blood –Skin optics, response to the UV radiation, Optical parameters of tissues – tissue welding – tissue contouring – tissue regeneration – Femto laser surgery – low level light therapy and photo dynamic therapy

UNIT V **9 Hours**

BIO-IMAGING TECHNIQUES AND ITS APPLICATIONS

An overview of optical imaging – Fluorescence Microscopy – Scanning Microscopy – In vivo Confocal Microscopy – Multi photon Microscopy – Optical Coherence Tomography (OCT) – Fluorescence Resonance Energy Transfer (FRET) imaging – fluorescence lifetime imaging Microscopy (FLIM) – Nonlinear optical imaging – Coherent Anti-stokes Raman Scattering –Bioimaging Applications.

Total: 45 Hours

Reference(s)

1. Introduction to Biophotonics, Paras N. Prasad, Wiley Inter-science, A John Wiley & Sons, Inc., Publication (Class notes are developed mainly based on this book.)
2. Introduction to Biomedical Imaging, Andrew G. Webb, 2002, IEEE Press.
3. Biomedical Optics: Principles and Imaging, Lihong.V.Wang, Hsin.-I. Wu, 2007, Wiley Interscience 2007. & "An Introduction to Biomedical Optics", R. Splinter and B.A.Hooper, Taylor & Francis.
4. Bioimaging Current Concepts in Light and Electron Microscopy, Douglas E. Chandler & Robert W.Roberson, Jones and Bartlett publishers.
5. Optical Imaging and Microscopy: Techniques and Advanced Systems, Peter Török and Fu-JenKao, 2004, Springer.

21OPH05 PHYSICS OF SOFT MATTER 3 0 0 3

Course Objectives

- To recognize the properties of soft matter and hard matter.
- To understand the fundamental interactions of colloids and gels.
- To explain the structure and phase behaviour of liquid crystals and supramolecules.
- To summarize the soft matter properties of structures and components of life.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Identify the salient features of soft matter and hard matter.
2. Exemplify the fundamental interactions and stability of colloids and gels.
3. Illustrate the structure and properties of liquid crystals.
4. Outline the aggregation and phase behaviour of surfactants, polymers, copolymers and block copolymers.
5. Analyse the soft matter behaviour of nucleic acids, proteins, polysaccharides and membranes.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	1												
3	2	2												
4	2	2												
5	2	2												

UNIT I **9 Hours**

CONDENSED MATTER

Intermolecular forces-Condensation and freezing-mechanical response: Hookean solid-Newtonian liquid-viscoelasticity. Glasses: relaxation time-viscosity- glass forming liquids. Soft matter: length scales-fluctuations and Brownian motion.

UNIT II **9 Hours**

COLLOIDAL DISPERSIONS & GELS

Forces between colloidal particles: Vander Waals forces-electrostatic double layer forces-steric hindrance-depletion interactions. Stability and phase behaviour: Crystallisation-strong colloids-weak colloids. Physical and chemical gels-classical theory of gelation-elasticity of gels.

UNIT III **9 Hours**

LIQUID CRYSTALS

Liquid crystal phases-distortions and topological defects-electrical and magnetic properties-polymer liquid crystals-Fredricks transition and liquid crystal displays.

UNIT IV **9 Hours**

SUPRAMOLECULAR SELF ASSEMBLY

Aggregation and phase separation-types of micelles- bilayers and vesicles. Phase behaviour of concentrated surfactant solutions-phase separation in polymers, copolymers and block copolymers.

UNIT V **9 Hours**

SOFT MATTER IN NATURE

Components and structures of life-Nucleic acids-proteins-interaction between proteins-polysaccharides-membranes.

Total: 45 Hours

References

1. Richard A L Jones, Soft Condensed Matter, Oxford University Press, UK, 2002.
2. Masao Doi, Soft Matter Physics, Oxford University Press, UK, 2013.
3. Ian W. Hamley, Introduction to Soft Matter, John Wiley & Sons, 2007.
4. A. Fernandez-Nieves, A M Puertas, Fluids, Colloids and Soft materials: An Introduction to Soft Matter Physics, John Wiley & Sons, 2016.
5. Maurice Kleman, Oleg D. Lavrentovich, Soft Matter Physics: An Introduction, Springer-Verlag, New York, 2003.

21OCH01 CORROSION SCIENCE AND ENGINEERING

3 0 0 3

Course Objectives

- Analyse the loss incurred due to corrosion in different sectors and terminologies related to corrosion.
- Identify forms and types of corrosion with suitable mechanism.
- Apply various methods of corrosion control, corrosion testing and monitoring.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Explain if corrosion can occur under specific operating conditions in a given equipment or construction and indicate regions of immunity, corrosion and passivity of a metal.
2. Compare different corrosion types on metals when exposed to air, water and at high temperatures (> 100 C).
3. Identify the corrosion mechanism on steel, iron, zinc and copper metal surfaces.
4. Calculate the rate of corrosion on metals using electrochemical methods of testing.
5. Propose the correct materials, design and operation conditions to reduce the likelihood of corrosion in new equipment and constructions.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2						1							
3	1	3												
4	2	2												
5	3	3					1							

UNIT I **9 Hours**

CORROSION

Importance of corrosion - spontaneity of corrosion - units of corrosion rate (MDD and MPY) - direct and indirect damage by corrosion - importance of corrosion prevention in industries - Pilling Bedworth ratio and its significance - passivation - area relationship in both active and passive states of metals - Pourbaix diagrams of Mg, Al and Fe and their advantages and disadvantages.

UNIT II **7 Hours**

TYPES OF CORROSION

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress corrosion-Catastrophic oxidation corrosion.

UNIT III **9 Hours**

MECHANISM OF CORROSION

Hydrogen embrittlement - corrosion fatigue - filiform corrosion - fretting damage and microbes induced corrosion. Corrosion mechanism on steel, iron, zinc and copper metal surfaces.

UNIT IV **10 Hours**

CORROSION RATE AND ITS ESTIMATION

Rate of corrosion: Factors affecting corrosion. Electrochemical methods of polarization: Tafel extrapolation polarization and linear polarization. Weight loss method - testing for intergranular susceptibility and stress corrosion. Non-destructive testing methods: Visual testing - liquid penetrant testing - magnetic particle testing - Ultrasonic monitoring, and eddy current testing.

UNIT V **10 Hours**

CORROSION CONTROL METHODS

Fundamentals of cathodic protection - types of cathodic protection (sacrificial anodic and impressed current cathodic protection). Stray current corrosion, problems and its prevention. Protective coatings: Metal coatings: Hot dipping (galvanizing, tinning and metal cladding) - natural inhibitors. Selection of suitable design for corrosion control.

Total: 45 Hours

Reference(s)

1. Mouafak A. Zaher, "Introduction to Corrosion Engineering", CreateSpace Independent Publishing Platform, 2016.
2. E. McCafferty, "Introduction to Corrosion Science", Springer; 2010 Edition, January 2010.
3. R. Winstone Revie and Herbert H. Uhlig, "Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering", 4th Edition, John Wiley & Science, 2008.
4. Mars G. Fontana, "Corrosion Engineering", Tata McGraw Hill, Singapore, 2008.
5. David E.J. Talbot (Author), James D.R. Talbot, "Corrosion Science and Technology", Second Edition (Materials Science & Technology), CRC Press; 2nd Edition, 2007.
6. http://corrosion-doctors.org/Corrosion-History/Eight.html.

21OCH02 POLYMER SCIENCE 3 0 0 3

Course Objectives

- Explain the properties of different polymers with its mechanism.
- Select the appropriate polymerization techniques to synthesize the polymers.
- Identify suitable polymers for various industrial applications.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Illustrate the types of mechanism of polymerization reactions and analyze the natural and synthetic polymers.
2. Identify the suitable polymerization techniques to synthesize the high-quality polymers.
3. Identify the structure, thermal, and mechanical properties of polymers for different applications.
4. Apply the polymer processing methods to design polymer products.
5. Analyze the polymers used in electronic and biomedical applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	1	2												
3	2	2												
4	1	1	2											
5	1	3	2											

UNIT I **10 Hours**

POLYMERS AND ELASTOMERS

Classification of polymers - Mechanism: Addition polymerization - free radical, cationic, anionic and co-ordination (Ziegler-Natta) polymerization - copolymerization - condensation polymerization (nylon-6,6) -ring opening polymerization (nylon-6). Elastomers: Natural rubber and synthetic rubber: styrene -butadiene rubber (SBR), butyl, neoprene, thiocol rubbers. High performance polymers: polyethers, polyether ether ketone (PEEK), polysulphones and polyimides.

UNIT II **8 Hours**

POLYMERIZATION TECHNIQUES

Homogeneous and heterogeneous polymerization - bulk polymerization (PMMA, PVC) - solution polymerization - polyacrylic acid, suspension polymerization (ion-exchange resins) - emulsion polymerization (SBR) - advantages and disadvantages of bulk and emulsion polymerization. Melt solution and interfacial poly-condensation.

UNIT III **8 Hours**

CHARACTERIZATION AND TESTING

Characterization of polymers by Infrared Spectroscopy (IR) and Nuclear Magnetic Spectroscopy (NMR) - Thermal properties: TGA and DSC - Testing tensile strength - Izod impact - Compressive strength - Rockwell hardness - Vicot softening point - water absorption.

UNIT IV **9 Hours**

POLYMER PROCESSING

Moulding: Compression - injection - extrusion and blow mouldings. Film casting - calendaring. Thermoforming and vacuum formed polystyrene - foamed polyurethanes. Fibre spinning: melt, dry and wet spinning. Fibre reinforced plastics fabrication: hand-layup - filament winding and pultrusion

UNIT V **10 Hours**

SPECIALITY POLYMERS

Preparation and properties of heat resistant and flame-retardant polymers. Polymers for electronic applications: liquid crystalline, conducting and photosensitive polymers – E-waste management. Polymer for biomedical applications: artificial organs, controlled drug delivery, Scaffolds in tissue Engineering –waste management.

Total: 45 Hours

Reference(s)

1. V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar, "Polymer Science", New Age International (P) Ltd., New Delhi, 2021.
2. Joel R. Fried, "Polymer Science and Technology", Prentice Hall of India (P). Ltd., 2014.
3. F. W. Billmeyer,"Text Book of Polymer Science", John Wiley & Sons, New York, 2008.
4. Barbara H. Stuart, "Polymer Analysis", John Wiley & Sons, New York, 2008.
5. George Odian , "Principles of Polymerization", John Wiley & Sons, New York, 2004.
6. R. J. Young and P. A. Lovell, "Introduction to Polymers", CRC Press, New York, 2011.
7. Common Biocompatible Polymeric Materials for Tissue Engineering and Regenerative Medicine (2019), Materials Chemistry and Physics https://doi.org/10.1016/j.

21OCH03 ENERGY STORING DEVICES 3 0 0 3

Course Objectives

- Compare the energy density of commercialized primary and secondary batteries.
- Classify the fuel cells and compare their efficiency in different environmental conditions.
- Demonstrate the various energy storage devices and fuel cells.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Find the parameters required for operation of a cell to evaluate the capacity of energy storage devices.
2. Identify the electrodes, electrolyte and cell reactions of different types of primary, secondary batteries and infer the selection criteria for commercial battery systems with respect to commercial applications.
3. Differentiate fuel cells based on its construction, production of current and applications.
4. Compare different methods of storing hydrogen fuel and its environmental applications.
5. Classify the solar cell based on the materials used in it.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1												
2	2	3					1							
3	3	1												
4	2	2					1							
5	3	3					1							

UNIT I **6 Hours**

BASICS OF CELLS AND BATTERIES

Components - classification - operation of a cell - theoretical cell voltage - capacity - specific energy - energy density of lithium and lead acid battery - charge efficiency- charge rate - charge retention - closed circuit voltage - open circuit voltage current density - cycle life - discharge rate-over charge-over discharge.

UNIT II **10 Hours**

BATTERIES FOR PORTABLE DEVICES AND ELECTRIC VEHICLES

Primary batteries: zinc-carbon - magnesium, and mercuric oxide - recycling/safe disposal of used cells. Secondary batteries: lead acid - nickel-cadmium - lithium-ion batteries - rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide - lithium anode cell - photo galvanic cells. Battery specifications for cars and automobiles. Extraction of metals from battery materials.

UNIT III **10 Hours**

TYPES OF FUEL CELLS

Importance and classification of fuel cells: Description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells - phosphoric acid - solid oxide - molten carbonate and direct methanol fuel cells.

UNIT IV **10 Hours**

HYDROGEN AS A FUEL

Sources and production of hydrogen: Electrolysis and photocatalytic water splitting. Methods of hydrogen storage: High pressurized gas - liquid hydrogen type - metal hydride. Hydrogen as engine fuel - features, application of hydrogen technologies in the future – limitations.

UNIT V **9 Hours**

ENERGY AND ENVIRONMENT

Future prospects of renewable energy and efficiency of renewable fuels - economy of hydrogen energy. Solar Cells: First, second, third and fourth generation solar cell - photo biochemical conversion cell.

Total: 45 Hours

Reference(s)

1. N. Eliaz, E. Gileadi, Physical Electrochemistry, Fundamentals, Techniques and Applications, Wiley, 2019.
2. J. Garche, K. Brandt, Electrochemical Power sources: Fundamentals Systems and Applications, Elsevier, 2018.
3. S.P. Jiang, Q. Li, Introduction to Fuel Cells, Springer, 2021.
4. A. Iulianelli, A. Basile, Advances in Hydrogen Production, Storage and Distribution, Elsevier, 2016.
5. M.M. Eboch, The Future of Energy, From Solar Cells to Flying Wind Farms, Capstone, 2020.

21OMA01 GRAPH THEORY AND COMBINATORICS

3 0 0 3

Course Objectives

- This course comprehends the graphs as a modelling and analysis tool in computer science & Engineering.
- It introduces the structures such as graphs & trees and techniques of counting and combinations, which are needed in number theory-based computing and network security studies in Computer Science.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Recognize the basic ideas of Graph and its characteristics.
2. Assess the characteristics of trees and its properties.
3. Predict the colouring of graphs and its applications in the respective areas of engineering.
4. Compute the permutations and combinations in the engineering field.
5. Demonstrate the types of generating functions and their applications in engineering.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2													
2	1	3													
3	2	3													
4	2	3													
5	3	3													

UNIT I **9 Hours**

INTRODUCTION

Graphs - Introduction - Isomorphism - Sub graphs - Walks, Paths, Circuits - Connectedness - Components - Euler graphs - Hamiltonian paths and circuits - Trees - Properties of trees - Distance and centers in tree - Rooted and binary trees.

UNIT II **9 Hours**

TREES, CONNECTIVITY

Spanning trees - Fundamental circuits - Spanning trees in a weighted graph - cut sets - Properties of cut set - All cut sets - Fundamental circuits and cut sets - Connectivity and separability - Network flows - 1-Isomorphism - 2-Isomorphism - Combinational and geometric graphs - Planer graphs - Different representation of a planer graph.

UNIT III **9 Hours**

MATRICES, COLOURING AND DIRECTED GRAPH

Chromatic number - Chromatic partitioning - Chromatic polynomial - Matching - Covering - Four colour problem - Directed graphs - Types of directed graphs - Digraphs and binary relations - Directed paths and connectedness - Euler graphs.

UNIT IV **9 Hours**

PERMUTATIONS

Fundamental principles of counting - Permutations and combinations - Binomial theorem - combinations with repetition - Combinatorial numbers - Principle of inclusion and exclusion - Derangements - Arrangements with forbidden positions.

UNIT V **9 Hours**

GENERATING FUNCTIONS

Generating functions - Partitions of integers - Exponential generating function - Summation operator - Recurrence relations - First order and second order - non-homogeneous recurrence relations - Method of generating functions.

Total: 45 Hours

Reference(s)

1. Narsingh Deo, Graph Theory: With Application to Engineering and Computer Science, Prentice Hall of India, 2003.
2. Grimaldi R.P., Discrete and Combinatorial Mathematics: An Applied Introduction, Addison Wesley, 1994.
3. Rosen K.H., Discrete Mathematics and Its Applications, McGraw Hill, 2007.
4. Clark J. & Holton D.A., A First Look at Graph Theory, Allied Publishers, 1995.
5. Mott J.L., Kandel A. & Baker T.P., Discrete Mathematics for Computer Scientists and Mathematicians, Prentice Hall of India, 1996.
6. Liu C.L., Elements of Discrete Mathematics, McGraw Hill, 1985.

21OGE01 PRINCIPLES OF MANAGEMENT 3 0 0 3

Course Objectives

- To develop cognizance about importance of management principles.
- Extract the functions and responsibilities of managers.
- To Study and understand the various HR related activities.
- Learn the application of the theories in an organization.
- Analyze the position of self and company goals towards business.

Programme Outcomes (POs)

PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO11.Project Management and Finance: 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.

Course Outcomes (COs)

1. Students will be able to understand the basic concepts of Management.
2. Have some basic knowledge on planning process and its Tools & Techniques.
3. Ability to understand management concept of organizing and staffing.
4. Ability to understand management concept of directing.
5. Ability to understand management concept of controlling.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1									2		3				
2									2		2				
3									2		2				
4									3		2				
5									2		2				

UNIT I **9 Hours**

INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

Definition of Management Science or Art Manager Vs Entrepreneur-types of managers - Managerial roles and skills Evolution of Management Scientific, Human Relations, System and Contingency approaches Types of Business organization - Sole proprietorship, partnership, Company - public and private sector enterprises - Organization culture and Environment Current Trends and issues in Management.

UNIT II **9 Hours**

PLANNING

Nature and purpose of planning - Planning process - Types of planning – Objectives - Setting objectives - Policies - Planning premises - Strategic Management - Planning Tools and Techniques - Decision making steps and process.

UNIT III **9 Hours**

ORGANISING

Nature and purpose – Formal and informal organization - Organization chart - Organization Structure Types - Line and staff authority - Departmentalization - Delegation of authority - Centralization and decentralization - Job Design - Human Resource - Management - HR Planning, Recruitment, Selection, Training and Development, Performance Management, Career planning and management.

UNIT IV **9 Hours**

DIRECTING

Foundations of individual and group behaviour - Motivation-Motivation theories - Motivational techniques - Job satisfaction - Job enrichment - Leadership-types and theories of leadership - Communication-Process of communication - Barrier in communication Effective Communication-Communication and IT.

UNIT V **9 Hours**

CONTROLLING

System and process of controlling - Budgetary and non-Budgetary control techniques - Use of Computers and IT in Management control - Productivity problems and management - Control and Performance-Direct and preventive control - Reporting.

Total: 45 Hours

Reference(s)

1. Robbins S, Management, (13th ed.), Pearson Education, New Delhi, 2017.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, Fundamentals of Management, Pearson Education, 7th Edition, 2011.
3. Robert Kreitner and Mamata Mohapatra, Management, Biztantra, 2008.
4. L. M. Prasad, Principles and Practice of Management. 7th Edition, Sultan Chand & Sons,2007.
5. P. C. Tripathi and P. N. Reddy, Principles of Management, Fourth Edition, Tata McGraw Hill, 2008.

21OGE02 ENTREPRENEURSHIP DEVELOPMENT I 3 0 0 3

Course Objectives

- Learn the basics and scope of the Entrepreneurship.
- Understand the generation of ideas of the Entrepreneurship.
- Evolve the legal aspects of the business.
- Learn to analyze the various business finance.
- Learn the basics of the Operations Management.

Programme Outcomes (POs)

PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Analyze the role of entrepreneurship in economic development.
2. Explain the types of ideas that to be used for entrepreneurship development.
3. Examine the legal aspects of business and its association.
4. Examine the sources of business and its analysis.
5. Analyse the different modes of operation management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1						1	2		2						
2						1	2		2						
3						1	2		2						
4						1	2		2						
5						1	2		2						

UNIT I **9 Hours**

BASICS OF ENTREPRENEURSHIP

Nature, scope and types of Entrepreneurships, Entrepreneur Personality Characteristics, Entrepreneurship process. Role of entrepreneurship in economic development

UNIT II **9 Hours**

GENERATION OF IDEAS

Creativity and Innovation, Lateral Thinking, Generation of Alternatives, Fractional, Reversal Method, Brain Storming, Analogies

UNIT III **9 Hours**

LEGAL ASPECTS OF BUSINESS

Contract act-Indian contract act, Essential elements of valid contract, classification of contracts, sale of goods act- Formation of contract of sale, negotiable instruments- promissory note, bills and cheques, partnership, limited liability partnership (LLP), companies act-kinds, formation, memorandum of association, articles of association.

UNIT IV **9 Hours**

BUSINESS FINANCE

Project evaluation and investment criteria (cases), sources of finance, financial statements, break even analysis, cash flow analysis.

UNIT V **9 Hours**

OPERATIONS MANAGEMENT

Importance – functions - deciding on the production system - facility decisions: plant location, plant layout (cases), capacity requirement planning - inventory management (cases) - lean manufacturing, Six sigma.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005.
2. Prasanna Chandra, Projects Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill Publishing Company Limited, New Delhi: 2000.
3. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006.

21OGE03 ENTREPRENEURSHIP DEVELOPMENT II 3 0 0 3

Course Objectives

- Evolve the marketing mix for promotion the product / services.
- Handle the human resources and taxation.
- Learn to analyze the taxation.
- Understand the Government industrial policies and supports.
- Preparation of a business plan.

Programme Outcomes (POs)

PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Examine the strategies and plans in marketing management.
2. Analyse the cases involved in human resource management.
3. Classify the direct and indirect taxes in business.
4. Analyze the supports given by government for improving the business.
5. Examine the various steps involved in preparing the business plan.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1						1	2		2						
2						1	2		2						
3						1	2		2						
4						1	2		2						
5						1	2		2						

UNIT I **9 Hours**

MARKETING MANAGEMENT

Marketing environment, Segmentation, Targeting and positioning, Formulating marketing strategies, Marketing research, marketing plan, marketing mix (cases).

UNIT II **9 Hours**

HUMAN RESOURCE MANAGEMENT

Human Resource Planning (Cases), Recruitment, Selection, Training and Development, HRIS, Factories Act 1948 (an over view).

UNIT III **9 Hours**

BUSINESS TAXATION

Direct taxation, Income tax, Corporate tax, MAT, Tax holidays, Wealth tax, Professional tax (Cases). Indirect taxation, Excise duty, Customs, Sales and Service tax, VAT, Octroi, GST (Cases).

UNIT IV **9 Hours**

GOVERNMENT SUPPORT

Industrial policy of Central and State Government, National Institute - NIESBUD, IIE, EDI. State Level Institutions - TIIC, CED, MSME, Financial Institutions.

UNIT V **9 Hours**

BUSINESS PLAN PREPARATION

Purpose of writing a business plan, Capital outlay, Technical feasibility, Production plan, HR plan, Market survey and Marketing plan, Financial plan and Viability, Government approvals, SWOT analysis.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005.
2. Philip Kotler., Marketing Management, Prentice Hall of India, New Delhi: 2003.
3. Aswathappa K, Human Resource and Personnel Management - Text and Cases, Tata McGraw Hill: 2007.
4. Jain P C., Handbook for New Entrepreneurs, EDII, Oxford University Press, New Delhi: 2002.
5. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006.
6. http://niesbud.nic.in/agencies.html.

21OGE04 NATION BUILDING, LEADERSHIP AND SOCIAL RESPONSIBILITY

3 0 0 3

Course Objectives

- To understand the importance of National Integration, Patriotism and Communal Harmony.
- To outline the basic awareness about the significance of soft skills in professional and inter-personal communications and facilitate an all-round development of personality.
- To analyse the different types of responsibility role of play for the improvement of society.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Understand religo-cultural diversity of the country and its impact on the lives of the people and their beliefs.
2. Acquire a sense of responsibility, smartness in appearance and improve self-confidence.
3. Develop the sense of self-less social service for better social & community life.
4. Apply the importance of Physical and Mental health and structure of communication organization and various mode of communication.
5. Acquire awareness about the various types of weapon systems in the Armed Forces.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2		1				1					3			
2	2		2				2					2			
3	2		1				1					2			
4	2		3				3					3			
5	2		1				1					2			

UNIT I **9 Hours**

NATIONAL INTEGRATION

Importance & Necessity, Factors Affecting National Integration, Unity in Diversity. Threats to National Security. Water Conservation and Rain Harvesting, Waste Management and Energy Conservation. Leadership Capsule-Traits-Indicators-Motivation-Moral Values-Honor Code-Case Studies: Shivaji, Jhansiki Rani, Case Studies–APJ Abdul kalam, Deepa Malik, Maharana Pratap, N Narayan Murthy Ratan Tata Rabindra Nath Tagore, role of NCC cadets in 1965 war.

UNIT II **9 Hours**

PERSONALITY DEVELOPMENT AND LEADERSHIP

Intra & Interpersonal skills - Self-Awareness- &Analysis, Empathy, Critical & creative thinking, Decision making and problem solving, Communication skills, Group Discussion – copping with stress and emotions, changing mindset, Public Speaking, Time Management, Social skills, Career counselling, SSB procedure and Interview skills.

UNIT III **9 Hours**

SOCIAL SERVICE, COMMUNITY DEVELOPMENT AND ENVIRONMENTAL AWARENESS

Basics of social service and its need, Types of social service activities, Objectives of rural development programs and its importance, NGO's and their contribution in social welfare, contribution of youth and NCC in Social welfare. Protection of children & women safety, Road/ Rail Travel Safety, New initiatives, Cyber and mobile security awareness. Disaster management Capsule-Organization-Types of Disasters-Essential Services-Assistance-Civil Defence Organization

UNIT IV **9 Hours**

HEALTH, HYGIENE AND COMMUNICATION

Sanitation, First Aid in Common Medical Emergencies. Health, Treatment and Care of Wounds. Yoga-Introduction, Definition, Purpose, Benefits. Asanas-Padamsana, Siddhasana, Gyan Mudra, Surya Namaskar, Shavasana, Vajrasana, Dhanurasana, Chakrasana, Sarvaangasana, Halasana etc.

Obstacle Training Contact: Obstacle training - Intro, Safety measures, Benefits, Straight balance, Clear Jump, Gate Vault, Zig Zag Balance, High Wall etc.

Communication: Basic Radio Telephony (RT) Procedure-Introduction, Advantages, Disadvantages, Need for standard- Procedures-Types of Radio Telephony Communication-Radio telephony procedure, Documentation.

UNIT V **9 Hours**

ARMED FORCES AND NCC GENERAL

Introduction to Digital Signal Processors- Basic Classification-Features TMS320C6713 Architecture-Functional Unit-Pipelining- Addressing Modes -Instruction set Simple Assembly Language Program.

Total: 45 Hours

Reference(s)

1. Director General NCC Website: https://indiancc.nic.in/ncc-general-elective-subject-course-design/.
2. Grooming Tomorrow's Leaders, published by DG, NCC. https://indiancc.nic.in/.
3. Youth in Action, published by DG, NCC. https://indiancc.nic.in/.
4. The Cadet, Annual Journal of the NCC. https://indiancc.nic.in/.
5. Précis Issued by respective Service Headquarters on specialized subject available to PI Staff as reference material. https://indiancc.nic.in/.