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ARYABHATTA KNOWLEDGE UNIVERSITY

Mithapur, Patna - 800 001
E-mail:- akuniv10@gmail.com

Notification

The Vice-Chancellor, Aryabhatta Knowledge University, Patna has approved the **Ordinance & Syllabus of B. Tech. in Silk Technology and B. Tech. in Textile Technology** of Aryabhatta Knowledge University, Patna in anticipation of approval from Academic Council, Executive Council of the University and Government of Bihar.

It is hereby being notified.

By order of the Vice-Chancellor

Sd. /-

Registrar (I/c)

Aryabhatta Knowledge University, Patna

Memo No.:- 012/Acad/12-03/AKU/2021- 1051

Date: 17.03.2021

Copy to:

1. PA to the Vice-Chancellor, PVC Office, Registrar Office, Controller of Examinations for information, Affiliation Section for information and needful and Exam Section with copy of said draft Ordinance and Syllabus for information and needful.
2. Shree Vishal Ratan Kumar to upload the notification on the University website.

Registrar (I/c)

Aryabhatta Knowledge University, Patna



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ARYABHATTA KNOWLEDGE UNIVERSITY

Mithapur, Patna - 800 001

E-mail:- akuniv10@gmail.com

पत्रांक: 012/ACAD/12-03/AKU/2021 -

दिनांक: 17.03.2021

प्रेषक:

कुलसचिव (प्र०),
आर्यभट्ट ज्ञान विश्वविद्यालय, पटना।

सेवा में,

निदेशक,
हस्तकरघा एवं रेशम निदेशालय,
उद्योग विभाग, बिहार सरकार, पटना

विषय : बिहार रेशम एवं वस्त्र संस्थान, नाथनगर, भागलपुर में **Silk Technology** एवं **Textile Technology** पाठ्यक्रमों से संबंधित अध्यादेश एवं सिलेबस के प्रारूप को विश्वविद्यालय के वेबसाइट पर अपलोड करने के संबंध में।

संदर्भ : भवदीय पत्रांक 515, दिनांक-28.05.2020।

महाशय,

उपर्युक्त विषयक प्रासंगिक पत्र के संबंध में निदेशानुसार कहना है कि **B.Tech. in Silk Technology** एवं **B.Tech. in Textile Technology** पाठ्यक्रमों से संबंधित अध्यादेश एवं सिलेबस के प्रारूप (संलग्न) का निर्माण विश्वविद्यालय द्वारा प्राचार्य, बिहार रेशम एवं वस्त्र संस्थान, नाथनगर, भागलपुर एवं अन्य विषय विशेषज्ञों की समिति के माध्यम से कराया गया है।

उक्त अध्यादेश एवं सिलेबस के प्रारूप को विश्वविद्यालय की शैक्षणिक परिषद्, कार्यकारिणी परिषद् एवं बिहार सरकार से अनुमोदन की प्रत्याशा में माननीय कुलपति महोदय द्वारा अनुमोदन प्रदान किया गया है, जिसे अधिसूचना सहित विश्वविद्यालय के वेबसाइट पर अपलोड किया जा रहा है।

भवदीय सूचनार्थ एवं आवश्यक कार्यार्थ।

अनुलग्नक: यथोक्त

विश्वासभाजन

ह०/-

कुलसचिव (प्र०)

आर्यभट्ट ज्ञान विश्वविद्यालय, पटना।

ज्ञापांक : 012/ACAD/12-03/AKU/2021 - 1050

दिनांक: 17.03.2021

प्रतिलिपि:-

1. प्राचार्य, बिहार रेशम एवं वस्त्र संस्थान, नाथनगर, भागलपुर सूचनार्थ एवं आवश्यक कार्यार्थ हेतु प्रेषित।
2. निदेशक, उच्च शिक्षा, शिक्षा विभाग, बिहार सरकार, पटना सूचनार्थ प्रेषित।
3. कुलपति के निजी सहायक/प्रतिकुलपति कार्यालय/कुलसचिव कार्यालय, आर्यभट्ट ज्ञान विश्वविद्यालय, पटना को सूचनार्थ प्रेषित।
4. श्री विशाल रत्न कुमार, वेब प्रोग्रामर, आर्यभट्ट ज्ञान विश्वविद्यालय को विश्वविद्यालय वेबसाइट पर अपलोड करने हेतु सूचनार्थ एवं आवश्यक कार्यार्थ हेतु प्रेषित।

कुलसचिव (प्र०)

आर्यभट्ट ज्ञान विश्वविद्यालय, पटना

ARYABHATTA KNOWLEDGE UNIVERSITY PATNA

CURRICULUM (CBCS)

Teaching and Examination Scheme

B. Tech. in Textile Technology

(1st to 8th Semester)

SEMESTER – I

| Sl. No. | Paper Code | Paper Title | L | T | P | Credit | IA | ESE | TOTAL | Hours |
|------------------|------------|---|---|---|---|-------------|----|-----|------------|-----------|
| Theory | | | | | | | | | | |
| 1 | 102101 | Physics (Electromagnetism) | 3 | 1 | 0 | 4 | 30 | 70 | 100 | 4 |
| 2 | 102102 | Mathematics –I (Calculus and Linear Algebra) | 3 | 1 | 0 | 4 | 30 | 70 | 100 | 4 |
| 3 | 100101 | Basic Electrical Engineering | 3 | 1 | 0 | 4 | 30 | 70 | 100 | 4 |
| 4 | 100102 | Engineering Graphics & Design | 1 | 0 | 0 | 1 | 30 | 70 | 100 | 1 |
| Practical | | | | | | | | | | |
| 1 | 102101P | Physics (Electromagnetism) | 0 | 0 | 3 | 1.5 | 20 | 30 | 50 | 3 |
| 2 | 100101P | Basic Electrical Engineering | 0 | 0 | 2 | 1 | 20 | 30 | 50 | 2 |
| 3 | 100102P | Engineering Graphics & Design | 0 | 0 | 4 | 2 | 20 | 30 | 50 | 4 |
| Total | | | | | | 17.5 | | | 550 | 22 |

TOTAL MARKS: 550 TOTAL CREDITS: 17.5 TOTAL HOURS: 22

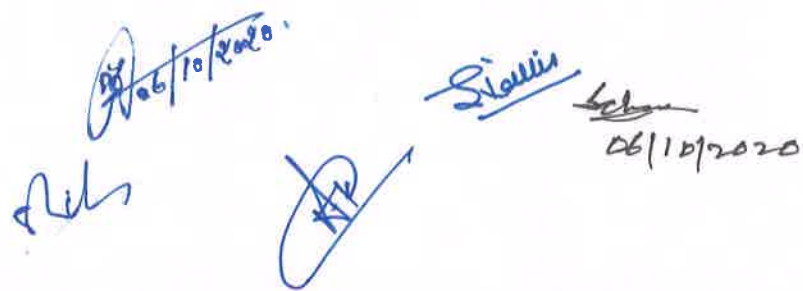
SEMESTER – II

| Sl. No. | Paper Code | Paper Title | L | T | P | Credit | IA | ESE | TOTAL | Hours |
|------------------|------------|---|---|---|---|-------------|----|-----|------------|-----------|
| Theory | | | | | | | | | | |
| 1 | 100203 | Chemistry | 3 | 1 | 0 | 4 | 30 | 70 | 100 | 4 |
| 2 | 102202 | Mathematics –II (ODE & Complex Variables) | 3 | 1 | 0 | 4 | 30 | 70 | 100 | 4 |
| 3 | 100204 | Programming for Problem Solving | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| 4 | 100205 | Workshop Manufacturing Practices | 1 | 0 | 0 | 1 | 30 | 70 | 100 | 1 |
| 5 | 100206 | English | 2 | 0 | 0 | 2 | 30 | 70 | 100 | 2 |
| Practical | | | | | | | | | | |
| 1 | 100203P | Chemistry | 0 | 0 | 3 | 1.5 | 20 | 30 | 50 | 3 |
| 2 | 100204P | Programming for Problem Solving | 0 | 0 | 4 | 2 | 20 | 30 | 50 | 4 |
| 3 | 100205P | Workshop Manufacturing Practices | 0 | 0 | 4 | 2 | 20 | 30 | 50 | 4 |
| 4 | 100206P | English | 0 | 0 | 2 | 1 | 20 | 30 | 50 | 2 |
| Total | | | | | | 20.5 | | | 700 | 27 |

TOTAL MARKS: 700 TOTAL CREDITS: 20.5 TOTAL HOURS: 27 IA (INTERNAL ASSESMENT), ESE (END SEMESTER EXAMINATION)

DEFINITION OF CREDIT

| Hou | Component | Credi |
|-----|------------------------|-------|
| r | | t |
| 1 | Lecture (L) per week | 1 |
| 1 | Tutorial (T) per week | 1 |
| 1 | Practical (P) per week | 0.5 |



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B.Tech. in Textile Technology (TX 112) SEMESTER – III

| S. No. | Course no. | Subject | Period | | | Credit | Evaluation Scheme | | | Hours of Exam |
|---------------|--------------------|---|-----------|----------|----------|-----------|-------------------|-----|------------|---------------|
| | | | L | T | P | | MSE | ESE | Sub Total | |
| Theory | | | | | | | | | | |
| 1 | | Introduction To Textiles | 2 | 0 | 0 | 2 | 30 | 70 | 100 | 3 |
| 2 | | Natural Fibres | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| 3 | | Yarn Formation-I | 3 | 1 | 0 | 4 | 30 | 70 | 100 | 3 |
| 4 | | Preparatory and Basic Fabric Formation | 3 | 1 | 0 | 4 | 30 | 70 | 100 | 3 |
| 5 | | Preparatory and Coloration of Textiles | 3 | 1 | 0 | 4 | 30 | 70 | 100 | 3 |
| 6 | 211303 (Common) | Mathematics-III (PDE, Probability & Statistics) | 3 | 1 | 0 | 4 | 30 | 70 | 100 | 3 |
| Total | | | 17 | 4 | 0 | 21 | | | 600 | |

Sessional/Practical

| S. No. | Course no. | Subject | Period | | | Credit | Evaluation Scheme | | | Hours of Exam |
|------------------|------------|-------------------------------------|-----------|----------|----------|-----------|-------------------|------------|------------|---------------|
| | | | L | T | P | | CPA | ESE | Sub Total | |
| 1 | | Textile Fibres Lab. | 0 | 0 | 2 | 1 | 20 | 30 | 50 | 3 |
| 2 | | Yarn Formation Lab – I | 0 | 0 | 2 | 1 | 20 | 30 | 50 | 3 |
| 3 | | Fabric Formation Lab – I | 0 | 0 | 2 | 1 | 20 | 30 | 50 | 3 |
| 4 | | Textile Chemical Processing Lab – I | 0 | 0 | 2 | 1 | 20 | 30 | 50 | 3 |
| Total | | | 0 | 0 | 8 | 4 | 80 | 120 | 200 | |
| Sub-Total | | | 17 | 4 | 8 | 25 | | | 800 | |

MSE (Internal Evaluation); ESE – End Semester Examination; CPA (Internal Evaluation)
 Total Credits 21 + 4 = 25; Total Marks 600 + 200 = 800 ; Total Contact Hours (L:T:P) = 17 + 4 + 8 = 29

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B.Tech. in Textile Technology

SEMESTER - IV

| S. No. | Course no. | Subject | Period | | | Credit | Evaluation Scheme | | | Hours of Exam |
|--|------------------|--|-----------|----------|----------|-----------|-------------------|-----|------------|---------------|
| | | | L | T | P | | MSE | ESE | Sub Total | |
| Theory | | | | | | | | | | |
| 1 | | Textile Polymer and Fibre Science | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| 2 | | Man Made Fibres | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| 3 | | Yarn Formation- II | 3 | 1 | 0 | 4 | 30 | 70 | 100 | 3 |
| 4 | | Fabric Formation Systems | 3 | 1 | 0 | 4 | 30 | 70 | 100 | 3 |
| 5 | | Textile Printing and Finishing | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| 6 | | Textile Testing-I | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| 7 | MOOCs | Open Elective –I (MOOCs/SWAYAM/ NPTEL etc. Course-I) | 2 | 0 | 0 | 2 | | | | |
| | Total | | 20 | 2 | 0 | 22 | | | 600 | |
| Sessional/Practical | | | | | | | | | | |
| S. No. | Course no. | Subject | Period | | | Credit | Evaluation Scheme | | | Hours of Exam |
| | | | L | T | P | | CPA | ESE | Sub Total | |
| 1 | | Yarn Formation Lab-II | 0 | 0 | 2 | 1 | 20 | 30 | 50 | 3 |
| 2 | | Fabric Formation Lab-II | 0 | 0 | 2 | 1 | 20 | 30 | 50 | 3 |
| 3 | | Textile Chemical Processing Lab – II | 0 | 0 | 2 | 1 | 20 | 30 | 50 | 3 |
| 4 | | Textile Testing Lab-I | 0 | 0 | 2 | 1 | 20 | 30 | 50 | 3 |
| | Total | | 0 | 0 | 8 | 4 | | | 200 | |
| | Sub-Total | | 20 | 2 | 8 | 26 | | | 800 | |
| MSE (Internal Evaluation); ESE – End Semester Examination; CPA (Internal Evaluation) Total Credits 22 + 4 =26; Total Marks 600 +200 = 800 ; Total Contact Hours (L:T:P) = 20 + 2 + 8 = 30 | | | | | | | | | | |

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B.Tech. in Textile Technology

SEMESTER - V

| S. No. | Course no. | Subject | Period | | | Credit | Evaluation Scheme | | | Hours of Exam |
|--|------------------|---|-----------|----------|----------|-----------|-------------------|-----|------------|---------------|
| | | | L | T | P | | MSE | ESE | Sub Total | |
| Theory | | | | | | | | | | |
| 1 | | Properties of Fibres | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| 2 | | Kinematics of Machines | 3 | 1 | 0 | 4 | 30 | 70 | 100 | 3 |
| 3 | | Textile Testing-II | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| 4 | | Fabric Structure and Design Analysis | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| 5 | | Advanced Yarn Manufacturing | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| 6 | | Advanced Fabric Manufacturing | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| 7 | MOOCs | Open Elective –II (MOOCs/SWAYAM/NPTEL etc. Course-II) | 2 | 0 | 0 | 2 | | | | |
| | Total | | 20 | 1 | 0 | 21 | | | 600 | |
| Sessional/Practical | | | | | | | | | | |
| S. No. | Course no. | Subject | Period | | | Credit | Evaluation Scheme | | | Hours of Exam |
| | | | L | T | P | | CPA | ESE | Sub Total | |
| 1 | | Textile Testing Lab-II | 0 | 0 | 2 | 1 | 20 | 30 | 50 | 3 |
| 2 | | Fabric Structure and Design Analysis Lab | 0 | 0 | 2 | 1 | 20 | 30 | 50 | 3 |
| 3 | | Advanced Yarn Manufacturing Lab | 0 | 0 | 2 | 1 | 20 | 30 | 50 | 3 |
| 4 | | Advanced Fabric Manufacturing Lab | 0 | 0 | 2 | 1 | 20 | 30 | 50 | 3 |
| | Total | | 0 | 0 | 8 | 4 | | | 200 | |
| | Sub-Total | | 20 | 1 | 8 | 25 | | | 800 | |
| MSE (Internal Evaluation); ESE – End Semester Examination; CPA (Internal Evaluation) Total Credits 21 + 4 = 25; Total Marks 600 + 200 = 800 ; Total Contact Hours (L:T:P) = 20 + 1 + 8 = 29 | | | | | | | | | | |

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B.Tech. in Textile Technology

SEMESTER - VI

| S. No. | Course no. | Subject | Period | | | Credit | Evaluation Scheme | | | Hours of Exam |
|----------------------------|------------------|--|-----------|----------|-----------|-----------|-------------------|-----|------------|---------------|
| | | | L | T | P | | MSE | ESE | Sub Total | |
| Theory | | | | | | | | | | |
| 1 | | Fundamentals of Knitting and Nonwoven Technology | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| 2 | | Process Control in Textiles | 3 | 1 | 0 | 4 | 30 | 70 | 100 | 3 |
| 3 | | Garment Technology | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| 4 | | Multi-fiber Processes | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| 5 | | Advanced Fabric Structure and Design | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| 6 | | Application of Electronics in Textiles | 3 | 1 | 0 | 4 | 30 | 70 | 100 | 3 |
| | Total | | 18 | 2 | 0 | 20 | | | 600 | |
| Sessional/Practical | | | | | | | | | | |
| S. No. | Course no. | Subject | Period | | | Credit | Evaluation Scheme | | | Hours of Exam |
| | | | L | T | P | | CPA | ESE | Sub Total | |
| 1 | | Knitting Technology Lab | 0 | 0 | 2 | 1 | 20 | 30 | 50 | 3 |
| 2 | | Garment Technology Lab | 0 | 0 | 2 | 1 | 20 | 30 | 50 | 3 |
| 3 | | Advanced Fabric Structure and Design Lab | 0 | 0 | 2 | 1 | 20 | 30 | 50 | 3 |
| 4 | | Application of Electronics in Textiles Lab | 0 | 0 | 2 | 1 | 20 | 30 | 50 | 3 |
| 6 | | Seminar* | 0 | 0 | 2 | 1 | | | | |
| | Total | | 0 | 0 | 10 | 5 | | | 200 | |
| | Sub-Total | | 18 | 2 | 10 | 25 | | | 800 | |

MSE (Internal Evaluation); ESE – End Semester Examination; CPA (Internal Evaluation)
 Total Credits 20 +5 =25; Total Marks 600 +200 = 800 ; Total Contact Hours (L:T:P) = 18 + 2 + 10 = 30
 * In addition to the above Industrial Practical Training of four weeks during summer vacation is compulsory.

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B.Tech. in Textile Technology

SEMESTER - VII

| S. No. | Course no. | Subject | Period | | | Credit | Evaluation Scheme | | | Hours |
|--|------------------|--|-----------|----------|----------|-----------|-------------------|-----|------------|-------|
| | | | L | T | P | | MSE | ESE | Sub Total | |
| Theory | | | | | | | | | | |
| 1 | | Entrepreneurship in Textiles | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| 2 | | Theory of Textile Structure | 3 | 1 | 0 | 4 | 30 | 70 | 100 | 3 |
| 3 | | Statistical Quality Control in Textiles | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| 4 | | Technical textiles | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| 5 | | Apparel Marketing and Merchandising | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| 6 | | Programme Elective-I | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| 7 | MOOCs | Open Elective –III (MOOCs/SWAYAM/NPTEL etc. Course-III) | 2 | 0 | 0 | 2 | | | | |
| | Total | | 20 | 1 | 0 | 21 | | | 600 | |
| Sessional/Practical | | | | | | | | | | |
| S. No. | Course no. | Subject | Period | | | Credit | Evaluation Scheme | | | Hours |
| | | | L | T | P | | CPA | ESE | Sub Total | |
| 1 | | Industrial Practical Training (during Summer Vacation for 4 weeks after 6 th Semester) / Internship | 0 | 0 | 0 | 2 | 30 | 70 | 100 | |
| 2 | | Project –I (Phase-I) | 0 | 0 | 4 | 2 | 40 | 60 | 100 | |
| 3 | | Technical Seminar | 0 | 0 | 0 | 0 | | | | |
| | Total | | 0 | 0 | 4 | 4 | | | 200 | |
| | Sub-Total | | 20 | 1 | 4 | 25 | | | 800 | |
| MSE (Internal Evaluation); ESE – End Semester Examination; CPA (Internal Evaluation) Total Credits 21 + 5 = 25; Total Marks 600 + 200 = 800 ; Total Contact Hours (L:T:P) = 20 + 1 + 4 = 25 | | | | | | | | | | |





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SEMESTER - VIII

| S. No. | Course no. | Subject | Period | | | Credit | Evaluation Scheme | | | Hours of Exam |
|---------------|--------------|--------------------------------|-----------|----------|----------|-----------|-------------------|-----|------------|---------------|
| | | | L | T | P | | MSE | ESE | Sub Total | |
| Theory | | | | | | | | | | |
| 1 | | Mechanics of Textile Processes | 3 | 1 | 0 | 4 | 30 | 70 | 100 | 3 |
| 2 | | Textile Management | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| 3 | | Programme Elective-II | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| 4 | | Programme Elective-III | 3 | 0 | 0 | 3 | 30 | 70 | 100 | 3 |
| | Total | | 12 | 1 | 0 | 13 | | | 400 | |

Sessional/Practical

| S. No. | Course no. | Subject | Period | | | Credit | Evaluation Scheme | | | Hours of Exam |
|--------|------------------|------------------------|-----------|----------|-----------|-----------|-------------------|-----------|------------|---------------|
| | | | L | T | P | | CPA | ESE | Sub Total | |
| 1 | | Project –II (Phase-II) | ... | ... | 12 | 6 | 40 | 60 | 100 | |
| | Total | | 0 | 0 | 12 | 6 | 40 | 60 | 100 | |
| | Sub-Total | | 13 | 1 | 12 | 19 | | | 500 | |

MSE (Internal Evaluation); ESE – End Semester Examination; CPA (Internal Evaluation)

Total Credits 13 + 6 = 19; Total Marks 400 +100 = 500 ; Total Contact Hours (L:T:P) = 12 +1 + 12 = 25

Total Credits (3rd to 8th Semester) = 25 + 26 + 25 + 25 + 25 + 19 = 145

Credit (1st to 2nd Sem.) = 17.5 + 20.5 =38

| Semester-VII | | Semester-VIII | |
|-----------------------------|---|-------------------------------|---|
| Programme Elective-I | | Programme Elective-II | |
| 1 | Advances in Chemical Processing of Textiles | 1 | Advancement of Nonwoven Technology |
| 2 | Advances in Knitting Technology | 2 | Textile Reinforced Composites |
| 3 | Sericulture and Silk Technology | 3 | High Performance and Specialty fibres |
| 4 | Fashion Designing | 4 | Waste Management and Pollution Control in Textiles |
| 5 | Geotextiles | 5 | Science of Clothing Comfort |
| | | Programme Elective-III | |
| | | 1 | Application of CAD/ CAM and CCM in Textiles |
| | | 2 | Functional and Smart Textiles |
| | | 3 | Application of Nanotechnology in textiles |
| | | 4 | Green Processing of Textiles |
| | | 5 | Project formulation and Appraisal in Textile Sector |

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| Sl. No. | Course No. | Subject | Credits | | | Total | Semester/Particular |
|---------|------------|-------------------------|---------|---|---|-------|---------------------|
| | | | L | T | P | | |
| 1 | 101 | Programme Elective-I | 1 | 1 | 1 | 1 | |
| 2 | 102 | Programme Elective-II | 1 | 1 | 1 | 1 | |
| 3 | 103 | Programme Elective-III | 1 | 1 | 1 | 1 | |
| 4 | 104 | Programme Elective-IV | 1 | 1 | 1 | 1 | |
| 5 | 105 | Programme Elective-V | 1 | 1 | 1 | 1 | |
| 6 | 106 | Programme Elective-VI | 1 | 1 | 1 | 1 | |
| 7 | 107 | Programme Elective-VII | 1 | 1 | 1 | 1 | |
| 8 | 108 | Programme Elective-VIII | 1 | 1 | 1 | 1 | |
| Total | | | 8 | 8 | 8 | 8 | |

Total Credits (8) for 8th Semester = 22 + 22 + 22 + 22 + 22 + 22 + 22 + 22 = 142

Course (1-10) = 10 x 14 = 140

| Semester-VII | | Semester-VIII | |
|--------------|---|---------------|--|
| 1 | Introduction to Chemical Processing in Textiles | 1 | Advanced of Advanced Technology |
| 2 | Advanced in Finishing Technology | 2 | Local Based Project |
| 3 | Textile and Silk Technology | 3 | High Performance and Specialty Fibres |
| 4 | Textile Dyeing | 4 | Waste Management and Pollution Control in Textiles |
| 5 | Textile Quality Control | 5 | Workshop in Quality Control |
| 6 | Textile Quality Control | 6 | Textile Quality Control |
| 7 | Textile Quality Control | 7 | Textile Quality Control |
| 8 | Textile Quality Control | 8 | Textile Quality Control |

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AICTE Model Curriculum for First Year Undergraduate degree courses in Engineering & Technology

Model Curriculum for First Year Undergraduate Degree Courses in Engineering & Technology

Chapter -1 General, Course structure & Theme & Semester-wise credit distribution

A. Definition of Credit:-

| | |
|------------------------------|-------------|
| 1 Hr. Lecture (L) per week | 1 credit |
| 1 Hr. Tutorial (T) per week | 1 credit |
| 1 Hr. Practical (P) per week | 0.5 credits |
| 2 Hours Practical(Lab)/week | 1 credit |

B. Range of credits –

A range of credits from 150 to 160 for a student to be eligible to get Under Graduate degree in Engineering. A student will be eligible to get Under Graduate degree with Honours or additional Minor Engineering, if he/she completes an additional 20 credits. These could be acquired through MOOCs.

C. Structure of Undergraduate Engineering program:-

| S. No. | Category | Suggested Breakup of Credits(Total 160) |
|--------|---|---|
| 1 | Humanities and Social Sciences including Management courses | 12* |
| 2 | Basic Science courses | 25* |
| 3 | Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc | 24* |
| 4 | Professional core courses | 48* |
| 5 | Professional Elective courses relevant to chosen specialization/branch | 18* |
| 6 | Open subjects – Electives from other technical and /or emerging subjects | 18* |
| 7 | Project work, seminar and Internship in industry or elsewhere | 15* |
| 8 | Mandatory Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge] | (non-credit) |
| | Total | 160* |

*Minor variation is allowed as per need of the respective disciplines.

Date
06/10/2020

Date
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CURRICULUM FOR UNDERGRADUATE PROGRAMME B.Tech. in TEXTILE TECHNOLOGY

3rd Semester

TTX-301: Introduction to Textiles [2-0-0-2]

Textile Industry

Sectors of textile industry viz. organized mill sector, decentralized small scale sector.

Sectors based on technology : Handloom, Powerloom, Garment, Cotton, Silk, Wool, Jute and Synthetic Fibres.

Indian cotton: Production, quality and global competition.

Changing scenario of Indian Textile Industry in the wake of WTO Agreement.

Strengths and weaknesses of the Indian Textile Industry in the global scenario.

Research and technology support to the Indian Textile Industry.

Textile Technology

Introduction of fibre, yarn, fabrics.

Sequence of operations for conversion of natural and manmade fibres into finished fabrics.

Fabric construction technology: knitting, weaving and production of non woven. Fabric to Garment.

Importance of Design.

Quality aspects of yarns, fabrics and garments.

Processing and finishing of fabrics and garments.

Applications of textiles in diversified fields.

Need for process control and use of statistics; Improvement in product quality; Current trends in research and development of textile machines and processes.

Recommended Books:

1. Gohl E P G and Vilensky L D, Textile Science, CBS Publishers and Distributors, New Delhi.
2. Corbman Bernard P., "Textiles Fiber to Fabric", McGraw-Hill International Editions, New York, 1983.
3. "Cotton Spinning", ATIRA Publication, Ahmedabad
4. Aswani, K.T., "Plain Weaving Motions", Mahangan Book Publishers, 1996.
5. Shenai, V.A., "Fundamental Principles of textile Processing", Sevak Publisher.
6. Ed. A R Horrocks and S C Anand, "Handbook of Technical Textiles", Woodhead Publication Ltd., Cambridge, 2000.

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TTX-302: Natural Fibres [3-0-0-3]

Fibres and polymers: Definition of Textiles, Fibre, Staple fibre, Filament, Yarn, Thread, Fabric and Clothing. Introduction to polymers; Degree of Polymerization; Types of polymer, Requirements of fiber forming polymers; Essential and desirable properties of textile fibres; Essential properties of fiber forming polymers; Classification of textile fibres. Orientation and crystallinity of fibres; Effect of orientation and crystallinity on the physical and chemical properties of fibres; Concept of thermoplastic and thermoset material; Definition of Fibre Morphology, Micro-structure of textile fibre and filament.

Cotton Fibres: Introduction, Growth, cultivation, harvesting and production of cotton fibres, grading and growing countries, commercial classification of cotton. Varieties of cotton: Genetically modified Cotton, Organic Cotton & Coloured Cotton. Chemical composition, Chemical structure, Morphological structure, Physical properties, Chemical properties and uses of cotton fibres.

Wool Fibres: Introduction, Growing of wool, grading of wool, Types of wool, Fibre extraction, Chemical Composition, Chemical structure, Morphological structure, Properties and uses of wool fibres. Felting of wool. Brief idea of conversion of wool fibres into woollens and worsted yarns.

Silk Fibres: Introduction, Different types of silk fibre (Mulberry, Tassar, Eri and Muga silk). Sericulture (Study of life cycle of Silk worm, Brief Knowledge of REARING OF MULBERRY & NON MULBERRY SILK, FOOD Plant for Silkworm, Diseases of silkworm). Production of Raw silk, Wild silk and Spun Silk. Reeling of silk, Throwing of silk. Different Varieties of silk yarns. Special features of silk fibre. Degumming of silk. Chemical composition, Chemical structure, Morphological structure, Properties and uses of silk. Introduction to Spider Silk.

Bast Fibres: Jute: Cultivation, Retting, Fibre Extraction, Properties and uses. **Flax (Linen):** Cultivation, Retting, Fibre Extraction, Properties and uses. Ramie: Chemical composition, properties and processing of Ramie fibre. Hemp: Physical and chemical properties, Structure, Primary processing of Hemp stalk and Retting. Sisal: Chemical composition, Properties, Fibre structure, Production and early processing. Mudar fibre: Properties and composition. Varieties, Properties and uses –Kenaf, pineapple, Banana fibre, Bamboo fiber and coir fibres.

Identification of Fibres: Feeling Test. Burning test. Microscopic test Staining Test. Chemical test and Density measurement.

Books Recommended:

1. Gohl E P G and Vilensky LD, "Textile Science", CBS Publishers, Delhi, 2nd Ed Reprint- (2005).
2. Cook Gordon J, "Hand Book of textile fibre", Vol. I and II, Woodhead Fibre Science Series, UK, 1984.
3. Mishra S P, "A Text Book of Fibre Science and Technology", New Age. International (P) Ltd., Pub., New Delhi, (2000).
4. Sreenivasamurthy H V, "Introduction to Textile Fibre", The Textile Association India, Mumbai, (1998).
5. Shenai V A, "Technology of Textile Processing", Vol. 1, Sevak Publications, Mumbai,
6. Gowariker V R, Viswanathan N V and Sridhar J, "Polymer Science", New Age International Ltd., New Delhi, 1996.
7. Gordon Cook J, "Hand book of Textile fibre", I. Natural Fibres, Woodhead Publishing Ltd, Cambridge, England, 1993.

Reference Books:

1. Bernard P Corbman, "Textiles: Fibre to Fabric", McGraw Hill Book Co., Singapore, (1983). ISBN:0070131376
2. Marjory L Joseph, "Essentials of Textiles", CBS College Publishing, New York, (1984).

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TTX-303: Yarn Formation -I [3-1-0-4]

Introduction to short staple spinning: Brief idea about short staple spinning technology.

Ginning: Objective of ginning, study of ginning machineries, Defects, causes, and remedies of ginning, Pre and post ginning, Baling process of fibres and bale weights, latest developments.

Mixing and blending: Definition, Objectives; principles of fibre mixing and blending, types of mixing and blending, Compatibility requirements; Perfect blend; Blending deficiencies; Index of blend irregularity; Blending methods and techniques; Mixing and blending machines. Blending performance; latest developments in blending machinery.

Blow room: Objectives, Sequence of machines in conventional and modern blow room line. Purpose of opening, cleaning, mixing and blending of fibres. Principle of opening and cleaning and its machinery, classification, study of opening and cleaning machine and its modern developments. Transportation of fibre mass. Details of lap forming mechanism, feed regulating motion, calendar roller pressure, length measuring device, lap build, lap defects and its remedies. Chute feed to card. **Single line processing:** Degree of opening and cleaning. Influence of process parameters on opening and cleaning. Performance assessment of blow room line. Machine and labour productivity; Norms. Important setting and its effect on the yarn property. Calculations pertaining to blow room.

Carding-Objectives; Principles of carding; Working of carding machine; Revolving flat card; Card clothing; Operating regions of the card; Forces acting on the fibres; Carding disposition and doffing disposition; Centrifugal forces; Action between feed roller and licker-in, Cylinder and Flats, Transfer zone at doffer, Transfer of fiber. Semi-high and High production Card. Neps in carding web. Autolevellers at Card – Need and Objectives, working of Autolevellers and Setting of Autolevellers, Numerical problems, norms, performance assessment, Developments in carding machine.

Drawframe: Objectives, principles of doubling and drafting. Detailed study of draw frame machine. Top and bottom rollers, top roller cots, roller weighting, drafting wave, roller slip and roller eccentricity, law of doubling, law of addition of irregularity, causes and control of irregularity of a drafted textile strand. Drafting: Various drafting system, modern drawframe, Autolevellers in draw frame – Objectives, working of Autolevellers and Setting of Autolevellers. Brief study on bercolisation, scouring, buffing and shore hardness. Numerical problems; norms; performance assessment; Latest developments.

Automation and recent developments in blowroom, card and draw frames. Fibre opening, carding and drawing for wool, jute and other fibres. Modification in process parameters for processing blended fibres in blowroom, card and drawframe.

Books Recommended:

Books Recommended:

1. Klein W, "Manual of Textile Technology", Vol. I – III, The Textile Institute, UK, 1987.
2. Oxtoby E, "Spun Yarn Technology", Butterworth and Co. Ltd., 1987.
3. Lawrence C A, "Fundamental of Spun Yarn Technology" CRC Press, USA, 2003.
4. Lord P R, "Handbook of Yarn Production", The Textile Institute, Woodhead Publication Limited, Cambridge, 2003.
5. Foster G A K, "*Manual of Cotton Spinning*", Vol. I –IV, The Textile Institute, Manchester (1958).
6. Salhotra K R, "Spinning of Manmades and blends on cotton system", 2nd Ed; The textile Association, India, 1989.
7. Khare A R, "*Elements of Blowroom, Carding and Drawframe*", Sai book Centre, Mumbai (1999).

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TTX-304: Preparatory and Basic Fabric Formation [3-1-0-4]

Introduction to various fabric forming principles: Weaving, knitting, nonwoven and braiding. Stages of woven fabric manufacturing. Weaving process flow chart.

Winding: Objectives, principles, types of packages, types of winding machines, uniform build up of cones, Mechanical and electronic type yarn clearer. Yarn tensioners: Additive, multiplicative, combined and compensating type. Patterning: Reasons and remedies. Yarn fault classifying systems. Basic features of auto winders like Autoconer, Barbar colmman, Murata etc. Precision and random winding, digicone winding. Latest developments. Machine and labour productivity. Norms. Performance assessment and calculations.

Pirn winding: Objectives, types of pirns, yarn traversing system, Hacooba pirn winding machine, different automation and standard winding parameters.

Warping: Objectives, types of warping, direct and sectional warping, conditions for warping, comparison of beam warping with sectional warping, basic features of warping machine, different types of creels, reeds, leasing systems. derivation for volume of yarn to be stored on beam, factors effecting warp quality on beam. Calculations related to warping. Latest developments. Machine and labour productivity. Norms. Performance assessment.

Sizing: Objectives, classification of sizing methods and sizing machines. Features of sizing machine, machine elements, size materials, sizing ingredients, size preparation, control points, principle of different non-conventional sizing techniques. Latest developments. Machine and labour productivity. Norms. Performance assessment and calculations.

Drawing in and tying in: Importance, different ways to do it, standard norms. Latest developments.

Basic fabric designs: concept of plain, twill and satin, drafting and lifting plans. Calculations of heald and reed count.

Weaving: History of weaving with manual and automatic loom, and modern loom revolutions. Overall concept about looms and its elements. Different motions of looms: Primary, secondary and auxiliary motions.

Shedding: Objective, Different types of shedding: Tappet, dobby, jacquard with advantage and disadvantages. Tappet shedding: its limitations, positive and negative shedding, types of shed, early and late shedding, shed timing, importance of bending factor.

Picking: Objective, Types of conventional picking: over picking, under picking and parallel picking with its mechanism, advantages and disadvantages, different picking accessories and their functions, Calculation of shuttle velocity and derivation for energy of picking, picking force. Picking timing such as late picking and early picking, reasons of false picking and shuttle fly.

Sley: Movement of sley, beat up, sley eccentricity and the factors which influence it, calculation related to sley eccentricity, effects of sley eccentricity on beat up force and timing available for shuttle passage.

Beat up: Objective, Movement of sley, beat up, sley eccentricity and the factors which influence it, calculation related to sley eccentricity, effects of sley eccentricity on beat up force and timing available for shuttle passage.

Calculations: Production, efficiency and balancing of machine, Calculations related to winding, warping and sizing. Numerical based on shedding, picking and sley movement.

Books Recommended:

1. "Winding", BTRA Monograph Series, Bombay Textile Research Association, Bombay, 1981.
2. "Warping and Sizing", BTRA Monograph Series, Bombay Textile Research Association, Bombay, 1981.
3. Mark R, Robinson A T C, "Principles of Weaving", The Textile Institute, Manchester, 1986.

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4. Talukdar M K, Srirammulu P K and Ajsaokar D B, "Weaving – Machine, Mechanism and Management", Mahajan Publisher Private Ltd., Ahmedabad, India, 1998.
 5. Booth J E, "Textile Mathematics", Part III, Textile Institute, Manchester, 1977.
 6. Goswami B C, Anandjiwala R D and Hall D M, "Textile Sizing", Marcel Dekker, USA, 2005.

TTX-305: Preparatory and Colouration of Textiles [3-1-0 4]

Introduction: Process line for pretreatment, colouration and finishing of textiles.

Singeing: Object of the process, types of singeing, details of various singeing methods, drawbacks and advantages. Process and quality control aspects involved.

Desizing: Object of Desizing, Different method of Desizing, Mechanism of removal of starch in various methods. Efficiency of desizing.

Scouring: Objectives, mechanism of removal of impurities, recipe and controlling parameters involved in Scouring. Kier Boiling M/c. Scouring of coloured textiles. Scouring of natural, man-made and blended textiles. Evaluation of scouring efficiency.

Bleaching: Objectives of bleaching: Hypochlorite, peroxide, chlorite and peracetic acid bleaching methods and their effectiveness on various textiles. Controlling parameters and mechanism involved in each method, Efficiency of bleaching.

Mercerization: Objectives, mechanism related to various physical and chemical changes in cotton during mercerization, Process parameters and operation details, Causticization. Wet and hot mercerization, Ammonia treatment of cotton. Performance of various mercerization / alkali treatment processes. Assessment of efficiency of mercerization: Barium activity number, its determination and interpretation.

Concept of colour: Visible spectrum, wavelength and blindness of colour. Metamerism/ isomerism.

Dyestuffs :- Introduction to Dyestuffs, Witt theory of Dyes, classification of Dyes according to mode of application and based on chemical constitution. Different between Dyes & Pigments.

Theories of colour: Additive and subtractive theories. Primary, secondary, tertiary, complementary and contrasting colours. Tristimulus values of colour. Introduction to colour measurement and computer colour matching concepts. Spectrophotometers and determination of K/S value, Yellowness, Whiteness and Brightness indices, reflectance factor, colour-co-ordinates, CIELAB values.

Theory of dyeing: Dye-fibre interaction, free volume theory.

Pretreatment and dyeing machineries: Singeing m/c, J-box, kier, mercerizing machine, loose fibre, yarn and package dyeing machines. Jigger, winch, jet and HTHP beam dyeing m/cs. padding mangles.

Dyeing of textiles: Dyeing technology of natural and manmade textiles with direct, reactive, vat, azoic, sulphur, solubalised vat, acid, metal-complex, basic and disperse dyes. Chemicals and auxiliaries used for textile dyeing and their functions Theories of dyeing. Action of electrolytes, effect of dye bath temperature, effect of material to liquor ratio, effect of dye bath pH, Evaluation of fastness properties of dyed materials.

Heat setting: Objectives and mechanism of setting. Different methods of heat setting and their effectiveness on various man made textiles and blends. Heat setting conditions and controls. Heat setting of polyester, nylon, acetate and their blends. Evaluation of degree of heat setting.

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Dyeing of blends: Classification of blends and fancy shades, Methods for dyeing of blends. Suitability of each method for dyeing of specific blend.

Identification of dyes: Identification of dye on dyed natural and manmade textiles.

Books Recommended

1. A K Roy Choudhary, "Textile Preparation and Dyeing", Science Publishers, USA (2006).
2. Peters R. H, "Textile Chemistry", Vol - II, Elsevier Publishing Company, London (1967).
3. Shore J, "Cellulosics dyeing", Society of Dyers and Colourists, Bradford, UK (1979).
4. Mittal R M and Trivedi S S, "Chemical Processing of polyester / cellulosic Blends", Ahmedabad Textile Industries Research Association, Ahmedabad, India (1983).
5. Karmakar S R, "Chemical Technology in the pretreatment processes of Textiles", Textile Science and Technology Series, Vol-12, 1st Edition, Elsevier (1999).
6. Shenai V A, "Technology of Textile Processing", Vol. III, Sevak Publications, 1975.

BSC306 : Mathematics III : (PDE, Probability & Statistics) [3-1-0-4]

Objectives:

- (1) To introduce the solution methodologies for second order Partial Differential Equations with applications in engineering
- (2) To provide an overview of probability and statistics to engineers

Contents:

Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables. (14 hours)

Probability: Different approaches to probability, addition and multiplication theorem of probability, Boole's inequality, conditional probability, Bayes theorem and applications, Moment generating functions. Random variables – discrete and continuous, distribution function, probability mass function, Probability density function, two dimensional random variables, mathematical expectation, Expectation of discrete and continuous random variables, properties of expectation, conditional expectation. Discrete and Continuous Probability Distribution: Binomial, Poisson, Normal, Exponential. (12 hours)

Statistics: Concept of statistics, collection and representation of data, frequency distribution, graphical Representation of data. Measures of Central tendency: dispersion, coefficient of dispersion, Moments, factorial moments, skewness and Kurtosis Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Sampling and sampling distribution, Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means,

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and difference of standard deviations. Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes. Student-t and F-test for Sampling and sampling distribution. (12 hours)

Course Outcomes:

Upon completion of this course, students will be able to solve field problems in engineering involving PDEs. They can also formulate and solve problems involving random variables and apply statistical methods for analysing experimental data.

Textbooks/References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
3. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
4. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
5. Bhattacharya G.K. and Johnson R.A.: Statistical Concepts and Methods, John Wiley, New Delhi, 2002.
6. Hogg R. V. And Elliot A.T, "Probability and Statistical Inference", Pearson Education, 6th Edition.
7. Hogg R V, Craig A T, "Introduction to Mathematical Statistics", Sixth Edition, Pearson Education, Delhi.

TTX-307P: Textile Fiber Laboratory [0-0-2-1]

Physical and Chemical identification of following textile fibres

1. Identification of cotton
2. Identification of wool
3. Identification of silk
4. Identification of Bast fibres
5. Identification of polyester
6. Identification of nylon
7. Identification of Acrylic
8. Identification of Polypropylene

Identification of fibres and their ratio in blended textile

9. Analysis of P/C blended fabric
10. Analysis of P/V blended fabric
11. Analysis of P/W blended fabric
12. Estimation of fiber/filament fineness using projection microscope.
13. Determine the thermal behavior of fibre by using DSC and TGA.
14. Identification of physical structure of fibre by XRD, SEM and NMR.
15. Identification of chemical structure of fibre by FTIR spectroscopy.

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TTX-308P: Yarn Formation Laboratory-I [0-0-2-1]

At least 10 experiments are to be performed by each student:

1. Study of general outline of opener and clearer machine employed in B/R line process.
2. Study of following in Shirley trash analyses machine.
 - i. Chief organs.
 - ii. Gearing arrangements.
 - iii. Teeth inclination and teeth per inch
3. Determination of trash content and analysis of waste by using Trash Analyser Machine.
4. Study of carding machine with technical details.
5. Study of gearing mechanism, calculation of the speed of different organs of carding machine.
6. Calculation of draft between different zones of carding machine and its production.
7. Study of card settings for different fibre lengths and types.
8. Maintenance and overhauling of carding machine.
9. Study of distribution of fibrous waste in a carding machine.
10. Study of the 'NEP -COUNT' in a card.
11. Study of drafting arrangement and top roller weighting system of draw frame machine.
12. Calculation of the total draft and its distribution in draw frame machine.
13. Effects of break draft and roller settings on sliver uniformity.
14. Measurement of nip-load pressure, roller eccentricity and shore hardness of top roller drafting rollers.
15. Maintenance and overhauling of draw frame machine.

TTX-309P: Fabric Formation Laboratory – I [0-0-2-1]

At least 10 experiments are to be performed by each student

1. Study of the motion transmission system in winding machine.
2. Study of the effect of slub catcher, yarn tensioner and yarn guide on package formation.
3. Study of Package stop motion in cone winding machine.
4. Calculation of winding speed on grooved drum winding system and study of anti-patterning system incorporated to it.
5. Study of precision winding machine and mechanism of package building.
6. Study of the motion transmission system in Pirn winding machine.
7. Calculation of winding speed and traversing speed of Pirn winding machine.
8. Study of the direct warping machine.
9. Study of the sectional warping machine and planning the width of a section according to pattern of the given striped fabric.
10. To study the passage of yarn on a sizing machine and the features of various parts/ mechanism of the sizing machine.
11. To select the proper reed and heald for a weaver's beam keeping in mind the beam, loom size and fabric construction.
12. Study of shedding mechanism of shuttle loom and cam positioning with respect to loom cycle.
13. Study of picking mechanism, Picker movement in relation with crank shaft rotation and calculation of average velocity of shuttle.
14. Study of sley movement, construction and calculation of sley eccentricity.

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TTX-310P: Textile Chemical Processing Lab- I [0 0 2 1]

At least 10 experiments are to be performed by each student

1. Desizing of cotton material.
2. Scouring of cotton
3. Scouring of polyester
4. Scouring of blend
5. Scouring of wool
6. Scouring of woven cotton fabric using Jigger
7. Degumming of silk
8. Bleaching of cotton with NaOCl
9. Bleaching of cotton with H2O2
10. Bleaching of cotton with NaClO2
11. Bleaching of polyester
12. Bleaching of blend
13. Bleaching of jute yarns / fabric
14. Bleaching of knitted cotton fabric using Winch
15. Mercerisation of cotton material
16. Dyeing of cotton with direct dye and after treatment
17. Dyeing of cotton with reactive dye
18. Dyeing of cotton with Sulphur dye.
19. Dyeing of cotton with azoic dyes
20. Dyeing of cotton with Vat dyes
21. Dyeing of cotton with solubilised vat dyes

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4th Semester

TTX-401: Textile Polymer and Fibre Science [3-0-0-3]

Course Learning Objectives:

- As the basic building block of all textile products is polymers, acquiring knowledge in this subject is necessary for all undergraduate Textile Technology students.
- This subject deals with basics of polymer science & Technology, general aspects of polymer production, polymer flow behaviour and polymer properties with emphasis given to polymer used for production of textile products.

Introduction: Introduction and definition of monomers and polymers. History and Classification of polymers. Characteristics of fibre forming polymers and their general applications. Differences between low molecular weight material and high molecular weight material. Specific features of high molecular weight materials.

Polymerisation: Introduction, Classification based on structure and methods of polymerization; Different mechanisms of polymerisation. Basic concept of step and chain growth polymerisation with special reference to polyester, polyamide, acrylic, and polypropylene. Kinetics of polymerisation. Prediction of gel point. Different methods of polymerization. Basic concept of bulk, solution, suspension and emulsion polymerisation.

Fibre: Introduction about fibre, special features of fibre / fibre forming polymers. Different processes for conversion of polymer to fibre. Basic understanding about common synthetic fibres ,e.g, Polyester, Nylon, Acrylic; Concept of high performance fibre; Introduction and use of Aramids, Carbon, Glass etc.

Introduction about application of fibres in Mechanical (Composite); Civil (Geotextile), Electronics (E-textile) etc.

Structure of polymers: Specific features of polymer structure, i.e., regularity and Irregularity; molecular weight and size; Configuration and conformation of molecules; Concepts of Number average, weight average and other expressions of molecular weight and molecular weight distribution. Determination of molecular weight and effect of molecular weight on the structure and properties of polymer; Methods of determination of molecular weight, viz., end group analysis, osmometry, light scattering, viscometry, gel permeation chromatography (GPC), Importance of molecular weight .Concept of rubbery state and rubber elasticity; Transition from glassy to rubbery state; Melting of polymers; Factors influencing Tg and Tm of polymers; Practical importance of phases and aggregation of states of polymers. Basic concept of methods of investigation of polymer structure, e.g., Electron microscopy, IR spectroscopy, NMR spectroscopy, X-ray scattering.

Structure property relation in polymer: Deformation in glassy and crystalline polymers. Basic concept of strength and durability. Factors affecting strength of polymers. Mechanism of polymer fracture. Concept of relaxation in polymers. Effect of relaxation process on the strength of polymers. Effect of fillers, cross-links etc on mechanical property.

Rheology of polymers - Newtonian and non-Newtonian Fluids. Basic equations related to fluid flow, capillary flow. Characteristics of polymeric solutions. Thermo dynamics of polymer solutions. Analysis of Mechanical and tensile behaviour of polymers. Time dependent mechanical and temperature dependent mechanical behaviour. Study of Maxwell's, Kelvin's & Burger's Models.

Chemistry of polymer degradation: Various types of degradation - oxidative, mechanical, Photo and thermal degradation. Use of Inhibitors and anti-oxidants to control polymer degradation.

Thermal analysis of polymers: Glass transition temperature of polymers. Determination of glass transition temperature. Free volume concept. Study of thermal characterization by DSC, DTA, TGA, TMA and DMA.

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Course Outcomes: At the end of the course the student will be able to:

- Students will acquire knowledge in basic concepts of polymer Technology with special reference to Textile polymers.
- After acquiring knowledge in this subject, the students will be able to work in polymer production industry and research laboratory.

Books Recommended:

1. "Polymers; Polymer characterization and analysis", ED., J I Kroschwitz, John Wiley and Sons, 1990.
2. "Thermal characterization of polymeric materials", Ed., E A Turi, Vol I and II, Academic Press, 1997.
3. Billmeyer F W, "Textbook of Polymer Science", John Wiley and Sons, New York, 1994.
4. Gowariker V. R, Viswanathan N.V and and Sridhar J, "Polymer Science", New Age International Ltd. Publishers, New Delhi, 1996.
5. Hearle JWS, "Polymers and their properties", Vol.I, John Wiley and Sons, NY, 1982.
6. Gupta V B and Kothari V K, "Manufactured Fibre Technology", Chapman and Hall, London, 1999.
7. High Performance fibre Hand book of fibre science and Tech.

TTX- 402: Man Made Fibres [3-0-0-3]

Introduction to man- made fibres: Definition of made fibres. Brief history of manmade Fibres. Relative merits and demerits of manmade fibres and natural fibres.

Conversion of polymers into fibres: Basic production systems of the man- made fibre. Melt spinning, solution dry spinning and solution wet spinning. Factors influencing selection of a Particular process for fiber formation, Relative merits and demerits of melt, dry and wet spinning processes, Variables of spinning, Different components of spinning process, i.e., extruder, gear pump, filters, manifold, spinning head, quenching chamber, winders. Different Quenching/solidification techniques, spinning of staple fibres and filaments. POY, MOY and FDY. High speed spinning.

Melt spinning: Raw material, technology of polymerization and extrusion of polyester, nylon 6, nylon 66 and polypropylene. Effect of process parameters on structure and properties of melt spun filament. Variables in melt spinning.

Solution dry spinning: Dry spinning of cellulose acetate. Acetylation of cellulose, Dope Preparation and spinning of cellulose diacetate and triacetate, Dry spinning of acrylic. Significance and types of co-monomers used during polymerisation of acrylic, Polymerisation. Dope preparation, extrusion and solidification of filaments. Effect of process parameters on Structure and properties of solution dry spun filament.

Solution wet spinning: Process flow diagram and significance of each step for solution wet spinning of viscose rayon. Chemistry of viscose rayon formation process, Influence of various additives and temperature of the regeneration bath and their influence on the process and properties of viscose rayon, Various types of rayons, i.e. high wet modulus, Ten-X, etc. Introduction about alternative routes of regenerated cellulosic fibre formation, Properties and Use, Wet spinning of acrylic, Different solvents

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and parameters of regeneration bath for wet Spinning of acrylic, Effect of process parameter on structure and properties of acrylic.

Drawing and heat setting of fibres: Object of drawing. Concept of neck drawing, Effect of drawing conditions on the structure and properties of fiber. High speed spinning and spin draw process, drawing of pre-oriented yarns and draw-warping. Object of heat setting. Different nature of set, Heat-setting behavior of fibres, Methods of heat-setting, Effect of heat setting parameters on the structure and properties of fiber.

Spin finish: Objective, properties and application of spin finish.

Tow conversion: Introduction of Tow to Top conversion, Different methods for tow to top conversion.

Bulk yarn and Texturing : Introduction of bulk yarn. Objectives of producing bulk yarns. Different methods of producing bulk yarns. Principles of manufacturing acrylic high bulk yarn. Concept and classification textured yarns. Different texturing methods and brief working principles of different texturing methods. Principles of false twist texturing. Material and Machine variables and their influence on the structure and properties of false twist textured yarn, Concept of air-jet texturing. Material and process variables in air-jet texturing and their influence on the structure and properties of air-jet textured yarns, Testing and evaluation of textured yarns, recent developments in texturing, Air entanglement process.

Books Recommended:

1. Vaidya A A, "Production of Synthetic Fibres", 1st Ed., Prentice Hall of India, New Delhi, 1988.
2. "Manufactured Fibre Technology", 1st Ed. V B Gupta and V K Kothari, 1st Ed., Chapman and Hall, London, 1997.
3. Mark H F, Atlas S M, Cernia E, "Man Made Fibre Science and Technology", 1st Ed., Vol.1, 2, 4, Science Publishers, New York, 1967.
5. Macintyre J E, "Synthetic Fibres", Wood head Fiber Science Series, UK, 2003.
6. "Hand Book of Fibre Chemistry", Ed. M Lewin and E M Pearce, Mercel Dekker Inc., 1998.
7. Hearle J W S, Hollick L and Wilson D K, " Yarn Texturing Technology", Woodhead Publishing Ltd., UK, 2002.
8. Goswami B C, Martindle J G and Scardino F L, "Textile Yarns Technology, Structure and Applications", Wiley-Interscience Publication, New York, 1976.

TTX-403: Yarn Formation II [3-1-0-4]

Combing process: Objectives, combing for shorter and medium varieties of cotton, cottons suitable for combing, Preparation of stock for combing, Conventional and Modern stock preparation techniques , Need for preparatory process for combing, hook direction, pre-comb draft & doublings. **Modern concept of lap preparation:** Construction and working of Sliver Lap, Ribbon Lap, Super Lap & Lap Former. Developments in lap preparation machines.

Constructional details of different Comber (for cotton and worsted)- feeding, nipper assembly, cylinder and detaching rollers, cylinder needles, web and sliver transport, drafting and coiling at comber, Study of combing cycle, Semi combing, normal combing, super combing and 24 double combing., Forward and backward combing, noil extraction at backward feed and forward feed comber, Comber Settings, Norms for production, speed, Combing efficiency, Fractionating efficiency of comber. Influence of

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combing operation on quality, Different faults & their remedies. Mathematical problems, norms, performance assessment, Machine and labour productivity. Recent developments.

Speed Frame: Objectives, Construction and working of a speed frame, functions of different machine components and high drafting system, roving twist in speed frame, winding principles and equations related to bobbin leading and flyer leading, building motion, cone drum profile, suspended flyer technology, semi-automatic and auto-doffing techniques. Roving bobbin transportation technologies numerical problems, norms, performance assessment. Developments in speed frame. Modifications required in speed frames to process various types of blend.

Ring spinning Process: Function and mode of operation of ring frame, role of drafting system, yarn guiding devices, forces acting between ring and traveller, yarn tension variation, balloon tension at maximum diameter, tasks of traveller, limiting speed, classification and form of traveller, traveller mass and material, different ring-traveller combinations, fiber lubrication, running on new-ring. Winding process, builder motion in ring frame, cop structure, spinning geometry, Ring Rail movement, causes of end breaks, Pneumafil (bonda) collection. Different types of drives to ring frame. Ring frame auto doffing techniques and ring-data type online measurement and monitoring systems. Modifications required in ring frames to process various types of blend.

Numerical problems, norms, and performance assessment. Machine and labour productivity. Latest developments including compact spinning. Improvements in various parts and features of modern ring frame for high speed spinning. Twist flow in ring spinning, Effect of various parameters on twist flow. Yarn and Package faults. Linking ring frame to winding (requirements for winding).

Doubling: Preparation for Doubling. Objects of doubling, assembly winding machine – its construction & working, stop motion. Construction of a Doubler, dry & wet doubling, different methods of threading the yarn through doubler, Construction of ring, traveler and spindles for doubler. Two for One twister. Defects in doubling process, and doubled yarn. Different types of doubled & cabled yarns used in Industry. Fancy yarns and fancy doubler.

Waste Spinning: Classification of cotton waste. Preparation and methods of converting waste into useful products. Machineries involved in their conversion.

Non-conventional spinning processes: Introduction to Non-conventional spinning processes.

Books Recommended:

1. Klein W, "Manual of Textile Technology", The Textile Institute, Manchester, Vol.1 and 3, 2002.
2. Klein W, "A Practical Guide to Ring Spinning", The Textile Institute, Manchester, Vol 4. 2002.
3. Klein W, "Man-made Fibres and Their Processing", The Textile Institute, Manchester, Vol.6, 2002.
4. Klein W, "New Spinning Process", The Textile Institute, Manchester, Vol.5, 2002.
5. Lawrence C A, "Fundamental of Spun Yarn Technology" CRC Press, USA, 2003.
6. Lord P R, "Handbook of Yarn Production", The Textile Institute, Woodhead Publication Limited, Cambridge, 2003.
7. K.R. Salhotra, Spinning of Manmade & Blends on Cotton System, Textile Association (India), 2004.

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TTX-404: Fabric Formation Systems [3-1-0-4]

Let-off System: Objective and types, types of tension variation, Warp and cloth control, different types of let-off systems, control of tension variation.

Take-up: Objective, Types of take-up and their mechanisms, periodic faults, anti crack motion, dividend calculation, and control of pick density, calculation related to it.

Warp Stop: Objective, Types of warp stop motions and their functioning, mechanism, advantage and disadvantage.

Weft Stop: Objective, Types of weft stop motions and their functioning, mechanism, advantage and disadvantage.

Warp protector: Objective, Types of warp protector motions and their functioning, mechanism, advantage and disadvantage. Temple: objective, importance and types.

Weft Replenishment System: Pirn replenishment mechanism: Cimmco and Ruti C, its limitations, different types of feelers used for it. Shuttle changing mechanism, bobbin loader mechanism and automatic loom winder.

Box changing motion: Objective, types, its advantage and disadvantage. Working mechanism of multiple box motions (2x1 and 4x1): weft mixing, cow burn, sliding gear box, pick-at will.

Dobby: Scope of doobby, different types of doobby: Keighley, climax, cam, paper, rotary, positive, cross border and their mechanism, Working principle of various types of non-electronic doobby.pegging system as per design of weave, pick finding devices for doobby, timings & settings. Electronic doobby: Working principle, machine parameters, microelectronics design features, drive arrangement, systems for pattern data transfer and design development.

Jacquard: Scope of jacquard, working of different types of jacquards: single lift single cylinder, double lift single cylinder, double lift double cylinder, and electronic jacquard. Harness ties and design ties, card punching machine and methods, increasing figuring capacity of Jacquard. Cross border jacquard, Special jacquard m/c. Developments in mechanical Jacquard, open shed Jacquards. Electronic Jacquard: working principle, constructional variants, various electronic jacquard systems, selection system, pattern data, transfer and management. CAD for doobby, jacquard, label and carpet. Programming possibilities in jacquard.

Concept of Quick style change

Shuttle-less Weaving: Problem of shuttle weaving, Development of shuttle less weaving, an elementary idea on Projectile, Air-jet, Water-jet, Rapier weaving machine, Special features of these machines. Calculation related to weaving process

Nonwoven: An Introduction to Non-woven Technology.

Books Recommended:

1. Mark R, Robinson A T C, "Principles of Weaving", The Textile Institute, Manchester, 1986.
2. Talukdar M K, Sriramulu P K and Ajgaokar D B, "Weaving - Machine, Mechanism and Management", Mahajan Publisher Private Ltd., Ahmedabad, India, 1998.
3. Aswani K T, "Fancy Weaving mechanism", Mahajan Publisher Private Ltd., Ahmedabad, India 1990.
4. Talavasek and Svaty V, Shuttleless Weaving machine, Elsevier Scientific Publishing Co, Amsterdam, 1981.
5. Lord P and Mohamad.M.H., " Weaving: Conversion of Yarn to fabric", Merrow Technical Library, UK,1988
6. Krcma R, "Manual of Non wovens", Textile Trade Press, UK,1971
2. Lunenschloss J and Albrecht W, —*Non-woven Bonded Fabric*, Ellis and Horwood Ltd, U.K. (1985).

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TTX- 405 Textile Printing and Finishing [3-0-0-3]

Introduction: An overview of the printing process. Selection of dyes/pigments/auxiliaries and textile substrate to suit the end use of the printed textile materials.

Printing methods: Hand block printing, roller printing and screen printing, rotary screen printing processes, Construction and working of roller printing and rotary screen machine, Engraving of roller, photoelectric method of screen preparation, Drawback and advantage of each method. Developments in printing machinery.

Print Paste: Constituent and characteristics of print paste, classification of thickener and Mechanism of working of thickeners. Use of different types of thickener to different colour Paste.

Printing After-treatments: Importance of after-treatment of printed textiles, Importance, process and mechanism of steaming, curing, ageing of prints and open soaping.

Printing Styles: Direct, discharge and resist styles of printing with dyes and pigments on natural, man-made and blended textiles.

Transfer Printing: Concept, classification, method and mechanism of print transfer. Transfer printing of natural, man- made and blended textiles. Transfer printing machineries. Foam Printing.

Digital Printing: Introduction to digital textile printing. Advantages and disadvantages of Digital textile printing over other printing Method.

FINISHING: Objects of finishing. Classification of finishing. Various finishing chemicals used and their properties.

Softening of textiles: Decatising process: mechanism and parameters of decatising. Chemical softening, classification, selection criteria of suitable softner for specific textiles, Evaluation of softner.

Mechanical Finish: Sanforizing: objectives, process, mechanism and machineries involved, Evaluation of process efficiency. Calendaring: Objects of calendaring, classification, types of calendars and choice of right calendaring machines. Influence of working parameters, construction and function of various calendaring m/cs.

Carbonisation: Objectives, selection of chemical, process parameters, trouble shoots, precautionary measures and efficiency of carbonisation.

Functional finishes: Problem of creasing and anti-crease finish on cotton and terry-cotton blends, Choice of chemical, catalyst and process parameters. Drawback and advantages associated with use of various anti-crease chemicals, Measures to reduce release of formaldehyde, Water proofing and water repellent finishes on cotton, Evaluation of water repellency. Soil release finish: Classification of soil and mechanism of their adherence on cotton, Various soil releases finishes. Evaluation of soil release efficiency. Flame retardant finish: Mechanism of burning of textiles, Burning cycle, Limiting Oxygen Index (LOI), Determination of LOI, choice of chemical for all types of flame retardent finishes, various proposals for application of flame retardants on various textiles. Anti-microbial finishes on natural, and man- made and blended textiles.

Finishing of woollen materials, silk fabrics and blended products.

Finishing of synthetic fibre fabrics - heat setting, de-lustering, anti-static, soil release finishes.

Fundamentals of computerized colour matching – K/S evaluation and principle of spectrophotometers.

Books Recommended:

1. Miles L.W.C, Textile Printing, Dyers Company Publication Trust, Bradford, England, 1981.
2. Shenai V.A, Technology of Printing, Sevak Publications, Mumbai, 1990.
3. Hall A.J, Textile Finishing, Haywood Books, London, 1996.

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4. Shenai V.A. and Saraf, N.M, Technology of Textile Finishing, Sevak Publications, Mumbai, 1990
5. Peters R H, "Textile Chemistry", Vol- III, Elsevier Scientific Publishing Co., New York, 1975.
5. Nunn D M, "The Dyeing of Synthetic Polymer and Acetate Fibres", Dyers Company Publication Trust, London, 1979.
6. Ujiie H, Digital printing of textiles, The Textile Institute, Woodhead Publishing Limited and CRC Press, Cambridge, England, 2006.

TTX-406: Textile Testing-I [3-0-0-3]

Objective of textile testing: Aim and scope of testing, Standardization of Testing, Testing quality schemes like wool mark ISE mark. ASTM, ISO, BS, and BIS standards. Terms Related to Textile Evaluation: Quality, Testing, Inspection, Quality Control, Statistical Quality Control (SQC), Quality Assurance (QA). Role of statistics in testing of textiles.

Selection of samples for testing: Sample, Sample size and Population. Sampling, Terms used in sampling, Types of sampling, Methods of sampling for testing: Fibre sampling from bulk (Zoning Technique for selecting samples from raw cotton, Core Sampling for raw wool); Fibre sampling methods from combed slivers, roving and yarns; Yarn sampling techniques; Fabric Sampling techniques.

Moisture in Textiles: Humidity and its importance to textile materials, Absolute humidity and Relative humidity, Moisture Regain and Moisture Content, Standard atmosphere and testing atmosphere, Standard condition for testing of textile material, Measurement of atmospheric conditions, Regain-Humidity Relations and hysteresis effect, Factors affecting the regain of textile material, Effects of moisture regain on fibre properties, Oven dry weight and correct invoice weight. Determination of moisture: Conditioning oven, Shirley moisture meter. Standard regain percentage of textile material.

Fibre dimension and quality testing: Fibre length measurement, Fibre Fineness measurement by various methods, measurement of fibre maturity, neps, trash-content, fibre contamination measurement, grading of different cotton, Measurement of fibre strength: single fibre strength and bundle strength of fibre. Application of HVI and AFIS, measurement of fiber friction and crimp.

Count of Yarn: Yarn numbering and conversion system, yarn count measurement, yarn diameter, relation between yarn diameter and count.

Yarn twist: Importance, effect of twist on various properties of yarn and fabric, measurement of Yarn twist in continuous filament, spun and plied yarns.

Tensile Testing: Terminology and definitions used in measurement of tensile properties of textiles. Various type of measuring instruments and their working principles, Principles of textile testing instruments - CRL, CRE, CRT & inclined plane, Stelometer, Pressley fibre strength tester. The working principle of Electronic dynamometer, strain gauge, transducer, UTM, Single yarn strength Testing, Lea tester and Yarn CSP measurement. Factors affecting tensile properties, elastic recovery, effect of impact loading and fatigue behavior, yarn friction.

Evenness Testing: Evenness testing of yarns, nature and causes of irregularities, principles and methods of evenness testing, evaluations and interpretation of evenness results, concept of index of irregularity, Analysis of periodic variations in mass per unit length. Variance length curves and spectrogram analysis. Yarn faults, classification, Uster Classimat and Classifault. Classimat fault analysis utility and

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principle of different types of instruments. Yarn hairiness, principle of measurement, measuring instruments. Test for filament and textured yarn. Advanced testing of cordage and ropes.

Books Recommended:

1. Saville B P, "Physical Testing of Textiles", Woodhead Publishing Ltd, Cambridge, 2002.
2. Ed. V. K. Kothari, "Testing and Quality Management", IAFL Publications, New Delhi, 1999.
3. Booth J E, "Principles of Textile Testing", CBS Publishers and Distributors, New Delhi, 1999.
4. Angappan P and Gopalakrishnan R, "Textile Testing", SSM Institute of Textile Technology, Komarapalayam, 2002.
5. Basu A, "Textile Testing", SITRA Coimbatore, 2002.

TTX-407P: Yarn Formation Laboratory- II [0 0 2 1]

At least 10 experiments are to be performed by each student

1. To estimate head to head difference in noil level (mill based study).
2. To study the effect of feed per nip on percentage in nep level during combing (mill based study).
3. To study the drafting, twisting and winding zone of speed frame.
4. To study the building motion in speed frame.
5. To study the differential motion of speed frame and calculation of bobbin speed.
6. Calculation of break draft constant, draft constant and twist constant and production of speed frame.
7. To study the influence of machine and process parameters on roving unevenness (mill based study).
8. To study the drafting, twisting and winding zone in ring frame.
9. To study the building motion in ring frame.
10. Calculation of draft constants, twist constant, coils per inch and production of ring frame.
11. To ascertain the effect of break draft and total draft on yarn unevenness and strength (mill based study).
12. Estimation of spinning tension as a function of traveller weight, yarn count and balloon height (mill based study).
13. To perform various settings and maintenance operation on ring frame such as:
 - ◆ Ring rail leveling
 - ◆ Spindle gauging
 - ◆ Spindle eccentricity
 - ◆ Lappet eccentricity
14. To study the effect of shore hardness on yarn quality (mill based study).
15. To study the influence of spindle speed and traveller weight on hairiness.
16. Study the chief organs, mechanism and calculations of open end and friction spinning machines.
17. To study the timing diagram of a comb.
18. To study the function of top comb and its depth of penetration with reference to noil extraction and fractionating efficiency (mill based study).
19. To study the nature of movement of nipper assembly.
20. To study the mechanism of detaching roller drive and the nature of its motion.
21. To study the effect of type of feed and detachment setting on noil percentage and fractionating efficiency.

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TTX-408P: Fabric Formation Laboratory-II [0 0 2 1]

At least 10 experiments are to be done:

1. Study of take up motion and calculation of loom take up constant.
2. Study of positive let-off system.
3. Study of Warp protection motion (both loose reed and fast reed).
4. Study of warp stop motion.
5. Study of weft stop mechanism.
6. Study of Beating up system in Terry towel loom.
7. Study of temple motions.
8. Study of pirn changing mechanism in a loom.
9. Study of side/centre weft fork mechanism.
10. Study of (4x1) multiple box motion.
11. Study of shuttle changing mechanism in a loom.
12. Study of selvedge formation in shuttle loom.
13. Study of loom winder mechanism in a loom.
14. Study of Dobby loom
15. Study of Jacquard loom.
16. Preparation of various designs by using Jacquard Punching Machine.
17. Identification of fabric faults by fabric inspection machine.

TTX-409P: Textile Chemical Processing Lab-II [0 0 2 1]

At least 10 experiments are to be performed by each student.

1. To dye wool fiber with
 - Reactive dyes
 - Acid dyes
 - Metal complex dyes
2. Dyeing of silk with acid dyes / acid mordant dyes/metal-complex dyes
3. Dyeing of polyester with disperse dyes
4. Dyeing of nylon with acid dyes / metal complex dye
5. Dyeing of acrylic with basic dyes
6. To print cotton fabric with hand block method
7. To print cotton fabric with Screen printing method
8. Preparation of screens for screen-printing.
9. Printing of cotton fabric in direct style
10. Printing of cotton fabric in discharge style
11. Printing of cotton fabric in resist style
12. Study of fastness properties of different dyed samples
13. Identification of dyes on dyed textiles
14. To finish cotton fabric with
 - Water repelling agent
 - Anti-crease finish
 - Softening agent
 - Urea – formaldehyde
15. Flame retardant finishing and Water proof finishing of cotton fabric using padding mangle.



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TTX-410P: Textile Testing Laboratories-I [0 0 2 1]

At least 10 experiments are to be performed by each student.

1. Determine moisture content/regain of a fibre sample by hot air oven method.
2. To prepare and analyze Baer Sorter diagram and determine the following:
Mean Length, Effective length, Short fibres Percentage, Dispersion Percentage.
3. Determine 2.5 % S.L., 50 % S.L., and uniformity ratio of a given cotton using fibrograph. Compare the fibrogram of manmade fibre with cotton.
4. Determine the micronaire value of a given cotton sample by Air-Flow method. Convert the result into SI units and give a suitable rating to the fibre sample.
5. Determine maturity coefficient and maturity ratio of a given sample by caustic soda method. Give appropriate rating to the fibre sample.
6. Determine Pressley Index of a cotton sample by Pressley Tester at zero and 3mm gauge length and convert result into tenacity. Compare and comment on the results at different gauge lengths.
7. Determine the bundle strength and elongation of a given manmade fibre using Stelometer. Analyze the effect of rate of loading on tensile properties of the fibre.
8. Tensile properties of a staple fibre by UTM
9. Determine fibre fineness of a manmade fibres/filaments.
10. Determine crimp (crimp %) of a given manmade fibre sample.
11. Determine stress relaxation and creep recovery of fibre.
12. Determine the Lea C.S.P by Lea CSP Tester and Autosorter and compare the results.
13. Determine the tensile properties of yarn by single thread strength tester.
14. Determine twist of yarn using different principle of measurement.
15. Determine the Classimat fault analysis (yarn fault classifying system).
16. Study evenness and imperfection in the given yarn and compare the results with USTER statistics. Study the spectrogram and irregularity trace to determine type of irregularity present. Study the imperfections at different sensitivity level for different yarn samples.
17. Prepare yarns Appearance Boards and compare with ASTM standards.
18. Study the hairiness of a given yarns using Hairiness Tester. Compare the results of Evenness Tester and Hairiness Tester with ASTM grade.
19. Determine coefficient of friction of a spun yarn and indicate the effect of waxing on coefficient of friction.
20. Determine various parameters like 2.5 % S.L., 50 % S.L. Strength, fineness, maturity ratio, uniformity ratio, trash percentage etc by using HVI and AFIS.

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CURRICULUM FOR UNDERGRADUATE PROGRAMME B.Tech. in TEXTILE TECHNOLOGY

SEMESTER - V

TTX-501: Properties of Fibres [3-0-0-3]

Fiber structure: Traditional view of fiber structure. Chemical structure and physical Structure, Degree of order and degree of orientation.

Structure investigation: Methods of investigation of fiber structure. Basic understanding of IR spectroscopy, X-ray, SEM and TEM.

Moisture absorption: Definitions of humidity, moisture regain, and moisture content. Relation between regain and relative humidity, Effect of stress and temperature on regain. Heat of sorption, swelling of fibres, Quantitative theory of moisture absorption.

Tensile properties: Factors influencing results of tensile experiment, expressing results, Different experimental methods; effect of variability. Elastic recovery. Effect of test conditions on recovery. Cyclic loading and fatigue. Fibre fracture and fatigue. Time effect. Creep and stress relaxation. Introduction to dynamic testing. Concept of models. Kelvin and Maxwell model. Bending and torsional rigidity of fibre.

Dielectric properties: Definition and effect of different parameters on dielectric properties. Electric resistance and effect of different factors on the electrical resistance of fibres.

Static electricity: Introduction and significance. Measurement of static electricity. Explanation of static phenomena.

Optical properties: Refractive index and birefringence. Birefringence and orientation of fiber. Reflection and lustre.

Thermal properties: Structural changes on heating. Thermal transitions. Concept Heat setting of fibres.

Fibre friction: Technological importance. Measurement of friction. Effect of load and area of contact. Static and kinetic friction. General theory of friction and application to fiber.

Books Recommended:

1. Meredith R, "The Mechanical Properties of Textile Fibres", North Holland Publishing Co; Amsterdam 1959.
2. Morton W E and Hearle J W S, "Physical Properties of Textile Fibres", 1st reprint, The Textile Institute, Manchester, 1986.
3. Gupta V B and Kothari V K, "Manufactured Fibre Technology", 1st Ed., Chapman and Hall, London, 1997.
4. Hearle JWS, "Polymers and their properties", Vol. I, John Wiley and Sons, NY, 1982.
5. Gedde U W, "Polymer Physics", Chapman Hall, London, 1995.

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TTX-502 / ME-XXX Kinematics of Machines [3-1-0-4]

Basic concepts: Kinematics of machine, kinematics link and their different type, types of kinematics pair, kinematics chain, mechanism and inversion of four bar chain and slider crank mechanism. Degree of freedom. Velocity Analysis: Motion of a link, velocity of a point on a link by relative velocity method, velocities and acceleration of four bar mechanism, slider crank mechanisms; rubbing velocity at a pin joint. Velocity of a point on a link by instantaneous centre method, properties and types of I-centre, Kennedy theorem and methods of locating I-centres in a mechanism.

Belt, rope and chain drive: Drive systems, Types of belt drives, belt tensions, velocity ratio, law of belting, length of belt, ratio of friction tensions, power transmitted, effect of centrifugal tension on power transmission, condition for maximum power transmission, concept of slip and creep. Variable, PIV and reversing drives. Use of V belts, ropes, chain, chain length and angular speed ratio, relative advantage and disadvantage of chain and belt drives.

Gears: Classification of gears, terminology used in gear, law of gearing velocity of sliding, forms of teeth, construction and properties of an involutes, cycloidal teeth, effect of centre distance variation on the velocity ratio, involutes profile tooth gear, length of path of contact, arc of contact, number of pairs in contact, interference, minimum number of teeth to avoid the interference between rack and pinion, undercutting, terminology of helical and worm gears.

Gear trains: Definition, simple, compound, reverted and epicyclic gear trains, velocity ratio of epicyclic gear trains and planetary gear trains.

Cams and follower: Types of cams and followers, cam terminology, types of motion of the follower, analysis of motion of the follower, analysis of motion of the follower for cams with specified contours.

Balancing: Static and dynamic balancing, balancing of several masses in different planes, balancing of reciprocating masses, balancing machines. Practical aspects of balancing.

Flywheels: Turning moment diagram for steam engine, four stroke internal combustion engines, fluctuation of energy and speed in flywheels, use of flywheel

Application in Textiles: Belts, chains, gear drives in textile machines. Different types of cam followers used in textile machines. Clutches and brakes, bush bearings, theory of lubrication, Rolling contact bearings used in textile machines.

Books Recommended:

1. Bevan T, "The Theory of Machines", CBS Publishers and Distributors, New Delhi, 2002.
2. Bansal R K, "A text book of Theory of Machines", Laxmi Publication Pvt. Ltd, New Delhi.
3. Rattan S S, "Theory of Machines", Tata Mc Graw Hill, New Delhi, 2001.
4. Ghosh A and Mallik A K, "Theory of mechanism and machines", Affiliated East West Press Pvt. Ltd, New Delhi, 1988.
5. Khurmi R.S and Gupta, "Theory of Machines" S. Chand Publisher, New Delhi.
6. Booth J E, "Textile Mathematics", Part III, Textile Institute, Manchester, 1978.



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TTX-503: Textile Testing-II [3-0-0-3]

Testing of yarn: Innovations in yarn testing instruments (dynamic, continuous and on-line testing of yarn quality).

Testing of Fabric: Measurement of fabric dimensions and other physical properties such as thickness, GSM, cover factor, crimp, and shrinkage.

Fabric Strength testing: Tensile, Tearing and bursting strength tests, factors affecting test results, Evaluation and interpretation of tensile test results.

Fabric Comfort: Introduction, importance and classification of Comfort. Fabric porosity and air-permeability. Relationship between fabric porosity and air permeability. Testing of Air Permeability, water permeability (Fabric wettability, Water repellency and waterproof testing), Fabric Flammability: thermal properties and flame resistance properties of fabric, testing of flame retardancy

Fabric handle: Fabric low stress mechanical properties such as smoothness, stiffness, softness and shear, drape behaviour, factors influencing fabric handle, Kawabata and FAST, Serviceability testing parameters such as abrasion resistance snagging test, honey dew and stickiness measurement.

Test related to fabric appearance such as pilling, crease and wrinkle recovery, colour fastness, Barre defect and other fabric defects.

Testing of Garments: Tests related to garment appearance and performance such as measurement of seam pucker, seams slippage and seam strength etc.

Statistical Techniques: Concept of reproducibility and repeatability, methods pertaining to fibre, yarn and fabric testing, concept of quality, quality assurance, textile product labelling, international quality parameters and standards like Uster standards, AATCC, JIS and ASTM.

Chemical Testing of Textiles: Color fastness, rubbing fastness, laundering fastness.

Books Recommended:

1. Saville B P, "Physical Testing of Textiles", Woodhead Publishing Ltd, Cambridge, 2002.
2. "Testing and Quality Management", Ed. V. K. Kothari, IAFL Publications, New Delhi, 1999.
3. Booth J E, "Principles of Textile Testing", CBS Publishers and Distributors, New Delhi, 1999.
4. Angappan P and Gopalakrishnan R, "Textile Testing", SSM Institute of Textile Technology, Komarapalayam, 2002.
5. Basu A, "Textile Testing", SITRA Coimbatore, 2002.
6. Fabric Testing, Ed. J Hu, Woodhead Textiles Series No. 76, 2008, UK.
3. *Textile Fibers: Developments and Innovations*, Ed V K Kothari, IAFL Publications, New Delhi (2000).

TTX- 504: Fabric structure and design analysis [3-0-0-3]

Basic Concepts: Introduction, Different types of yarn such as spun, filament, textured and fancy yarns and their impact on textile design, Concept of fabric designing through fabric structure and textile printing, Fabric cover, yarn crimp, count, and fabric weight; importance of fabric structure and analysis, detection of directions of warp and weft.

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Woven Design Fundamentals: Introduction, classification of woven fabrics, method of fabric weave presentation, use of design paper, Repeat of the design, Elements of woven design, weaving plans. Types of draft plans, Relation between design, draft and lifting plan, Construction of drafts and lifting plans; Denting Plan.

Basic Weaves: (i) **Plain Weaves:** Introduction, Classification of plain woven cloths - approximately square, warp faced and weft faced fabrics, Method of construction, Ornamentation of plain fabrics, features and uses of plain weave and its derivatives, (ii) **Twill Weaves:** Introduction, Classification, Method of construction, features and uses of twill weave and its derivatives. The Angle of twill, Factors determining the performance of twill weaves. (iii) **Satin and Sateen Weaves:** Introduction, Method of construction, features and uses of Satin and sateen weaves and their derivatives.

Absorbent Fabrics: Introduction, Method of preparation/construction, features and uses of Diamond and Diaper Weaves, Honey comb weaves, Huck-a-back and mock -leno weaves.

Crepe Weave: Introduction, Special feature, construction of the weave, method of preparation of its derivatives and uses.

Bedford cord weaves: Introduction, Method of construction, features, cross-sectional view, derivatives and uses.

Welts and piques: Special features, construction of weave, mechanism of indentation formation and uses.

Colour and its Application: Light and colour phenomena, Theories of Colour: Light theory and Pigment theory, Visual effects of various colours, Tint, Hue and Shade. Modification of colours, Colours in combination: Colour contrast, Contrast of hue, Contrast of tone, Colour harmony. Methods of colour Application.

Color and Weave Effect: Weave and color combinations, features, method of preparation of Continuous line effect, Hounds tooth, Birds eye, Crows foot, Hair lines and Step pattern. Special Colour and Weave effects. Figured Colour and Weave effects.

Stripe and Check Weaves: Features, criteria for selection of weaves for combination, rules governing the joining of different weaves. Method of preparation and uses.

Figuring with Extra threads: Introduction, Methods of introducing extra figuring threads, methods of disposing of the surplus extra threads, Extra warp and weft figuring and its construction and uses.

Backed fabrics: Definition, features, classification and usage. Graphical representation, warp backed and weft backed cloth, reversible backed fabric, wadded backed fabric.

Calculations: Raw material calculations to produce different weaves. Technical specifications of important fabrics.

Books Recommended:

1. Groszicki Z J, "Watsons Textile Design and Colour", Newnes Buttersworth, 1988.
2. Groszicki Z J, "Watsons Advanced Textile Design", Newnes Buttersworth, 1989.
3. Klibbe J W, "Structural Fabric Design", revised edition, 1965, North Carolina State University.
4. Nisbeth H, "Grammar of Textile Design", 3rd edition, D B Tarapore Wala sons and Co., 1994.
5. Gokarneshan N, "Fabric Structure and Design", New Age International, New Delhi, 2004.
6. Robinson A T C, Marks R, "Woven Cloth Construction", The Textile Institute, Manchester, 1973.
7. Hayavadana J, Woven Fabric Structure Design and Product Planning, Woodhead Publishing India Pvt. Ltd. New Delhi, 2015
8. Gokarneshan N., Practical Guide to Fabric Manufacture & Cloth Analysis Laboratory, Mahajan Pulishers Pvt. Ltd., Ahmadabad, 2005, ISBN 81-85401-26-8.

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TTX-505: Advanced Yarn Manufacturing [3-0-0-3]

Introduction to unconventional spinning: Introduction, Limitation of ring spinning, Principles of unconventional method of yarn manufacturing, Classification of new spinning yarn technology, Principle of open-end spinning process, Advantages and Limitations of open-end spinning process. Fibre characteristics requirements for different leading spinning technologies. Possibilities and limitations of different spinning technologies.

Rotor Spinning: Principle and raw material preparation. Chief organs and their functions. Design and working of rotor spinning machine and effect of each on the process and product quality. Assessment of Rotor spun yarn structures and properties and comparison with Ring spun yarn. Numerical problems, norms and New developments.

Air-jet Spinning: Principle and raw material preparation. Process and machine parameters affecting product quality. Principle of vortex yarn manufacture. Difference between air jet spun and vortex spun yarn structure.

Friction Spinning: Principle and raw material preparation, process and machine parameters affecting product quality. Assessment of DREF-II and DREF-III yarn structures and properties.

Compact Spinning: Principle and raw material preparation for compact spinning. Comparative assessment of the structure and performance with respect to ring yarn.

Other Spinning system: Principles of different converters. Self twist, twist less, warp spinning, Electrostatic spinning, Core spinning, Siro spinning, Bobtex yarn manufacture, solo spun yarn manufacture. Latest developments, Basic principles of textured yarn manufacture.

Books Recommended:

1. Klein W, Manual of Textile Technology: New Spinning Systems, 1st Ed; The Textile Institute, Manchester, UK 1993.
2. Lawrence C A, Fundamentals of Spun Yarn Technology, 1st Ed; CRC Press LLC, Florida,USA (2003)
3. Chattopadhyay R and Ishtiaque S M, Advances in Yarn Manufacturing Process, Department of Textile Technology, IIT Delhi 1991.
4. Hearle J W S, Hollick L and Wilson D K, "Yarn Texturing Technology", Woodhead Publishing Ltd., UK, 2002
5. Salhotra K R and Ishtiaque S M, Rotor Spinning : Its advantages, limitations and prospects in India, 1st Ed; National Information Centre for Textile and Allied Subjects, 1995.

TTX-506: Advanced Fabric Manufacturing [3-0-0-3]

Introduction: Limitation of shuttle looms, Problems of shuttle loom: Maximum speed of shuttle loom, design problem of shuttle loom, basic concept of increasing the weft insertion rate in weaving machine.

Shuttleless Looms: Introduction, Comparison of shuttle and shuttleless looms, Classification of shuttleless looms, weft velocity, Comparison of various weft insertion systems, selvages, weft storage units, Requisites for successful installation of shuttleless looms.

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Preparation of Yarn for shuttle-less weaving: Winding, warping, sizing and weft preparation and drawing of warp yarn. Warp and weft yarn requirement for shuttleless weaving. Knotting machines, Weft accumulators– types, Formation of unconventional selvages – tuck-in, leno, chain, fused and adhesive.

Projectile Weaving Machine: Basic principle of projectile loom, sequence of weft insertion, cam drive shedding mechanism, beat-up, torsion bar picking, loom timing, checking of gripper, let-off and take-up motion, selvedge formation, Energy equation of torsion bar, velocity and acceleration of the projectile. weaving performance and fabric quality.

Rapier Weaving Machines: Classification of rapier weaving machines: Flexible, Rigid rapiers, Principles of tip to tip and loop transfer. Weft insertion cycle, Rapier drives, Salient features, Single phase double acting rapier, two phase double acting rapier. Velocity of the rapier. Loom timing. Fabric defects and remedies. Weft insertion rate and production calculation.

Air jet weaving Machine: Principle of air jet weaving, Sequence of weft insertion in air jet loom. Types of confuser guide, nozzles, profile reed. Air requirements. Loom timing diagram Problem in air jet weft insertion. Factors affecting pneumatic weft propulsion, motion of weft, nozzle design. Fabric defects and remedies. Weft insertion rate and production calculation.

Water-jet Weaving machine: Principle of water jet weaving, Weft insertion mechanism, Nozzles, quality of warp required for water jet, selvedge formation, environmental problem, quality of water, problem of water-jet loom. Loom timing diagram, Fabric defects and remedies. Weft insertion rate and production calculation.

Techno-economics of shuttle-less weaving. Weft feeding in shuttle-less weaving.

Multi phase Weaving Machine: Basic concept of multiphase weaving. shedding operation in warp way and weft way multiphase loom. Advantages and disadvantages of multiphase weaving process, circular loom, yarn path and weft insertion in circular loom.

Narrow Fabric Loom: Different type of narrow fabrics. Mechanism of weft insertion and fabric formation in narrow fabric weaving machine.

Carpet Weaving: Woven carpet, design and process of manufacturing carpets, raw material used technical specifications and its uses.

Multi Axial Warp knitted Fabric: Fabric Structure, Properties and end uses.

Leno weaving, Triaxial weaving, Denim manufacturing, Filament weaving., Weaving of slit yarn fabrics

Braided structures: Types of braiding processes, classification of braids, braid geometry, structure-property relationship, over braiding.

Books Recommended:

1. Marks R and Robinsons A T C, "Principles of weaving", Textile Institute, UK, 1986.
2. Lord P R and Mohamad M H, "Weaving: Conversion of Yarn to Fabric", Merrow Technical Library, UK, 1988.
3. Ormerod A, "Modern preparations and weaving machinery", Butterworth and co., UK, 1983.
4. Talavasek O and Svaty V, "Shuttleless weaving machine", Elsevier Scientific Publishing Co., Amsterdam, 1981.
5. Lunenschloss J and Albrecht W, "Non-Woven Bonded Fabric", Ellis and Horwood Ltd., UK, 1985
6. Krcma R, "Manual of Non wovens", Textile Trade Press, UK, 1971
7. Ormerod A, Weaving, Technology and Operations, Woodhead Publishing Ltd.
8. **Woven Fabric Production** – II, NCUTE, New Delhi 2002.

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TTX- 507P: Textile Testing Laboratories-II [0 0 2 1]

At least 10 experiments are to be performed by each student.

1. Characterize a woven fabric with respect to its dimensional properties.
 - a. thread density b. yarn number c. yarn crimp d. weave
 - e. cover factor f. areal density g. skewness h. Thickness
2. Determine the compression property of a fabric (thickness).
3. Determine the percentage crimp and corrected count with the help of crimp Tester.
4. Determine the crimp rigidity by using hot crimp contraction method.
5. Determine the tensile strength and elongation of a woven fabric and compare the load- elongation curve with non-woven and knitted fabric.
6. Determine the tear resistance of a fabric using Elmendorf Tear Tester.
7. Determine the bursting strength of a fabric on a hydraulic bursting tester.
8. Determine the abrasion resistance and pilling resistance of a fabric.
9. Determine the crease and wrinkle recovery of fabric and observe effect of loading time and recovery time on crease recovery.
10. Determine the Drape coefficient of a fabric sample.
11. Determine the Air permeability and Flammability of a fabric.
12. Determine the Air permeability of a fabric.
13. Determine the Flammability of a fabric.
14. Determine the thermal resistance of a fabric by Guarded hot plate method.
15. Determine the stiffness of a fabric by Shirley stiffness tester.
16. Determine bending rigidity by (HEART) loop method.
17. Determine the water permeability, water vapour permeability and water repellency of a fabric.
18. Determine the moisture management property and drying rate of a fabric and analyze the wear comfort of clothing.
19. Determine and compare the seam strength, seam slippage and seam puckering of a fabric sewn with different types of sewing threads.
20. Study of various low stress mechanical properties of fabric by using FAST.

TTX- 508P: Fabric structure and design analysis laboratory [0 0 2 1]

At least 10 experiments are to be performed by each student.

Unit 1: To analyze the yarn and fabric particulars of the different weave structures along with their graphical presentation and weaving plans.

1. Analysis of Plain weave
2. Analysis of Twill weave
3. Analysis of Satin/sateen weave
4. Analysis of Diamond/Diaper weave

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5. Analysis of Honeycomb weaves
6. Analysis of Huck-a-back weaves
7. Analysis of Perforated weaves/Mockleno weaves
8. Analysis of Crepe weaves
9. Analysis of Bedford cord weaves
10. Analysis of Welt and pique weaves
11. Analysis of Stripe and check weaves
12. Analysis of Figuring with Extra threads fabrics
13. Analysis of Backed fabrics
14. Analysis of Decorative natural silk fabrics.
15. Analysis of Decorative Artificial silk weave fabrics

Unit 2: Design and Colour

1. Preparation of colour charts showing primary, secondary, and tertiary colour
2. Preparation of mixed colour effect
3. Practice of colour harmony and contrast
4. Preparation of small border design
5. Free hand sketching
6. Preparation of design for jacquard
7. Practice of developing all-over design effects for various fabrics.
8. Practice of developing Border designs.
9. Practice of developing Cross border designs.
10. Practice of representing colour and weave effects on point paper.
11. Creation of stripes and checks effect on paper using suitable colours.
12. Creation of floral design on paper by suitable colours.
13. Creation of animation patterns and other designs on paper by suitable colours.
14. Creation of suitable designs on dobby looms.
15. Creation of suitable designs on jacquard.

TTX- 509P: Advanced Yarn Manufacturing Lab [0 0 2 1]

Note: Practical as per the topics in the syllabus for the course will be conducted in the laboratory class. Following is the suggested list of exercises out of which a minimum of 8-10 experiments must be performed by a student during the semester

List of Experiments

1. Study of construction, material flow and working mechanism of rotor spinning.
2. Study of drafting, twisting and winding operation and determination of draft & production of rotor spinning.
3. Estimation of minimum twist required to spin yarn continuously in ring and rotor spinning.
Estimation of twist loss in rotor spinning.
4. Effect of opening roller speed on rotor spun yarn characteristics and estimation of fibre breakage by the opening roller of rotor spinning machines
5. Study of operating principle, material flow and various parts of air jet spinning.
6. Study of drafting, twisting and winding operation of air jet spinning.

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7. Study the chief organs, mechanism and calculations of friction spinning machines.
8. Study of drafting, twisting and winding operation of friction (Dref II and Dref III) spinning.
9. Study of Compact spinning, methods of fibre compacting, modification and attachments.
10. Assessment and control of variability in ring, rotor and air-jet spun yarns
11. Comparative study of ring, rotor and air jet yarn structure and properties
12. Study of time and motion study.
13. Study the construction, material flow and working mechanism of electrostatic spinning machine.

TTX-510P: Advanced Fabric Manufacturing Lab [0 0 2 1]

Note: Practical as per the topics in the syllabus for the course will be conducted in the laboratory class. Following is the suggested list of exercises out of which a minimum of 8-10 experiments must be performed by a student during the semester.

List of Experiments

1. To study the positive and negative aspects of shuttle and shuttle less loom.
2. Study of let-off and take-up of shuttle less weaving machine.
3. To study the different selvedge formation: Tuck-in, Leno, Fused and Knitted selvedge.
4. To study the working of positive let-off and electronic let-off and their advantages.
5. To study the accumulators used in Shuttleless weaving machines
6. Study of weft preparation for picking in Shuttle less weaving machines
7. To Study the weft insertion mechanism of projectile weaving machine with its advantages
8. Study of weft transmission process to the projectile loom
9. To study the working of Rapier loom system and sequence of weft insertion.
10. Study different methods to drive the Rapier head in a rapier loom
11. To study the working of Air jet loom and sequence of weft insertion in air jet weaving.
12. Study of selvedge formation technique of Air-jet weaving machine.
13. To study the working principle of confuser, relay nozzle and profile reed
14. To study about the mechanism of Water jet picking system and principle involved in the operation of weft supply system.
15. To study about the circular multi-phase weaving machine, merits and demerits of circular multi-phase weaving machine.
16. Study the mechanism of weft insertion and fabric formation in narrow fabric weaving machine.
17. Study the mechanism of carpet manufacturing process.

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SEMESTER – VI

TTX-601: Fundamentals of Knitting and Nonwoven Technology [3 0 0 3]

Knitting: Introduction, Process, comparison of weaving and knitting, warp and weft knitting, classification of weft knitting machines, Yarn quality requirements for weft knitting.

Weft Knitting Elements: Knitting needles, loops, sinkers, cam systems, type of feeding systems, Tensioning devices, stop motions.

Weft Knitted Structures: Properties and uses of basic weft knitted structures- Plain, Rib, Interlock and Purl along with their derivatives. Different types of stitches. Course, wale, stitch density and loop length, Basic weft knitting machines.

Flat Knitting Machines: Process of loop formation, cam track, features, and structures Produced.

Patterning in weft knitting: Devices for patterning in circular knitting machine Electronic needle selection.

Science of Knitting: Concept of loop length, knitting tension, spirality, production Calculations, fabric faults in weft knitting.

Warp Knitting: Introduction, classification of warp knitting, Patterning in warp knitting, Machines and mechanism. Study of let-off and take up mechanism, lapping diagrams, stitches in warp knitting, and structures in warp knitting. Yarn preparation for warp knitting, Production calculations.

Latest developments: Knitting machines, other structures in knitting, blanket manufacturing.

Nonwoven: Historical Development, Definitions of nonwovens, Classification of Nonwoven fabrics, nonwoven properties and applications including environmental considerations. Development of nonwoven industry and future perspective, Types of fibres and bonding agents used, Characteristic properties of polymer dispersions, thermo sensibility and cross linking, various techniques of dry and wet lying of fibrous web. Needle punching technology, Felting needles, needle classification and their specifications, Factors affecting the properties of needle punched fabrics, Brief idea about the Spun lacing, spun bonding, melt blowing, thermal bonding and Stitch bonding techniques, Adhesive Bonding, Methods of bonding agent application, Cohesive bonding, various types of dryers in adhesive bonding, Thermal bonding techniques, Finishing of nonwoven fabrics, Applications of nonwoven and Testing of Nonwoven fabrics.

Books Recommended:

1. Spencer D J, "Knitting Technology", 2nd edition, Pergamon Press, 1989
2. Ajgaonkar D B, "Knitting Technology", Universal Publishing Corporation, 1998.
3. Booth J E, "Textile Mathematics", Vol. 3, Textile Institute, Manchester, 1977.
4. Lunenschloss J and Albrecht W, "Non-Woven Bonded Fabric", Ellis and Horwood Ltd., UK, 1985
5. Albrecht W, Fuchs H and Kittelmann, "Nonwoven Fabrics", Wiley-VCH Weinheim, 2003.
6. Krcma Radco, "Manual of nonwovens", Textile Trade Press, UK, 1971.
7. Gulrajani M L, "Book of Papers of International Conference on Nonwovens", The Textile Institute, UK, 1992.

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TTX- 602: Process Control in Textiles (3104) [3-0-3]

System of process control in spinning: Role and scope, key variables, establishing norms or standards, Collection and interpretation of data and corrective action. Online and offline control measures in spinning.

Mixing quality and Cost: Instrumental evaluation of cotton, Control of mixing quality through fiber characteristics, control of mixing cost and quality, linear programming for cotton mixing and its formulation and approach.

Yarn realisation: Records and estimation of yarn realization and waste in spinning mill, norms for yarn realisation.

Waste and cleaning in Blow room and carding: Calculation of Trash content and cleaning efficiency, Norms for waste and cleaning efficiency, assessing the performance of Blow room and card. Nep generation and Fibre rupture. Neps removal efficiency and fibre rupture in carding, Online monitoring and control of neps on modern cards.

Comber waste control: Technological conditions, optimization of comber waste extraction, norms and procedures for control of comber waste.

Control of yarn quality: Measurement, assessment and control of count, strength, unevenness and imperfections of yarn.

System of process control in weaving: Scope and approach to process control in weaving. Establishing and standards schedule of checks and machinery audit.

Quality Control and Productivity in winding warping and sizing: Approach, scope, control and optimization.

Control of productivity in Loom shed: scope and approach, control of loom speed, efficiency and stops. Quality of yarn. Expected loom efficiency, loom allocation.

Fabrics Quality in Weaving: Scope and approach, control of some specific fabric defects, grey fabric imperfection. Analysis and Control measures for woven and knitted fabric defects.

System of Process Control in Chemical Processing: Scope and approach, norms and standards.

Quality control and Productivity: Quality control and productivity in Bleaching, dyeing, printing and finishing. Control of damages in chemical processing.

Books Recommended:

1. Garde A R and Subramanian T A, "Process Control in Cotton Spinning," ATIRA, Ahmedabad, 2nd Ed., 1978.
2. Paliwal M C and Kimothi P D, "Process Control in weaving", ATIRA, Ahmedabad, 1983.
3. Majumdar A, Das A, Alagirusamy R, and Kothari V K, "Process Control in Textile Manufacturing", Woodhead Publishing, Cambridge, UK, 2012.
4. Gokhale S V and Modi J R, "Process and Quality Control in Chemical Processing of Textiles", ATIRA, Ahmedabad, 1992
4. Ratanam T V, "Quality control in spinning", SITRA, Coimbatore, 1994.
5. Salhotra K R, Chattopadhyay R and Ishtiaque S M, "Process control in spinning", IIT, Delhi, CD cell, 2001.

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TTX-603: Garment Technology [3 0 0 3]

Course Objective: To impart knowledge on conversion of fabrics into garment.

Course Outcomes: After completing this course, the students will be able to:

1. Give overview of garment industry and learn the criteria for selection of fabrics
2. Describe the process sequence for converting fabric into garment
3. Assess the various stitching parameters and seam types
4. Summarize the various trimming and finishing for garment making
5. Criticize possible faults in garment making and Application of computer in garment Industry.

Prerequisite: Student must have knowledge of different fabric structures and fabric properties.

COURSE CONTENT:

Garment Manufacturing: Introduction, Indian apparel industry. Present scenario and future of Indian apparel industry. Different garment production systems.

Selection of Fabrics: Garment from Woven, knitted and various other fabrics available in market, their characteristics and applications to suit to different purposes.

Pattern making: Introduction to pattern making and garment construction. Different terminologies. Drafting, Basic bodies blocks, Muslin pattern, Commercial pattern, Methods of making basic pattern, Grading of pattern, size and size charts.

Spreading and lay planning: Introduction to symmetrical and asymmetrical fabrics, criteria of spreading, mode of fabric spreading, methods of spreading, spreading m/cs. Principles of lay plan, types of lay plan. Marker planning, marker making and Marker plan efficiency.

Fabric Cutting: Introduction to cutting room processes, cutting methods and their merit demerits. Bundling system.

Garment Sewing: Introduction to sewing m/c and its parts, sewing room processes and working details. Different types of sewing m/c and its suitability, Different sewing m/c driving system. Attachment of sewing m/c, Sewing needle and its sizes.

Sewing stitches and seams types: Stitch formation, types of stitches, seam classification, seam geometry, seam strength and slippage, seam puckering. Thread calculation and its consumption.

Trimming and Garment accessories: Definition, types, trimming methodologies and accessories application.

Garment finishing: Fasteners, thread tucking, care and size labeling system, checking, pressing, folding and packing, packing standards for domestic and export markets.

Garment Processing: Preparatory processes. Apparel dyeing, printing, washing and finishing processes. Apparel dyeing machines.

Quality Control in Garment manufacturing: Control in pattern making, grading, fabric laying, marking, sewing and finishing, control of garment defects.

Computer Application in Garment Manufacturing: Application in pattern making, grading, lay planning, sewing and finishing. Concepts of CAD, computer aided embroidery designs, Concepts of computer integrated manufacturing (CIM) to the garment industry. Technological advancement in garment Industry.

Books Recommended:

1. Carr H and Lantham B, "The Technology of Clothing Manufacture", Om Book Service, Delhi.
2. Mehta P V and Bhardwaj S K, "Managing Quality in apparel industry", Om Book Service, New Delhi.
3. Aldrich W, "Metric Pattern Cutting", OM Book Service, New Delhi, 1998.
4. Cooklin Gerry, "Garment Technology for Fashion Designers", OM Book Service, New Delhi, 1997.
5. Eveleyn M and Ucas, "Clothing Construction", 2nd Edition Hughton Mifflin Co, Boston 1974.

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TTX-604: Multi-fiber Processes [3 0 0 3]

Survey of the established practices for spinning of man-made fibres, Present practices and assessment of available methods of contaminant removal. Fibre characteristics and spinnability of manmade fibres. Relationship between fibre properties and yarn quality and yarn characteristics. Role of spin finish and fibre crimp in processing. Blending and its objectives. Estimation of blend intimacy and blend irregularity and factors affecting them. Migration. Selection of blend constituents. Effect of blend composition on yarn properties. Assessment of blending at different stages of a spinning line. Development in bending machines. Conventional spinning system. Processing of man-made fibres and blends on cotton system of spinning. Detailed study of the changes required in processing short and long staple manmade fibres on cotton system. Properties of blended yarns. Spinning of dyed fibres. Melange and fancy yarn production.

Aspects of Spinning of man- made fibres and wool on rotor spinning system. Spinning of micro fibres.

Processing of wool fibre:

Worsted /semi-worsted/ Woollen Spinning. Processing of long fibres on woollen/worsted system. Woollen yarn vs. worsted yarn; Manufacturing of woollen yarn- preliminary processes, blending or mixing, woollen carding, woollen spinning, woollen yarn numbering; Manufacturing of worsted yarn – worsted carding, back washing, oiling, gilling and combing, tow to top conversion, worsted drawing, worsted yarn spinning, worsted yarn numbering, norms and modern developments; Manufacturing of worsted and woollen fabrics by weaving, knitting and nonwoven routes; Utility of FAST system in worsted garment manufacturing.

Processing of other animal hair fibres like Cashmere, Mohair, Angora, Alpaca etc.

Processing of silk fibre:

Raw silk reeling: various devices, methods, quality control during reeling; Raw silk testing and quality control; Production of spun silk yarn; Manufacturing of silk fabrics with special emphasis on silk satin, velvets, brocades, crepe de chine and georgette structures; Evaluation of silk fabric handle.

Processing of Bast fibres:

Introduction and process sequence for jute spinning. Blending of jute. End use of jute and jute blended yarns and fabrics. End use of Linen blended and linen yarn and fabrics. Production of manmade and their blends with modern spinning systems. Processing hemp, ramie.

Processing of leaf, spear and fruit based fibres like Sisal, Banana, Bamboo and coir fibres.

Books Recommended:

1. Salhotra K R, "Spinning of Manmades and blends on cotton system", 2nd Ed; The textile Association, India, 1989.
2. Klein W, "Man-made Fibres and Their Processing", The Textile Institute, Manchester, Vol.6, (2002).
3. Lawrence C A, Fundamentals of Spun Yarn Technology, 1st Ed; CRC Press LLC, Florida, USA (2003)
4. Chattopadhyay R, "Advance in Technology of yarn Production", 1st Ed; Nodal Centre for Upgradation of Textile Education, IIT, Delhi, 2002.
5. Richards R T D and Sykes A B, "Manual of Textile Technology: Woollen Yarn Manufacture", The Textile Institute, Manchester 1994.
6. Tomar, R.S. – Hand Book of Wool and Blended Suiting Process, Woodhead Publishing, ISBN: 978-1-84569-954-3.
7. Lipenkov Ya, "Wool Spinning", Mir Publishers, Mascow, 1983, Volume 1 & 2.

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8. Tammanna N. Sonwalkar, Hand Book of Silk Technology, New Age International (r) Ltd, Publishers, New Delhi, 2001.
9. Atkinson R R, "Jute fibre to Yarn", B.I. Publication, Bombay, India, 1965.
10. Edited by Robert R Franck, "Bast and Other Plant Fibres", The Textile Institute, Woodhead Publishing Ltd, Cambridge, England, 2005.

Recommended References:

1. Corbman, B.P. - Textiles: Fibre to Fabric, McGraw Hill International Edition, 1983
2. Lee, Y.W. - Silk reeling and testing manual, FAO Agricultural Services Buiietin 136.
3. Matsudaira, M., Kawabata, S. - A Study of The Mechanical properties of Woven Silk Fabrics (Part I, II, III), Journal of The Textile Institute, 1988, 79 (3), pp. 490-503.
4. Lee, Y.W. - Silk reeling and testing manual, FAO Agricultural Services Buiietin 136.
5. Matsudaira, M., Kawabata, S. - A Study of The Mechanical properties of Woven Silk Fabrics (Part I, II, III), Journal of The Textile Institute, 1988, 79 (3), pp. 490-503.

TTX-605: ADVANCED FABRIC STRUCTURE AND DESIGN [3 0 0 3]

Double Cloth: Definition, features, classification and uses. Method of preparation of self stitched and centres stitched double cloths, their salient feature and uses, Wadded double cloth.

Treble Cloths: Introduction, Construction of Treble Cloths, Methods of Stitching.

Pile Fabrics: Introduction, Classification of pile fabrics: Warp Pile and Weft Pile fabrics.

Terry Pile Weaves: Introduction, classification, process of formation of pile, graphical representation of terry weaves, loop sprouting, extra attachments.

Weft Pile Fabrics: All-over or plain Velveteens, Weft plushes, Corded velveteens, figured velveteens.

Warp Pile Fabrics: Produced by various methods: (a) Face-to-Face Principle (b) with aid of Wires, All over or continuous pile structure - Figured pile structure.

Figured Pique Fabrics: Introduction, Classification of the Figured Pique Structure: Loose-back Pique, Half Fast-back Pique and Fast-back Pique. Methods of Designing. Wadding Picks for Figured Pique Fabrics.

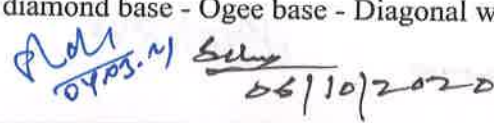
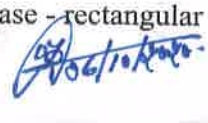
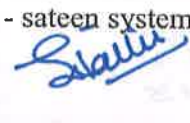
Damasks and Brocades: Principle of designing simple damask and brocades. Warp rib, Weft rib, Multi weft brocades.

Gauze and Leno Structures: special features, principles of leno structure, Methods of Producing Leno Structure. Basic shed formation - Different types of Doup healds, Russian Cords design - Easing Mechanism, Madras - Muslin structure.

Narrow Fabrics: Construction of ribbons and tapes - Zip fastener tapes.

Construction and Development of jacquard design: Construction of squared paper designs, Developments of figures, Insertion of ground weaves, Composition of designs, Geometric ornamentation.

Arrangement of Figures : Unit Repeating Designs - drop design - half drop design - Half drop bases - diamond base - Ogee base - Diagonal waved line base - rectangular base - sateen system of distribution.

Tapestry Structures: Simple weft face tapestries – Repp-stitched weft face tapestry structures – Combined warp and weft tapestry structures.

Lappet Weaving: Lappet wheel construction - Lappet Mechanism - Swivel weaving Mechanism. Special Jacquards: Self twilling - Sectional - Inverted hook - Border - Compound jacquards.

Spool and Gripper Axminster Carpets: The spool Axminster system, The Gripper Axminster system, The Spool – Gripper system.

Indian Traditional design. Introduction to CAD for woven designs.

Books Recommended:

1. Groszicki Z J, "Watsons Textile Design and Colour", Newnes Buttersworth, London, 1988,
2. Groszicki Z J, "Watsons Advanced Textile Design", Newnes Buttersworth, 1989.
3. Klibbe J W, "Structural Fabric Design", revised edition, 1965, North Carolina State University.
4. Nisbeth H, "Grammar of Textile Design", 3rd edition, D B Tarapore Wala sons and Co., 1994.
5. Gokarneshan N, "Fabric Structure and Design", New Age International, New Delhi, 2004.
6. Turner.J.P, "*The Production and properties of Narrow Fabrics*", Textile Progress, Vol8, No.4, 2004
7. Hayavadana J, Woven Fabric Structure Design and Product Planning, Woodhead Publishing India Pvt. Ltd. New Delhi, 2015

ECX 606: Application of Electronics in Textiles [3 1 0 4]

1. Boolean Algebra and Logic Gates: Introduction to Boolean Algebra, Logic Circuits and logic Gates, Minimisation of Boolean expressions.

2. Digital Logic Circuits: Introduction to Adder and Subtractor circuits, Multiplexers, De Multiplexers, Encoders and decoders, Semiconductors Memories like ROM and RAM, Introduction to A/D and D/A Converters

3. Microprocessors: Evaluation of Microprocessor, System Block diagram, Microprocessor operation, Hardware and Software requirement, from large computer to singal Chip microcomputers, machine language and assembly language. The 8085 MPU and 8080 MPU Instruction classification, Instruction format, Instruction to8085/8080 basic instructions, writing and executing an 8085based assembly language programme, Dynamic debugging, Basic interfacing concepts.

4. Electronics in Textile machines: Overview of Electronic and control in modern textile testing Equipment and Machines, Control elements, Systems and Examples, Automation by microprocessor and microcontrollers, Motor and power drives, Power drives, Power control drives etc Optical sensors, Resistance temperature detectors, Limit switch and stop motion, Auto levelling, Electronic yarn cleaners, PLC (perfect Length Count) controllers, Continuous bobbin feeder (CBF) Electronic tensioners etc.

5. Wearable Electronics: Multifunctional textile with incorporated electronics for integrated communication, Music, Health monitoring, Defence, Support functions, Wearable computers etc.

Books Recommended:

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1. Malvino P and Leach, "Digital principle and applications" 5th Edition, Tata McGraw Hill, New Delhi, (2003)
 2. Gaonkar S R., "Microprocessor Architecture, Programming and applications with 8085/8080" 5th Edition, Prentice Hall Private Ltd, New Delhi, (2000)
 3. Jain R P, "Modern Digital Electronics", 3rd Ed., Tata McGraw Hill, New Delhi, 2003.
 4. Ashok Kumar L. and Vigneswaran C., "Electronics in Textiles and Clothing: *Design, Products and Applications*", CRC Press, Taylor & Francis Group, 2016.

TTX- 607P: Knitting Technology Laboratory [0 0 2 1]

At least 8-10 experiments are to be performed by each student.

1. To study the path of yarn through plain knitting machine.
2. To study the different knitting elements including the cam system.
3. To study the driving mechanism of plain knitting m/c.
4. To study the cloth take-up mechanism of plain knitting m/c.
5. To study the rib knitting m/c including arrangement of dial and cylinder needles, cam system and driving mechanism.
6. To study the Interlock knitting m/c including arrangement of dial and cylinder needles, cam system and driving mechanism.
7. To study cam system of V - bed rib knitting m/c.
8. To study driving mechanism of V - bed rib knitting m/c.
9. Preparation of Fabric sample (rib, circular, half cardigan and full cardigan) in V-bed rib knitting machine.
10. To study the effect on loop length with the change in cam setting in flat knitting machine.
11. To study the effect of variation in yarn input tension on the loop length in V-bed rib flat knitting machine.
12. To study plain, rib and Interlock knitted fabrics (course per inch, wales per inch, loop length etc.)

TTX- 608P: Garment Technology Laboratory [0 0 2 1]

At least 10 experiments are to be performed by each student.

1. Study and collect different woven fabrics, blended fabrics, and knitted fabrics used in garments and their use in garments (01 Lab).
2. Study of sewing machine and its parts (01 Lab).
3. Study and prepare Body measurements charts and Direct and standard system of measurement (01 Lab).
4. Study and construction of hand stitches - Basting, Running, Hemming, Back stitch and its variations (01 Lab).
5. Study and construction of seams - Plain, French, Lapped, Flat fell, Hongkong, eased and top stitched (01 Lab).

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6. Study about different collar types Peter pan, cape, mandarin, shirt, scalloped, sailor & rippled collar (01 Lab).
7. Study and construction of Gathers, Pleats and Tucks (01 Lab).
8. Study of Paper patterns - Types, Contents of paper patterns, uses of paper patterns (01 Lab).
9. Study of various Tools used in Garment construction - Measuring, Marking, embroidery, cutting, pressing, general tools (01 Lab).
10. Study and development of patterns for simple designs using basic blocks (01Lab).
11. Study and construction of basic blocks to assemble a garment (01 Lab).
12. Garment stitching and finishing (03 Lab).
 - Darts
 - Waist bands
 - Pockets
 - Placket - slit and seam
 - Neckline finish
 - Sleeve attachments
13. Study of various types of cutting methods used for cutting a garment (01 Lab).
14. To explain important skill that enables the designer to convert a design sketch into a three dimensional form (01 Lab).
15. To get the Knowledge and operation of CAD package for pattern making/digitizing/grading/ marker making (01 Lab).
16. Study and applications of various type of software used in apparel manufacturing processes (based on tuka-tech and all reach software) (01 Lab).
17. Designing of T -shirts, Skirts, Pant and shirt using garment software (02 Lab).
18. Design wedding dresses for women / man using fashion studio (CAD) software (01 Lab).
19. Design dresses for women / man sport player using fashion studio (CAD) software (01 Lab).

TTX-609P: Advanced Fabric structure and design Laboratory [0 0 2 1]

At least 10 experiments are to be performed by each student.

1. Analysis of Double Cloths
2. Analysis of Terry weaves.
3. Analysis of Figured piques fabrics.
4. Analysis of dobby design fabrics.
5. Analysis of fancy woven design fabrics.
6. Analysis of jacquard design fabrics.
7. Analysis of printing design fabrics.
8. Generating of geometric, abstract, floral, animation and combined designs.
9. Application of paint brush and other related software in colour mixing.
10. Utilization in design software for creating textile designs intended for dobby.
11. Utilization in design software for creating textile designs intended for jacquard.
12. Utilization in design software for creating textile designs intended for printing.
13. Simulation of fabric appearance of woven designs by varying fabric set and yarn count.
14. Analysis of colour and weave fabrics and simulating the appearance using computer.

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- 15. Scanning of fabric and simulating the appearance of the same.
- 16. Scanning of yarn and imitating the appearance of a yarn in woven fabric form.
- 17. Transformation of design to production particulars
- 18. Practice of developing all over design using Indian historical designs.
- 19. Practice of developing all over design using Chinese historical designs.
- 20. Practice of composing textile design for house hold and furnishing fabrics.

ECX 610P: Application of Electronics in Textiles Laboratory [0 0 2 1]

At least 10 experiments are to be performed by each student.

- 1 Verification of truth Table of various Logic Gate
- 2. Verification of different Theorem of Boolean algebra
- 3 Verification of truth Table of adder circuits
- 4 Verification of truth Table of subtractor circuits
- 5 Verification of truth Table of multiplexer 74150
- 6 Verification of truth Table of demultiplexer 74154
- 7 Write a programme to add two hexadecimal numbers and store the sum into a memory location.
- 8 Write a programme to find a larger of 8 bit number
- 9 Write a programme to find a smallest of 8 bit number
- 10 Write a programme to sort a list of number in ascending and descending order
- 11 Write a programme to multiply two 8 bit numbers
- 12 Write a programme to find 2'ss compliments of 8 bit number
- 13 Write a programme to load the data bytes in some register, mask the higher order bits and display the lower order bits in some memory location
- 14 The block of data is stored in memory location starting from XX55 to XX5A.
Write a programme to transfer the data to the locations XX80 to XX85 in the reverse order. load the data bytes in some register, mask the higher order bits and display the lower order bits in some memory location
- 15 Study of electronics components of textile testing equipments.
- 16 Study of limit switches of stop motion of spinning machines.
- 17 Study of electronics components on winding and weaving machines.

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CURRICULUM FOR UNDERGRADUATE PROGRAMME B.Tech. in Textile Technology

SEMESTER – VII

TTX-701: Entrepreneurship in Textiles [3-0-0-3]

| Course Content Modules | Description | Hr. |
|------------------------|--|-----|
| Module 1 | Entrepreneur, Creativity and innovation, and their Commercialization: What is creativity? What is innovation? Example of creativity that leads to innovation. The commercialization of creative and innovative ideas. Trends in technology development. Entrepreneur: Their Characteristics, Role of an entrepreneur in Industrial development. Entrepreneurship: Entrepreneurship Management And Ownership, Contrast entrepreneurship with management, theories of entrepreneurship (Max Weber, Schumpeter, Hegan, Peter Drucker). Starting A New Business: Business Planning/ Strategic Planning And Strategic Management, Site Selection And Layout. | 6 |
| Module 2 | Establishing New Venture: Opportunities for Entrepreneurship, Meaning and Definition of SSI, Ancillary industry, Importance of SSI, Government policies for SSI. Basic criteria for final selection of a business opportunity, Amount of investment, Nature of technology. Input requirement for setting up SSI, Institutional support to SSI at State & National level. Products Identification in various fields, Causes of industrial disputes, Machinery for settlement of disputes, Idea of risk management. | 8 |
| Module 3 | The Business Plan Development: What is a Business Plan? The Need for a Business Plan, Define the structure of a business plan, Discuss the critical elements of an effective business plan, Preparing a Business Plan: (a) Forecasting Developments and Charting an Action Plan (b) Identifying the Product/Service (c) Evaluating the Business Venture (d) Market Research and Feasibility Study; Differentiate the feasibility study and the business plan, Identify requirements for venture feasibility. | 6 |
| Module 4 | Enterprise Management: Identify mechanisms of and requirements for growth of a venture, Describe effective organizational structures, Discuss the operational challenges for entrepreneurs, Review alternative operations strategies for adapting an organization to changes in the marketplace, Differentiate entrepreneurial and traditional corporate career paths, Organizational structure relevant to small organization, Procedures involved in the management of man, machine, material and methods of production and operation. | 8 |
| Module 5 | Financing Business: Type of capital, importance of financial management in context to small scale industry, Sources of Debt Financing, Sources of Equity Financing, and Financial Controls. | 4 |
| Module 6 | Marketing Products: Creating the Marketing Plan, Pricing for Profit, Creative Advertising and Promotion. Forecasting Market Conditions, Assessing Alternative strategic plans | 4 |
| Module 7 | Promoting Entrepreneurship in Textiles: Scope in Textile Entrepreneurship, Problems in textile entrepreneurship, Govt. schemes in promoting textile entrepreneurs. Overview of Incentives and Subsidies given by governments. Financial Assistance for Small Enterprise: Institutional: (a) Bank Loan (b) Angel Funding (c) Venture Funding (d) Self Employment Schemes of Government of Bihar (e) Government Financial Institutions: Khadi and Village Industries Board (KVIB), Rajiv Gandhi Udyami Mitra Yojana (RUGMY) f) Prime Minister Employment Generation Programme (PMEGP). | 8 |
| Module 8 | Indian Entrepreneurship and Case Studies : Overview and analysis of successful entrepreneurs (such as Jamshedji Tata, G.D. Birla, Aditya Birla, Dirubhai Ambani, Azim Premji etc.), Discussion of Indian business environment. | 4 |

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Text Books:

1. Vasant Desai, "Dynamics of Entrepreneurship Development".
2. Dr.P.C.Shejwalkar, "Entrepreneurship Development".

Recommended Readings:

1. David H. Holt, "Entrepreneurship: New Venture Creation", Prentice Hall of India (2000)
2. Hisrich Peters, "Entrepreneurship".
3. Shrinivas Pandit, "Thought Leaders".
4. Brigitte Berger, "The culture of Entrepreneurship".
5. Kenneth R., Van Voorthis, Entrepreneurship and Small Business Management.
6. B. Gupta and N.P. Srinivasan, Entrepreneurial Development.
7. Dollinger, "Entrepreneurship Strategies and Resources", Pearson Education (2003).

TTX- 702: Theory of Textile Structure [3 1 0 4]

COURSE OBJECTIVE: To enable the students to understand the fundamentals of the yarn and fabric structure, measures of structural parameters and factors influencing them and to provide an elementary idea about tensile, bending, shear and drape behaviour of fabric.

COURSE CONTENT:

Yarn Structure: Introduction, Types of yarn, Basic Geometry of Twisted Yarns: the idealized helical yarn structure, yarn count and twist factors, twist contraction and retraction, Limits of Twist, Relationship among yarn count, twist, and diameter, Packing of fibres in yarn: open and closed packing, Specific volume of yarns, Relationship between twist, and diameter and twist angle,

Fibre Migration: Migration and its importance in yarn mechanics, Ideal migration, Parameters affecting migration, characterization of migration behaviour, mechanism of migration in single and plied structure, techniques of determining the position of fibre in a yarn.

Structural Mechanics: Extension of yarn under small load; Analysis of tensile forces of yarn under stress; Prediction of breakage, Nature of rupture for continuous filament yarn. Extension and breakage of spun yarn: Traditional view and approach by Hearle and El-Sheikh. Bending mechanics of yarns; Theory of yarn mass variation, Theory of plied yarn. Hairiness of staple fiber yarns.

Fabric Geometry: Engineering approach to the analysis of fabric, Ashenhurst theory and its application. Fabric cover and fractional cover. Cover factor in SI unit. GSM and cover factor relationship. Pierce geometrical model, relationship between h, p, c, Crimp interchange, Jammed Structure, Concept of similar cloth. Minimum possible cover factor. Race track geometry, Kemp model, close limit of weaving concept of pierce elastic thread model, Geometry of plain knitted fabric. Knitted fabric tightness factor and GSM. An elementary idea about tensile, tear, bending, shear and drape behavior of fabric. An elementary idea about fabric objective measurement technology.

Blended Yarn: Blended yarn structure, Hamburgers Theory. Structure property relationship of ring, rotor, air-jet, friction spun yarn. Mathematical models and their applications in the study of tensile, bending, shear, compression and buckling of woven fabrics.

Books Recommended:

1. Hearle J W S, Grosberg P and Backer S, "Structural Mechanics of Fibres Yarns and Fabrics", Wiley Inter-science, New York, 1969.

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2. Goswami B C, Martindale J G and Scardino F, "Textured yarn technology, structure and applications", Wiley Interscience Publisher, New york, 1995.
3. Peirce F T and Womersley J R, "Cloth Geometry", reprint, The Textile Institute, Manchester 1978.
4. Hearle J W S, Thwaites J J and Amirbayat, "Mechanics of Flexible Fibre Assemblies", Sijthff and Noordhoff International Publishers BV, Alphen aan den Rijn, Netherlands, 1980.
5. Behera B. K. and Hari P. K., "Woven textile structure: Theory and applications", Woodhead Publishing Series in Textiles: Number 115, Woodhead Publishing Limited and CRC Press LLC, The Textile Institute, 2010.
6. Journals: Textile Research Journal, Princeton, USA and Journal of Textile Institute, Manchester, UK

TTX- 703: Statistical Quality Control in Textiles [3 0 0 3]

COURSE OBJECTIVE: To enable the students to understand about total quality management, different TQM tools, techniques, Quality standards and to solve any problem of real situation probabilistically and able to classify the problem into continuous and discrete.

COURSE CONTENT:

Quality Management: Definition of quality and its importance, different approaches to quality, Description of Deming's fourteen points and Ishikawa's seven tools of quality, utility of statistical method for quality control and improvement, concept of Total Quality Management (TQM), ISO 9000 Standards, Quality Function Deployment (QFD) and Quality Costs.

Basic Approaches to Quality Control: Definition of quality control, tools of quality control: flow chart, brain storming, fish bone diagram, check sheets, bar graph, charts, Pareto analysis, histogram, scatter diagram.

Statistical Quality Control: Statistics as basis of quality control, variation as basis of statistical quality control, Population and sample, descriptive and inductive statistics, discrete and continuous variables, collection and classification of data, frequency distributions, measures of central tendency, measures of dispersion, random variables and probability distribution.

Statistical Analysis for Continuous Function: Population and sampling distribution of mean, statistical estimation theory, point's estimates, concept of single tail and double tail test, Student's t-distribution, confidence limit, statistical decision theory, tests of hypotheses and significances, type I and type II errors, difference between two sample means. Test for single variance, Chi-square test, the F distribution, test for the difference between two variances, confidence limits for variance and ratio of two variances, choice of sample size.

Statistical Analysis for Discrete Function: Application of binomial and Poisson's distribution, normal approximation, test for a single proportion and difference between two proportions, application of chi-square χ^2 distribution, contingency table.

Subjective Tests: Rank correlation, tied rank, coefficient of concordance.

Acceptance Sampling: Basic idea about acceptance sampling, OC curve, producer's risk and customer's risk.

Control Charts: Advantages using quality control charts, random and assignable causes, action and warning limits, \bar{X} , R, \bar{p} , $n\bar{p}$ and \bar{c} chart, Process Capability Ratio (C_p and C_{pk}), concept of 6 sigma process control, brief idea about CUSUM and EWMA chart.

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ANOVA and Regression: Some basic concept of Analysis of Variance, method of least squares, linear regression methodology, correlation and standard error.

Books Recommended:

1. Leaf G A V, "Practical Statistics for the Textile Industry", Part-I and II, The Textile Institute, U.K, 1984 and 1987.
2. Montgomery D C, "Introduction to Statistical Quality Control", Fourth Ed., John Wiley and Sons (Asia) Pte. Ltd., Singapore, 2004.
3. Mehta P V, "Quality Management: An Overview", in „Testing and Quality Management', Vol. 1, Ed. V K Kothari, IAFL Publication, New Delhi, 1999.
4. Spiegel M R and Stephens L J, "Schaum's Outlines Statistics", Third Ed., Tata McGraw Hill, New Delhi, 2000.
5. Walpole R.E. and Myers R.H., "Probability and Statistics for Engineers and Scientists", McMillan Publishing Company, New York, 1985.
6. McLoun M and Militky J, "Statistical data analysis: A practical guide", Woodhead Publishing Ltd. UK, 2011.
7. Hayavadana J, "Statistics for textile and apparel management", Woodhead Publishing Ltd., UK, 2012.

TTX-704: Technical Textiles [3 0 0 3]

Introduction: Definition and scope of "Technical Textiles", Classification, Products, market overview and growth projections of technical textiles. Brief idea about technical fibres, yarns and fabric structures and their relevant properties.

Hi Tech Fibres: Speciality/High performance fibres: Ultra fine, micro fibres, nano fibres, Hollow fibres, Aramid fibres, Carbon fibres, glass fibres.

Fabric finishing, coating and lamination: Brief idea about Flame retardant finishes, Water and soil repellent finishes and antimicrobial finishes; Coating techniques; Classification of Laminates and Types of laminates.

Textile-Reinforced Composite Materials: Introduction, Importance and advantages, Definition of composites, textile composites and textile structural composites, classification of composite materials, Reinforcement materials, Matrix/Resin, General requirements of composite materials. Brief idea about manufacturing processes of Composites, Applications of Composites and Composite Testing.

Filtration textiles: Introduction, Definition of filtration parameters, theory of dust collection and solid liquid separation, filtration requirements, concept of pore size and particle size, role of fiber, fabric construction and finishing treatments.

Automotive Textiles: Introduction, Application of textiles in automobiles, requirement and design for different tyres, airbags and belts, methods of production and properties of textiles used in these applications.

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Geotextiles: Introduction, Geosynthetics and its field, Types of geotextiles, Functions of geotextiles and parameters influencing this functions, Selection of fibres and fabrics for geotextiles and its criteria, Manufacturing of geotextiles, Essential properties of geotextiles, Design and durability of geotextiles, geotextiles testing and evaluation, Applications of geotextiles.

Medical Textiles: Introduction, Fibres used, Natural and synthetic polymers and Textile-based techniques used for medical application, Classification of Medical Textiles, Non- implantable materials, Extracorporeal Devices, Implantable materials, Healthcare and Hygiene products, Safety, Legal and ethical issues involved in the medical textile materials.

Protective Clothing: Brief idea about different type of protective clothing, functional requirement of textiles in defence including ballistic protection materials and parachute cloth, temperature and flame retardant clothing, chemical protective clothing, water proof breathable fabrics. Materials used in bullet proof and cut resistant clothing.

Sports and recreation textiles: Functional requirement of different type of product and their construction.

Sewing threads, cords and ropes: Types, method of production and applications, functional requirements, structure and properties.

Textiles in Agriculture: Material, method of production and areas of application of agro textiles.

Textiles in Packaging: Different types of fabrics used for packaging. Methods of production and properties of textiles used in these applications.

Other uses of technical textiles: Functional requirements and types of textiles used for paper making, agricultural, electronics, power transmission belting, hoses, canvas covers and tarpaulins.

Testing of Technical Textiles: Testing of Filtration Characteristics, Test for geotextiles, Test for protective clothing, Test of various form of medical textiles, Test for textiles for sports application, Test for Composites, Testing for sewing threads, industrial cords etc, Special tests for carpets and nonwoven fabrics.

Books Recommended:

1. Ed. A R Horrocks and S C Anand, "Handbook of Technical Textiles", Woodhead Publication Ltd., Cambridge, 2000.
2. Ed. Sabit Adanaur, "Wellington Sears Handbook of Industrial Textiles", Technomic Publishing Company, Inc., Pennsylvania, USA, 1995.
3. NWM John, "Geo- Textiles".
4. Ed. R W Sarsby, "Geosynthetics in civil engineering", Woodhead Textiles Series No. 57, UK, 2006.
5. Ed. G V Rao and G V S Raju, "Engineering with Geosynthetics", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1990.
6. Ed. M Raheel, "Modern Textile Characterization Methods", Marcel Dekker, Inc., 1996.
7. Mukhopadhyay S K and Partridge J F, "Automotive Textiles", Textile Progress, Vol. 29, No. ½, 1999, Textile Institute, Manchester, UK.
8. Ukponmwan J. O, Mukhopadhyay A. and Chatterjee K. N., "Sewing Threads", Textile Progress, Vol. 30, No. 3/4, 2000, Textile Institute, Manchester, UK.
9. Ed. V. K. Kothari, "Testing and Quality Management", IAFL Publications, New Delhi, 1999.
10. Ed. J Hu, "Fabric Testing", Woodhead Textiles Series No. 76, UK, 2008,

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TTX705: Apparel Marketing and Merchandising [3 0 0 3]

Organization of the Apparel Business: Nature of Apparel, Organization of the Apparel Industry- Business Concepts applied to the Apparel Industry- International Issues- Cooperation in Manufacturing and Distribution.

Marketing: Domestic and International marketing, challenges for international marketing, Development of a product line, design, costing, developing a sample, Product standards and specifications, market research, research process, identification of markets, promotion mix, advertising, sale promotion, promotion budget, coordination between sales and production.

Merchandising: Philosophy, Types of Merchandising, Types of retail merchandise, Merchandising Services, Outsourcing, Merchandise buying and handling process, merchandise pricing, Framework of retailing, Factors affecting retail pricing, Merchandise plans, determining merchandise sources, demand analysis, evaluating merchandise, merchandise forecasting and budgeting, planning inventory levels, development of relationship between the textile and retailing industry, setting up the dealers and merchandisers. **Export:** Export houses, star trading export houses, Export process, Payment Options and procedures. Documentation for Export: Commercial Documents, Regulatory Documents, Certifications, International trade agreements, Export Pricing. **Export Policies:** Government Policies for export, Export Incentives, Role of AEPC in boosting export.

Books Recommended:

1. Kotler Philip, "Marketing Management", Prentice Hall of India, Delhi, 9th Edition, 1998.
2. Bheda R, "Managing Productivity in the apparel Industry", Communications, New Delhi, 2000.
3. Cooklin G, "Introduction to Clothing Manufacture", Om book service, New Delhi, 2002.
4. Mehta P V and Bhardwaj S K, "Managing Quality", New Age International, New Delhi, 2001.
5. Rosenau J A and Wilson D L, "Apparel Merchandising", Amazon, USA, 2001.
6. Belay Seyoum, Export-Import Theory, Practices, and Procedures, Routledge.
7. Koshy Darlie O., Garment Exports - Winning Strategies, PHI Learning, New Delhi latest edition.
8. B. S. Rathore & J. S. Rathore, **Export Marketing**, Himalaya Publishing house, Bombay, 1997.
9. Sapna Pradhan, Retail Merchandising Tata McGraw Hill Education Private Limited 2009
10. Ruth E Clock, **Apparel Manufacturing and Sewn Product Analysis**, Pearson/prentice hall, 2005.

TTXPE-706: Programme Elective-I

| Semester-VII | | |
|---------------------------------|--------------|---|
| TTXPE-706: Programme Elective-I | | |
| 1 | TTX PE1-706A | Advances in Chemical Processing of Textiles |
| 2 | TTX PE1-706B | Advances in Knitting Technology |
| 3 | TTX PE1-706C | Sericulture and Silk Technology |
| 4 | TTX PE1-706D | Fashion Designing |
| 5 | TTX PE1-706E | Geotextiles |

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TTXPE1-706A: Advances in Chemical Processing of Textiles [3 0 0 3]

Combined pre-treatment methods: Basic criteria for combining pre-treatment methods, combined desizing and bleaching, scouring and bleaching, desizing - scouring and bleaching of natural, manmade and blended textiles.

Controlled application techniques: Concept of short liquor processing: advantages and limitations, Short liquor pre-treatment and dyeing of various textiles, Performance assessment of each method.

Fastness determination: Various Fastness criteria of dyed and printed textile. Grading and methods to determine fastness relating to washing, light, perspiration, sublimation and chlorine treatment.

Evaluation of auxiliaries: Importance and method of evaluation of wetting agents, optical brighteners, flame retardants, water repellents and soil release agents.

Reduction in wastage of energy: Development of new continuous and batch machines as well as modified processes.

Reduction in waste water load: Specification of water for use in industries and its discharge to public sewage, bio-degradation of chemicals, Assessment of waste water load, Preventive measures to reduce this load.

Theory of coloration of textiles: Basic approaches for application of colouring materials on various textiles, dye-fibre interaction through physical and chemical forces.

Thermodynamic study of dyeing: Study of vat dye on cotton, acid dye on wool and nylon, Dyeing equilibrium and concept of half time dyeing.

Development in chemical processing: Various developments in pre-treatments, dyeing, printing and finishing of textiles in reference to use of water, right first time dyeing and controlled application techniques.

Process and quality control: Detailed study of chemical processing methods, Control of process parameters, Quality of raw and processed materials, Evaluation of quality of processed textiles after each processing step.

Shade reproduction and repetition: Theory and tri-stimulus values of colour, colour coordinates, Primary, secondary and tertiary colours. Colour yield, Analysis of shade, Reproduction of shade.


Automation in dye house: Automation in dyeing machineries, colour rooms. On- line monitoring of concentration of dye and chemicals.

Books Recommended:

1. Bird C L and Boston W S, "The theory of coloration of textiles", Dyers Company Publication Trust, Bradford, England, 1975.
2. Manivaskaram N, "Treatment of Textile Processing Effluent", Sakthi Publications, Coimbatore, 1995.
3. Peters R H, "Textile Chemistry", Vol- III, Elsevier Scientific Publishing Co., New York, 1975,
4. Smethwurst G, "Basic water Treatment", IBT Publications, Delhi, 1989.
5. Sule A D, "Computer colour analysis", New Age International (P) Ltd., New Delhi, 1997.

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TTX PE1-706B: Advances in Knitting Technology [3 0 0 3]

Introduction to knitting, basic weft-knitted structures, Circular weft knitting machine and mechanism, Flat bed knitting, Warp knitting machines and knitting elements, Double needle bar warp knitting machine, Yarn and its selection for knitting, Knitting of textured yarns, Scope of Lycra yarn in knitting, Scope of jute yarn in knitting, Yarn tension in knitting and its measurement, Quality aspects in knitting, Developments in flat bed weft knitting, Developments in circular bed weft knitting, Developments in warp knitting, Mechanics of loop formation in weft knitting, Mechanics and mechanism of warp loop formation, Production of spacer fabrics in knitting, Scope of knitting in garment manufacturing, Potential benefits of seamless garment knitting, Scope of knitting in the manufacture of medical textiles, Technical textiles – the new product range in knitting, Analysis and testing of knitted fabrics, Concept of green business in knitting and knitwear industries.

Books Recommended:

1. Ray S C, "Fundamentals and advances in knitting Technology", Woodhead publishing limited, 2001.
2. Edited by K F Au, Hong Kong Polytechnic University, Hong Kong, "Advances in knitting technology", Woodhead Publishing Series in Textiles No. 89.
3. Spencer D J, "Knitting Technology", 2nd edition, Pergamon Press, 1989.
4. Ajgaonkar D B, "Knitting Technology", Universal Publishing Corporation, 1998.
5. Booth J E, "Textile Mathematics", Vol. 3, Textile Institute, Manchester, 1977

TTX PE1-706C: SERICULTURE AND SILK TECHNOLOGY

Course Learning Objectives:

Status of sericulture and growth of silk industry in India & abroad

2. Principles of Rearing silk worms, environmental condition of rearing, grainages.
3. Physical and commercial characteristic of cocoon reeling M/c. Technology advancements
4. Silk by products, wet processing, and recent developments in wet processing.

Module-1: Introduction to Sericulture and silk industry, Status of sericulture and silk industry in India and abroad. Mulberry cultivation practices, environmental conditions, types of mulberry, Silk worm rearing, and Environmental conditions for silk worm rearing, various methods. Chawki rearing, Late age silk worm rearing, recent developments in rearing. Seed production & Grainage activities. Diseases & pests & their control.

Module-2: Different types of cocoons, Physical and commercial characteristics, sorting and testing of cocoons. Stifling of cocoons, objects, various methods: open pan, three pan, Conveyor cooking etc. Merits & Demerits of silk reeling, systems of reeling, charka, Cottage basin, multi end filature automatic reeling machine, Re-reeling, recent developments in silk reeling.

Module-3: Silk throwing, Objects, Winding, doubling, Rewinding and twisting, Manufacture of silk yarns for ordinary, Chiffon, Crape, Georgette fabrics. Recent developments in silk throwing machines. Silk weaving preparatory for warp & weft yarns, handloom & power looms special features, modifications required to weave silk fabrics.

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Module-4: Introduction to spun silk industry, Different source of waste, Sequence of operations in spun silk production, end uses of spun silk yarns. Noil yarns. Testing & grading of silk yarns. Chemical processing of silk degumming of silk fabrics.

Module-5: Dyeing of silk fabrics. Printing & finishing of silk fabrics. Recent developments in wet processing of silk fabrics, silk by-products, properties and application. Introduction to non-mulberry silks and their applications.

Course Outcomes: At the end of the course the student will be able to:

1. This course makes the students to understand silk potential in India and abroad.
2. Student can take the projects and research work in Silk Technology field jointly with KSSRDI, central silk board, and State Silk Board.
3. Students to be become entrepreneurs in silk industries like Reeling, Twisting, Silk weaving and by products this course will give valuable outputs.

Textbook/s

1. S R Ullal and M N Narasimhanna, **Hand Book of practical sericulture**, Central Silk Board, India, 1987.
2. Various Authors, **Manuals on Sericulture Vol – I, II**; FAO Publication, 1976
3. T N Sonwalkar, **Hand Book of Silk Technology**, Taylor and Francis, 1993.
4. D. Mahadevappa, V G Halliyal, D G Shankar, Ravindra Bhandiwad, **Mulberry silk Reeling Technology**, Oxford and IBH publishing company Pvt. Ltd, 2000.

Reference Books

1. Compiled by Zhejiang Silk Engineering Institute, Silk Weaving, Science Pub Inc, 2002.

TTXPE1-706D: FASHION DESIGNING [3 0 0 3]

COURSE OBJECTIVE: To impart knowledge on human body measurements, creating pattern, and to develop commercial pattern with design aspect by manipulating the basic pattern and to apply historic costume knowledge to modern fashion design construction.

COURSE CONTENT:

Introduction to Fashion: Introduction to fashion and apparel design. Origin of fashion, concept, analysis, trends and creations, style-fad-trends. Fashion of different eras, French and Greek revolutions, fashion promotion.

Fashion theories: trickle down, trickle across and bottom up theory, Factors affecting fashion.

Elements of design: Basic concept of design, elements of art, Definition of line, shape, form, size, space, texture and colour. Structural and decorative dress designing, creating varieties through designs.

Principles of Design: Definition Harmony, Proportion, Balance, Rhythm, Emphasis.

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Anatomy for designers: Human Proportion and figure construction. Methods of determining individual proportions.

Psychology of Clothes: First impression, role of socio- psychological and economical aspects, Meaning and application of clothing psychology.

Fashion promotion, Display of fashion materials: definition and Importance, source technique and window display, classic fashion shows. Important fashion centers of the world and India.

Cultural Knowledge: Societal sense and aesthetics, Indian aesthetics, western medieval aesthetics, Modern and Postmodern aesthetics

Computer aided designing: Fashion sketching, colour matching and computer graphics.

Folios: Creative, Dress, designer.

Books Recommended:

1. Erwin Model, "Clothing for Moderns", Mac Millan Publications, New York, 1994.
2. Tate and Sharon Lee, "Inside fashion design", Harper Publication Inc., UK, 1976.
3. Mary Kefgen, "Individuality in Clothing – Selection and Personal Appearance", Mac Millan Publications, New York, 1981.
4. Mike P, Grover and E Mory, "Computer Aided Design and Manufacturing", Prentice Hall of India Ltd. Delhi, 1993.
5. Bhattacharya Anand, "Garment Technology", NCUTE, IIT, Delhi, 2003.

TTXPE1-706E: Geotextiles [3 0 0 3]

COURSE OBJECTIVE: To impart knowledge regarding Geotextiles, selection of right type of fibre, yarn and fabric for the end-use application of geotextiles. To teach about the pre-requisite performance properties of textiles to be used as Geotextiles.

COURSE CONTENT:


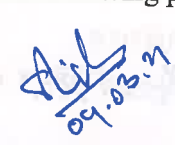
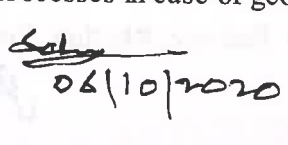
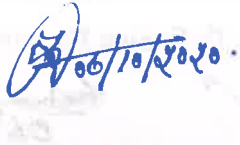

Introduction: Usefulness of geotextiles, Classifications, Essential properties of geotextiles. Understanding soil characteristics, properties affecting engineering behaviour of soil, identification, classifications, permeability, effective stress and pore water pressure, seepage of soils and design of filter criteria.

Geosynthetics types, functions and application areas of geotextiles, fibres and fabric selection criteria for geotextiles applications.

Natural Fibre Geotextiles: Development of natural materials as geotextiles, Natural fibres Applications for natural geotextiles.

Engineering properties of geotextiles, Performance of natural fibre geotextiles for soil strengthening.

Mechanics of reinforcement, filtration and drainage by geotextiles and functions, material construction and manufacturing processes in case of geotextiles.

Evaluation of geotextiles with and without soil, evaluation of filtration and drainage functions, reinforcement, creep, moisture barrier characteristics, durability and ageing.

Application of Geotextiles: Geotextiles and reinforced soil structures: Retaining walls, embankment, foundation. Geotextiles in roads and railways: separation, draining and filtering.

Geotextiles in environmental control: covers and liners, landslides, and erosion control.

Books Recommended:

Text Books:

1. S K Shukla, YinJian-hua, "Fundamentals of Geosynthetic Engineering", Taylor and Francis, UK, 2006.
2. Raj P Purushothama, "Soil Mechanics and Foundation Engineering", Pearson, India, 2007
3. Ed. A R Horrocks and S C Anand "*Handbook of Technical Textiles*", Woodhead Publication Ltd., Cambridge, 2000.
4. Ed. G V Rao and G V S Raju, "*Engineering with Geosynthetics*", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1990.
5. R. W. Sarsby, "*Geosynthetics in Civil Engineering*", Woodhead Publishing Series in Textiles No. 57, UK, 2011.

Reference Books:

1. S. Adanur, Wellington Sears "*Handbook of Industrial Textiles*", 6th edn, New York, Technomic, 1995.
2. John N W M, "*Geotextiles*", Blakie, Chapman and Hall, New York, USA, 1987.

TTX-707: Industrial Practical Training (during Summer Vacation for 4 weeks after 6th Semester) / Internship

Note: Students will carry out Industrial Practical Training / Internship as a part of curriculum as per university guidelines.

TTX-708: Project –I (Phase-I)

Note: Students are expected to complete a project in groups or alone as deemed fit by the faculty and department. They should work under supervision of Faculty member/s of department, or in collaboration with other departments, or preferably with Industry. The project should demonstrate application of the fundamentals learnt during the course of study and should also be innovative.

Students will carry out minor project during 7th semester as a part of curriculum as per university guidelines.

Technical Seminar

Note: Technical Seminar as per university guidelines.

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SEMESTER - VIII

TTX- 801: Mechanics of Textile Processes [3 1 0 4]

Processes Opening and cleaning: Role of friction in textile processing, Principles of bale management. Elementary ideas of tuft opening; dust and foreign matter separation. Forces acting on fibres during opening and cleaning, analysis of fibre compactness and blending in blowroom. Analysis of piano feed regulating motion. Evaluation of Blow Room performance: Mechanisms of contaminant removal.

Carding: Carding process, Mechanics of fibre entanglement and hook formation during carding. Theories of carding. Transfer mechanism of fibres, Cylinder load and transfer efficiency, Design of high production card, fibre shedding and card wire geometry, Fibre configuration and estimation of degree of disorder, Effect of different parameters on hook formation, evaluation of carding performance.

Draw Frame: Role of draw frame on yarn quality and process parameters, Hook removal in roller drafting, Theories of roller drafting, Drafting Force and its impact on drawing quality. Evaluation of draw frame performance.

Combing: Theoretical aspects of combing, Fibre fractionation in combing. Parameters affecting combing performance and quality, evaluation of combing performance.

Speed frame: Mechanism of package building and twisting in speed frame. Differential Gearing and Designing of cone drums in Speed Frame, Evaluation of roving frame performance.

Ring Spinning: Drives on modern ring frames. Yarn tension in ring spinning. Balloon theory in spinning.

Rotor Spinning: Spinning tension in rotor spinning, spinning geometry, twist flow in rotor spinning, end breaks. Mechanism of drafting and yarn formation in high speed spinning systems.

Preparatory for Weaving: Mechanics of package building during winding, Winding rate, relationship between bobbin diameter and winding rate, relationship between bobbin diameter and spindle speed, Performance of sensors, Splicing and yarn tension during unwinding, Yarn tension controlling devices, Cone angle and traverse in sectional warping, Stretch control in sizing, Weft package/ Pirn sloughing and its control.

Weaving: Kinematics of sley and heald motion, Shed depth and interference factor, Shedding cam design, Mechanism of picking, Shuttle retardation and its importance, Causes of pick variation, Cloth fell equation, Bumping condition.

Books recommended:

1. Booth J E, "Textile Mathematics" vol. 3 1st ed, The Textile Institute, Manchester 1975.
2. Chattopadhyay R, Advances in Technology of Yarn Production, 1st Ed, NCUTE, IIT Delhi 2002.
3. Winding, BTRA Monograph series, The Bombay Textile Research Association, Bombay, 1981.
4. Warping and Sizing, BTRA Monograph Series, The Bombay Textile Research Association, Bombay, 1981.
5. Marks R and Robinson A T C, Principle of Weaving, The Textile Institute, Manchester, 1986.

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TTX-802: Textile Management [3 0 0 3]

Introduction: Objects of Textile Management. The textile industry of India: Past & its evolution to the present day. A Brief Profile of Indian Textile Industry. Technocracy and Management. Industry as a Social System. Indian Textile Industry and its Importance. The structure of the Indian textile industry. Primary Principles of Textile Industry. Management Problems of Indian Textile Industry and their remedies.

Principle and Function of Management: Planning, Organizing, Staffing, Leading, Directing and Control. Scientific Management.

Financial Management in Textiles: Sources of funds for textile industry, Introduction to working capital, Balance sheet, Profit & Loss Account, Budget, Budgeting, Auditing. Analysis & interpretation of Balance sheet, Ratio analysis, fund-flow statement. pay-back period. Reconciliation of financial & cost accounts. Elements of Cost for Textile Industry. Essential factors in Textile Costing. Profit planning and cost control for textile industry. Control of Wastage of the material.

Marketing management in Textiles: Concept, marketing function, pricing practice, advertising & sales promotion, market research. Various Textile Industry marketing practices in fibres, yarns, grey fabrics, finished fabrics and garments. Retailing in textiles vis-à-vis consumer trend and behaviour.

Plant Location and Layout: Plant location and site selection, Factors affecting location, Plant layout, Objectives of Plant Layout, Principles of layouts, Different types of layouts and their advantages & disadvantages, Plant layout procedure, Factors influencing layouts. Effect of automation on plant layout, advantages of a good layout, symptoms of bad layout. Layout plan for spinning, weaving and process house, Knitting and Composite mills. Air conditioning and humidification systems used in Textile Mills.

Machine Balancing: Calculation for different machines required for carded and combed yarns, weaving, preparatory and chemical processing.

Labour Balancing: Labour allocation in different departments of a textile mill. Workload standards for card tenters, Speed frame and Ring frame tenters, Winders, Weavers etc. in the terms of tripartite agreement and Labour Laws. Nepotism. Efficiency of Labour. Factors affecting the efficiency of Labour. **Industry laws** like labour laws, factory acts and its study. Working environment.

Maintenance Management: Maintenance systems, Maintenance cost, Maintenance schedules, Maintenance scheduling, down time management, down time analysis, Safety provisions in textile industry.

Materials Handling: Introduction, Definition and functions, Principles of materials handling, Material handling methods, engineering and economic factors, relationship to plant layout, Selection and types of material handling equipments, Study of different types of equipments used for materials handling in spinning, weaving, knitting mills.

Export-Import: Export-Import policies & Documentations for Textile industry.

Textile industry scenario, Textile Industry growth, problems & government policy, Textile policy 2000 Govt. of India, ISO accreditation, Make in India concept, start up policy of government its utilization for textile industry. The challenging future of the Indian textile industry and trade.

Books Recommended:

1. Kulkarni M. G, "Textile Manufacturing", Current literature Co. Pvt. Ltd., Malhotra House, Mumbai.
2. Dudeja V D, "Management of Textile Industry", Textile Trade Press, Ahmedabad, 1981.
3. Ormerod A, "Textile Project Management", The Textile Institute, Manchester, UK, 1992.
4. Varma D.S, "Textile Mill Planning & Organization", Metropolitan Book Co. Ltd. Publ, Delhi, 1964
5. Benjamin, "Practical Cotton Mills management".
6. Prasanna Chandra, "Project Planning, Analysis, Selection, Implementation and Review", Tata McGraw Hill Publishing Co. Ltd.
7. Tirupathi P C and Reddy P N, "Principles of Management" MCgraw Hill Education, 2012.

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- 8 C. B. Mamoria, "Personnel Management" Himalaya Publication House.
9. Kerzner H, "Project Management" 1st Ed., CBS Publishers and distributors, Delhi, 1987.
10. Khan M Y and Jain P K, "Cost Accounting and Financial Management", Tata McGrawhill, Delhi, 2008.
11. Verma H. K., "Costing in Cotton Textile Industry".
12. Bhavé P V, Srinivasan V, Cost Accounting in Textile Mills, ATIRA, Ahmedabad.
13. Kotler P, "Marketing Management", Prentice Hall of India, Delhi, 9th Edition, 2002.
14. Talukdar M K, Sriramulu P K and Ajaokar D B, "Weaving – Machine, Mechanism and Management", Mahajan Publisher Private Ltd., Ahmedabad, India, 1998.
15. Higgins, "Handbook of Maintenance Management", Prentice Hall New York, 1999.
16. Purushottam B, Work Quality Management in Textile Industry, Woodhead Publishing Ltd, 2013.
17. Darab B. Unwalla, "Textile Technocracy".
18. A. S. Chauhan, Management of Systems.
19. Belay Seyoum, Export-Import Theory, Practices, and Procedures, Routledge.
20. Koshy Darlie O, Garment Exports - Winning Strategies, PHI Learning, New Delhi latest edition.
21. Barry Band Joel R.E. "Retail Management" Metnam Publishing Co., New York, 1989.

TTXPE-803: Programme Elective-II

| Semester-VIII | | |
|----------------------------------|--------------|--|
| TTXPE-803: Programme Elective-II | | |
| 1 | TTX PE2-803A | Advancement of Nonwoven Technology |
| 2 | TTX PE2-803B | Textile Reinforced Composites |
| 3 | TTX PE2-803C | High Performance and Specialty Fibres |
| 4 | TTX PE2-803D | Waste Management and Pollution Control in Textiles |
| 5 | TTX PE2-803E | Science of Clothing Comfort |

TTXPE2-803A: Advancement of Nonwoven Technology [3 0 0 3]

Raw materials: Natural and Synthetic fibres, Bonding agents, Types of bonding agents, Basic structure of bonding agent formulation, Characteristic properties of polymer dispersions, Adhesive fibres, Soluble fibres.

Web formation techniques: Fibre preparation, Dry laying, wet laying, Spunlaying, Melt blowing, SM, SMS fabrics.

Mechanical Bonding: Developments in needle punching technology, Factors affecting the tensile and bulk properties of needle punched fabrics, Spunlacing technology, factors affecting the properties of spunlaced fabric, Stitch bonding techniques.

Chemical Bonding: Adhesive Bonding, Methods of bonding agent application, Cohesive bonding, Drying by convection, conduction, radiation, infra red drier and high frequency driers.

Thermal bonding: Thermal bonding techniques, Area bonding, Point bonding and their properties.

Spunbonding and Meltblowing: Techniques, structure and properties of fabrics.

Finishing of nonwoven fabrics: Shrinkage, Calendaring, Pressing, Splitting, Grinding Washing, Dyeing, Printing, Softening, Coating and Laminating.

Applications: Medical and Hygiene, Apparel, Household and Home Textiles, Geotextiles, Filtration, automotive textiles, agriculture, leather industry

Testing of Nonwoven fabrics: Standards and methods of testing nonwoven fabrics

Books Recommended:

1. Lunenschloss J and Albrecht W, "Non-Woven Bonded Fabric", Ellis and Horwood Ltd., UK, 1985.

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2. Albrecht W, Fuchs H and Kittelmann, "Nonwoven Fabrics", Wiley-VCH Weinheim, 2003.
3. Mrstina V and Fejgal F, "Needle punching textile technology", Elsevier, 1990.
4. Krcma Radco, "Manual of nonwovens", Textile Trade Press, UK, 1971.
5. Gulrajani M L, "Book of Papers of International Conference on Nonwovens", The Textile Institute, UK, 1992.

TTXPE2-803B: Textile Reinforced Composites [3-0-0-3]

COURSE OBJECTIVE: To enable the students to learn about Reinforcements, matrices used for the composites, manufacturing process and application of composites

COURSE CONTENT:

Introduction: Definition of composites, textile composites and textile structural composites; Classification of composites, Textile materials for composites, Matrix and Reinforcements, Classification of Textile Reinforced Structures based on axis and dimension; non-axial, mono-axial, biaxial, triaxial and multiaxial structures, UD, 2D,3D structures, Role of interfaces in composites, Critical fibre length, Rule of mixtures.

Basic Constituents Materials In Composites: Types and Properties of reinforcements, Matrix Materials. Interface - mechanisms and theories. Prepregs: Introduction - Manufacturing techniques - property requirements, Compaction. Textile Preforms- weaving, knitting and braiding. Multi-axial multiply non-crimp fabrics.

Techniques for Manufacture of Composites: Introduction - manufacturing processes – open mould process, closed mould process and continuous process. Metal matrix composites, Ceramic matrix composites - types-importance and processing.

Mechanical Properties of Textile Composites: Mechanism of stress transfer, Toughness and Thermal behavior of composites, various techniques of composites design and fabrication, Composites for structural engineering; Basic design and analysis of textile structural composites. Testing of Reinforced Plastics – Tensile, flexural, Impact, Interlaminar shear and compression properties.

Application of Polymer Composites: Applications of Textile structural composites, Composites application in aerospace, construction industry, and sports products, Electrical, Polymer composite for biomedical and vibration damping.

Environmental effects in Composites, Green composites; Synthesis and Properties of Nanocomposites.

Books Recommended:

1. Reinhart T J, "Introduction to Composites", in Engineering Materials Handbook, Vol. 1, Composites, ASM International, 1993.
2. Leonard Hollaway, "*Handbook of Polymer Composites for Engineering*", Woodhead Publishing limited, 2007
3. Derek Hull, "*An introduction to composite materials*", Cambridge University press.
4. Long A C, "*Design and Manufacture of Textile Composites*, Woodhead Publishing limited, U.K, 2005.

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5. Chau T, and Ko F K, eds., "Textile Structural Composites", Elsevier, 1989.
6. Adanaur S, "Textile Structural Composites", in Handbbook of Industrial Textiles. ed. S Adanaur, Technomic Publishing Co., USA, 231-274.
7. Russell Diefendorf, "Carbon/Graphite Fibers", in Engineering Materials Handbook, Vol. 1, Composites, ASM International, 1993.
8. Bogdanocivh A and Pastore C, "Mechanics of Textile and Laminated Composites", Chapman & Hall Due, 1997.
9. Hearle J W S , "High Performance Fibres Composites and Engineering Textile Structures", Journal of the Textile Institute, Special issues, The Textile Institute, 1990
10. Rakesh K. Gupta, Elliot Kennel and Kwang-Jea Kim, "Polymer Nanocomposites Handbook", CRC Press Taylor & Francis, New York, 2010
11. White J R, and De S K, "Short Fiber-Polymer Composites", Wood head Publishing limited, 1996
12. George Lubin, "Handbook of Fiberglass and Advanced Plastics Composites", Van Nostrand Reinhold Company, New York, 1969.

TTXPE2-803C: High Performance and Specialty Fibres [3 0 0 3]

COURSE OBJECTIVE: To enable the students to learn about various high performance fibres which are used for technical textiles, their chemical structure, properties and production processes.

COURSE CONTENT:

Introduction: Basic concept of high performance and specialty fibres; Definition, classification and structural requirements of high performance and specialty fibres, Growth Patterns - Major attributes and advantages – Product development areas.

Aramid And Aromatic Polyesters: Introduction, Fibres formation, Fibre & structure properties and performance, Application. Vectran (Melt spun wholly aromatic polyester fibre): Fibre production, properties and application.

Carbon Fibres: Introduction, Classification and Types, Manufacture of carbon fibres from Polyacrylonitrile, viscose rayon and pitch precursors based, fibres properties and applications.

Glass Fibres: Introduction, Types and Composition, Manufactures Processes, Fibre finish, Fibre structures, Fibre properties and Applications.

Optical Fibres: Light Propagation, Fibre manufacture, properties and Applications.

Ceramic Fibres: Classification and fibre formation, composition and structure, properties and application.

Elastomeric Fibres: Manufacturing Processes, Fiber Properties, Application and future trends.

Polyethylene Fibres: Introduction, Concept of gel spinning, Manufacturing Processes UHMPE fibres, fibres characteristics, Fibre Properties, Application and future trends.

Metallic Compound Fibres: Aluminium oxide fibres and Lead Fibres, Preparation and processes, Fibre structure, properties, Applications.

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PBO (Polyphenylene benzobisoxazole) fibres: Fibre production, properties and application.

PEEK Fibres: Fibre production, properties and application.

Lyocell fibre: Introduction, Fibre production, properties and application.

Speciality Fibres: Highly aesthetic fibres – evolution, specialized non circular cross section - blending, mixed and conjugate spinning- super fine fibres. Spinning of ultrafine fibres. Spinning of continuous filament type- direct spinning, conjugate spinning with alternately arranged polymers. Random type spinning-melt blowing, and flash spinning. Bicomponent fibres and hybrid fibres, Superabsorbent polymers and fibres.

Books Recommended:

1. T. Hongu, "New fibers", Woodhead Publishing, Cambridge, England, 1997.
2. T. Hongu, "New millennium fibers", Woodhead Publishing, Cambridge, England, 2005.
2. Hearle J W S, "High Performance fibres", Woodhead Publishing, Cambridge, England, 2001
3. Nakajima T, "Advanced fiber spinning Technology", Woodhead Publishing, UK, 1996.
4. Mukhopadhyay S K, "High Performance Fibres", Textile Progress Vol.25, Textile Institute, England, 1993.
5. Menachan Lewis and Jack Preston, "High Technology Fibres", Part A (1988), Part B (1993), Part D (1996), Marcel Dekkar Inc, New York.
6. Lewis. E .M. Pearce, J .Preston, "Hand book of fibre science and technology" Vol-4, Marcel Dekkar, New York 1989.
7. Donnet J. B. Bansol R .C, Carbon fibres , Marcel Dekkar, New York 1990.

TTXPE2-803D: Waste Management and Pollution Control in Textiles [3 0 0 3]

COURSE OBJECTIVE: To describe the process parameters and control measures in each stage of yarn and fabric manufacturing process to produce quality product at reduced cost of production, create the awareness to control the effluents due to wet processing and to provide know ledge in different methods of treating the effluents from wet processing.

COURSE CONTENT:

Spinning waste: Its generation, classification, its re-use and management, Soft waste, hard waste, different types of pollution in spinning industry.

Weaving waste: Its generation, different types, its re-use and management. Different types of pollution in weaving industry. Its impact on human being.

Textile waste water characteristics: Chemical nature of discharged bath after each process, contribution of chemicals to the waste water load. Concept of biological and chemical oxygen demand.

Textile waste water problem: Effect of waste-water on sewage and land.

Chemical used in textile industry: Toxicity of various chemicals, viz. alkalis, oxidizing and reducing agents, acids, carriers, resins and bleaching agents etc, Role of each chemical on waste water load.

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Treatment of textile effluents: Primary, secondary and tertiary treatments in ETP. Colour removal, various chemicals used in ETP.

Effluent Testing: Testing of BOD, COD, TOC and interpretation of results.

Books Recommended:

1. Asolekar S, "Environmental problems in chemical processing of textiles" 1st Ed. NCUTE, Department of Textile Technology, IIT-Delhi, 2000.
2. Padma Vankar, "Textile Effluents" 1st Ed. NCUTE, Department of Textile Technology, IIT Delhi, 2002.
3. Edmund B, "The Treatment of Industrial Wastes" 2nd Ed. McGraw-Hill Kogakusha, New Delhi, 1976
4. Peavy, Rowe and Tchobanoglous, "Environmental Engineering" 2nd Ed. McGraw-Hill, Singapore, 1985.
5. Vaidya A A, "Production of Synthetic fibres", Prentice-Hall India Ltd, New Delhi, 1988.

TTXPE2-803E: Science of Clothing Comfort

COURSE OBJECTIVE: To enable the students to learn about important characteristics of the fabric responsible for its comfort properties and different phenomena which take place in the fabric related to the comfort properties of the fabric.

COURSE CONTENT:

Comfort – Introduction, types and definition; human clothing system; Psychology and comfort: perception of comfort, psychological research techniques, comfort sensory descriptors, psychophysics, scales of measurement, scales to measure direct responses, wear trial technique, comfort perception and preferences, Application of science of clothing comfort.

Thermo physiological comfort: clothing and thermal comfort; Thermal comfort - thermoregulatory mechanisms of the human body, two-node model of thermal regulation, dynamic thermal interaction between the body and clothing, role of clothing on thermal regulations. thermal conductivity of fibrous materials,

Heat and moisture transfer: wearer's temperature regulations, effect of physical properties of fibres, behavior of different types of fabrics, transfer of liquid moisture and vapour transfer through fibrous materials, dynamic heat and moisture transfer in fabric, moisture exchange between fiber and air, boundary conditions, method of solution, moisture sorption of wool fabrics, behavior of fabrics made from different fibres, impact of microclimate.

Psychological comfort - Transient temperature and moisture sensations, coolness to the touch, warmth, dampness, clamminess and moisture buffering during exercise, environmental buffering; Neurophysiological Processes of Comfort: Neurophysiologic basis of sensory perceptions, Perceptions of sensations related to mechanical, thermal and moisture stimuli.

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Tactile Aspects of Comfort: Fabric mechanical properties and tactile- pressure sensations like fabric prickliness, itchiness, stiffness, softness, smoothness, roughness and scratchiness, fabric hand value, clothing comfort aspects in relations with garment size and fit.

Predictability of clothing comfort performance: prediction of fabric hand, prediction of clothing thermophysiological comfort, predictability of sensory comfort, predictability of subjective preferences; application of clothing comfort research.

Current trends and new developments in the study of clothing: new materials and finishes; new techniques and new concepts.

Books Recommended:

1. Apurba Das and Alagirusamy R, "Science in Clothing Comfort", Wood head Publishing India Limited, New Delhi, 2010.
2. Lyman Fourt and Norman R.S. Hollies, "Clothing Comfort and Function" Marcel Dekker, INC., NEW YORK 1971
3. Li Y, "The Science of Clothing Comfort", Textile Progress, Vol.31, No.1/2, The Textile Institute, Manchester
4. Guowen Song, "Improving Comfort in Clothing", Woodhead Publishing Limited, Cambridge, 2011.
5. Zhang Wei Yuan, "Clothing Comfort and Function", China Textile Press ,2011
6. Kothari, V K, "Testing and Quality Management ", CBS Book Publishers, New Delhi, 2000.
7. Saville B P, "Physical Testing of Textiles," The Textile Institute, Woodhead publication limited, Cambridge, 1999,
8. Hassan M. Behery, "Effect of Mechanical and Physical Properties on Fabric Hand", Wood head Publishing Ltd.

TTXPE-804: Programme Elective-III

| Semester-VIII | | |
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| TTXPE-804: Programme Elective-III | | |
| 1 | TTX PE3-804A | Application of CAD/ CAM and CCM in Textiles |
| 2 | TTX PE3-804B | Functional and Smart Textiles |
| 3 | TTX PE3-804C | Application of Nanotechnology in textiles |
| 4 | TTX PE3-804D | Green Processing of Textiles |
| 5 | TTX PE3-804E | Project Formulation and Appraisal in Textile Sector |

TTXPE3-804A: Application of CAD/ CAM and CCM in Textiles

COURSE OBJECTIVE: To make the students familiar with software which are used to create weave and print designs, computer integrated weaving machines, Computer aided production planning in Textile and Garment Manufacturing and to build students confidence in controlling the computer integrated machines

COURSE CONTENT:

Introduction to Computer Systems: Basic Concepts and application of CAD / CAM and CCM in Textiles. Computer Software-operating- Programming Languages-general Software Features and trends.

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Data base management system: Data processing Database Management system fundamentals-data base design concepts. Introduction to Computer Algorithms and program logics

Computerized Knitting & Weaving: Concepts of CAD/CAM in Fabric Manufacturing. Features of Electronic Dobby & Electronic Jacquards. Electronic Dobby -- Working principle - Machine parameters - Microelectronics Design features - Drive arrangement - Systems for pattern data transfer - Design development.

Electronic Jacquards: Electronic Jacquard Working principle - Constructional variants - Various electronic jacquard systems - Selection system - Pattern data - Transfer and management.

Basics of Weaving Design Software: Algorithms of computerized Drafting, Lifting & Weft insertion Plan. Automatic Weft Colour selection. Computer Aided Fabric Design System, Introduction to the operation of design software for woven, knitted and printed textiles - Exploration of basic structure, color and textural effects using design software. Development of Jacquard designs - Process of drafting - sketch design - Development of figures - Composition of design - Geometric ornamentation - Arrangement of figures - Weave simulation. Colour matching through computer colour matching (CCM) system.

Garment Manufacturing: Apparel CAD system, CAM in Garment Manufacturing, Hardware and Software requirement. Complete pattern design system in preparation for grading, marker making and pattern manipulation. Computerized production pattern making - Hardware, software and system programming to produce a sample production pattern. Computer aided manipulation of pattern pieces to create individual styles. Application of computer colour matching (CCM) system in Garment Manufacturing.

Computerized Production Planning and process control: Computer aided production planning in Textile and Garment Manufacturing: Application of Computer for purchase, inventory control and sales, computerized quality control and production control. Introduction to finite scheduling concept and fast react software. Creating product and order planning, concept of ERP, CIM, CAPP etc. updating. Elimination of late deliveries - General set up, Application of DBMS in Apparel Merchandising process. Control mechanisms - critical path and time tables.

Computerized Quality Control: Introduction to image processing and imaging system-Fabric defect identification using image processing-Artificial neural networks - Data acquisition and fault classification. Yarn Scanner. Yarn Fault Identification

CAD/CAM/CCM applications in fashion field - garment designing, weaving, knitting and embroidery, textile dyeing and printing.

Recommended Books:

1. Stephen Gray "CAD / CAM in clothing and Textiles ", Gower Publishing Limited, 1998,
2. Winfred Aldrich, CAD in Clothing & Textiles, Blackwell Science, 1994.
3. Mikell P Groover & Mory W Zimmers. Jr, "CAD/CAM Computer Aided Design & Manufacturing", Pearson Education Pub. 2000.
4. Radhakrishnan R, Subramanyan S, Raju V, "CAD/CAM/CIM" New Age International Pub.
5. Jacob Solinger, "Apparel Manufacturing Handbooks", Van no strand and Reinhold Company, 1980.
6. Nayak R K and Rajiv Padhye, "Garment Manufacturing Technology", Woodhead Publishing 2015.
7. Alexis Leon and Mathews Leon, "Fundamentals of Information Technology" Leon press, 1999
8. "Computers in the world of textiles ", The textile Institute ISBN: 0-0900739-69X. Compilation of papers presented at the Annual world conference Sep 26 -29, 1984 Hongkong,
9. CAD for Fashion Design by Renee Weiss Chase, Prentice hall Pub.
10. Fashion Design on Computers By M. Kathleen Colursy, Prentice Hall.2004.
11. Patric Taylor, "Computer in the Fashion Technology", Om Book Service, 1997.

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TTXPE3-804B: Functional and Smart Textiles [3 0 0 3]

COURSE OBJECTIVE: To impart knowledge on the functional properties and applications of interactive textiles, PCMs, intelligent systems, responsive textiles and wearable electronics and to impart knowledge on the types and applications of smart textiles.

COURSE OUTCOMES: On completion of this course, Students will be able to

1. Learn the various aspects of smart and intelligent textiles.
2. Gain knowledge about the incorporation of smart elements in textile substrates.
3. Will be able to take up project and research work in emerging areas smart textile.

COURSE CONTENT:

Smart technology for textiles and clothing: Introduction, Definition and Classification of Functional and Smart textiles; development of smart technology for textiles and clothing – sensors/actuators, for signal transmission, processing and controls. Smart and Intelligent Textiles: Passive and Active functionality, Research and development in new products-niche application.

Electrically active polymer materials: Polymer gel, application of non-ionic polymer gel and elastomers for artificial muscles.

Heat storage and thermo-regulated textiles: Basic concepts of heat storage materials, Phase Change Materials (PCM), PCMs in textiles, Intelligent textiles with PCMs, Mode of PCM performance in clothing Manufacture of heat-storage and thermo-regulated textiles and clothing, Properties of heat-storage and thermo-regulated textiles and clothing, Application, and future trends

Polymeric membranes: PVA and PAAc network, Polymers prepared by plasma and radiation grafting.

Fiber Bragg gratings: Fabrication of grating, Mechanical properties of FBG, Optical response of FBG sensors under various deformations, Applications, Smart textile composites integrated with fibre optic sensors.

Stimuli-responsive textiles: Fundamental concepts, Current status, Textiles working on mechanical stimulus- permeation stimulus-optical stimulus, Application, Future trends.

Hollow fibre membranes for gas/fluid separation: Importance, Historical over view, Theories of permeation process, Development of phase inversion and hollow fibre membranes, Future trends.

Embroidery and smart textiles: Adaptive and responsive textile structures (ARTS), Wearable motherboard: Manufacture, Properties and Applications

Adaptive Responsive Textile Structures (ARTS): Textiles in computing, energy harvesting, Concept of wearable electronics, application, Future trends.

Wearable technology: Wearable motherboard: Manufacture, Properties and Applications; Electronic Textiles: wearable computers, flexible electronics. Wearable technology for snow clothing.

Bio-processing for smart textiles and clothing: treatment of wool with enzymes, treatment of cotton with enzymes, enzymatic modification of synthetic fibres, spider silk, intelligent fibres.

Tailor-made intelligent polymers for biomedical applications: Fundamental aspects of shape memory materials, Concept of biodegradable shape memory polymers, degradable thermoplastic elastomers having shape memory properties, degradable polymer networks having shape memory properties.

Textile scaffolds in tissue engineering: Ideal scaffold system, Scaffold materials, textile scaffolds - Micro structural aspects, Mechanical aspects.

Smart medical textiles: Smart wound care materials, Textile based drug release systems, Textile based sensors for health care.

Conductive textiles as flexible substrates: Method of manufacturing conductive textiles, Techno-economic aspects of various technologies, Application of conductive textiles as EM shielding screen- Clean room curtain and flooring- Wearable antenna- Embedded electrodes in soft ground improvement.

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Testing of smart textiles: Role of smart textile testing, Testing of shape memory effect Fabrics- phase change materials- Self cleaning materials-Electronic responsiveness-EM shielding, Future trends.

Books Recommended:

1. X. Tao, Xiaoming Tao ,” Smart Fibres, Fabrics and Clothing”, Woodhead publishing Lt., England. 2001.
2. Jinlian Hu , “Adaptive and Function polymers, Textiles and Their Applications”, Imperial college press (2011).
3. Tao Xiaoming, “Wearable Electronics And Photonics”, Woodhead publishing limited (2005).
4. H. Mattila, H. Mattila, “ Intelligent Textiles and Clothing”, CRC press (2006).
5. Vincenzini, “Smart Textiles”, Trans tech pub ltd (2009).
6. Van Langenhove L, “Smart textiles for medicine and health care: Materials, Systems and Applications”, The Textile Institute and Woodhead Publishing, 2007.
7. Mattila H R, “Intelligent textiles and clothing”, Woodhead Publishing Limited, Cambridge, England. 2006.
8. Tatsuya Hongu, and Glyn O Phillips, “New fibres” Woodhead Publishing Limited, Cambridge 2004.
9. Fabric Testing: Edt. Jinlian Hu, The Textile Institute and Woodhead Publishing, 2008.

TTXPE3-804C: Application of Nanotechnology in textiles [3 0 0 3]

Introduction: Introduction and Definition of Nanoscience and Nanotechnology; Size and surface dependence of their physical and chemical properties, Importance of Nanoscale Science and Technology; Introduction to nanomaterial; Introduction to nanomaterial: Definition, Concept, Requirement, Application of nanotechnology in diverse fields.

Production of Nanomaterials: Principle and production of nanomaterials, nanoparticles, nanospheres etc, Bottom-up and top-down approaches for production of nanomaterials/Nanoparticles, Electrospinning technique.

Nanoparticles and potential applications in Textiles: Carbon Black nanoparticle, carbon nanotubes (CNT), classification and, application, Formulations of Titanium Nano particles, Metal Nano Particle, Clay Nano Particle and study of their properties.

Nanofibers for Textile Applications: Production of nanofibers, Applications of Nanofibers in Air and water filtration, Controlled drug delivery, Tissue reconstruction, Barrier materials, Anti-microbial fabric other advanced technique in field of various engineering.

Nano-Enhanced Finishing Treatments: Nano formulations for dyes, Nano coatings and nano finishing, Nano Emulsion to get value addition on Textiles.

Nano-Textile Products and their utility:

- Sports fabrics: improved mechanical properties, and odour-reducing antibacterial properties.
- Therapeutic textiles: antimicrobial wound dressings, clothing and bedding.
- PPE (personal protective equipment): improved chemical or heat resistance.
- Military textiles: flexible body armor, radio shielding and camouflage.
- Wearable electronics: computers made from nanofibers and flexible circuit board.
- Nanocomposites and their applications.

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Societal implications of nanoscience: Ethical, legal and environmental implications, Concept of bionanotechnology and its merits.

Analysis of Nano Scale Textile Material: Principles and Instrumental Technique (SEM, XRD, AFM, TEM, Particle size and Particle size distribution, Stability etc).

Books Recommended:

1. Brown P J and Stevens K, "*Nanofibres and Nanotechnology in Textiles*", Woodhead Pub. Ltd., Cambridge, 2007.
2. Schmid G., Chichhester, "Nanoparticles: From Theory to Application", John Wiley, 2004.
3. Lynn E. Foster, "Nanotechnology: Science, Innovation, and Opportunity" Prentice Hall Professional Technical Reference December 2005.
4. Mark Ratner, Daniel Ratner, "Nanotechnology: A Gentle Introduction to the Next Big Idea" Prentice Hall Professional Technical Reference. 2002.
5. Pinnavaia, T. J., and Beall, G. W., "Polymer-Clay Nanocomposites", Wiley and Sons, NY, 2000.
6. Yury Gogotsi, "*Nanotubes and Nanofibres*", CRC Taylor & Francis, Boca Raton, 2006.
7. Nanocomposite Science And Technology by Braun Paul V. Wiley-VCH
8. Adanur, S., and Ascioğlu, B., "Processing Characterization of PVA Nanofibers in Electrospinning", Proc. of ICCE/11, Hilton Head, SC, August 8-14, 2004

TTXPE3-804D: Green Processing of Textiles [3 0 0 3]

COURSE OBJECTIVE: To teach ecology related issues connected with the Textile Industry, their consequences and the Standards applicable and to impart knowledge on the technologies that are in line with preservation of ecology in the area of textile chemical processing.

COURSE CONTENT:

Eco Standards and Eco-Labels: Regulations concerning azo dyes- banned amines, Pesticides, Heavy metals, Formaldehyde and Pentachlorophenol in textiles. Global eco standards and eco-labels. Ecomark scheme of India. Criteria for an eco-label based on the life cycle. Eco-Management: Concept of eco-management, eco-audit, certification and labeling of ecofriendly textiles

Eco-Testing of Textiles: Testing of banned chemicals such as free formaldehyde, pesticides, pentachlorophenol, heavy metals, azo dyes containing aromatic amines & benzidine and halogen carriers. Principle of Instruments used – Chromatography (HPLC, GC) and Mass Spectrometry and Atomic Absorption/Emission Spectrometry.

Approach To Eco-Friendly Processing: Concept of Sustainable Textiles, Fibre origin, Approach and Alternative methods/chemicals in Pretreatments, Eco-friendly dyes and dyeing, Eco-Friendly Finishing – formaldehyde free finishing, Halogen free FR finish, Comfort and Hygiene Finishing using natural agents like Neem - Aloe vera – Chitosan for anti-microbial finishing

Advanced Processing Techniques: Principle and advantages of dry processing. Plasma treatment – principle, plasma as a source of reducing the effluent and energy consumption, as a source of enhancing the dyeing properties, as a source of finishing of textiles in eco-friendly manner. Super critical carbon dioxide processing of textiles, Surface modification by VUV irradiation – VUV lamp, Laser modification, Dielectric Barrier Discharge, and Corona. Electrochemical reduction - Ultrasonic dyeing. Concept of low level application of chemicals

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Enzymatic Processing of Textiles: Enzyme treatments: Enzymes in preparatory processes - desizing, scouring, bleaching – Amylase, pectinase, protease, catalase, lipase etc. Enzymes used as discharging agents in printing – Laccase, Enzymes used in finishing – Bio finishing by cellulase. Enzymes for surface modification of natural and synthetic fibres

Books Recommended:

1. Keith Slater, "Environmental impact of textiles", Woodhead Publishers, June 2003.
2. Miraftab M and Horrocks A R, "Eco Textiles", The Textile Institute, Woodhead Publishing Ltd., Cambridge, 2007.
3. 'Ecofriendly textile processing' symposium proceeding-IIT Delhi, Nov 1995.
4. "Eco -Textiles, Special Report", The Bombay Textile Research Association, Mumbai, 1996.
5. "Eco-Friendly Textiles: Challenges to the Textile Industry", Textiles Committee, Mumbai, 1996.
6. Chavan R B and Radhakrishnan J, "Environmental Issues - Technology Options for Textile Industry", IIT Delhi Publication, 1998.
7. Asokan R, "Eco-Friendly Textile Wet Processing", NCUTE Publications, New Delhi, 2001.
8. Shishoo R, "Plasma Technologies for Textiles", Woodhead Publishing Limited, UK, 2007.
9. Cavaco-Paulo A and Gübitz G M, "Textile Processing with Enzymes", Woodhead Publishing Ltd., UK, 2003.
10. Asim Kumar Roy Chaudhary, "Textile Preparation and Dyeing", Oxford IBHP Publishing house, New Delhi, 2006.

TTXPE3-804E: Project Formulation and Appraisal in Textile Sector [3 0 0 3]

Course Objectives: To provide the sound knowledge to the students about the concept and principles of project formulation in textile sector

Course Outcomes: After completing this course, students will able to:

1. Learn the fundamental concepts of project formulation in textile
2. Determine the basic constraints for project formulation
3. Outline the various government laws and legislations prior to project formulations
4. Summarize the concept of cash flow statements and profitability in the project formulation of textiles.

Prerequisites: Knowledge of Textile Manufacturing, processing & process control aspects.


Course Content:

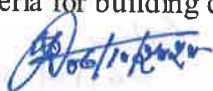
Introduction to Project Planning: Concept of project planning, Phases involved in budget planning.

Formulation of project for various textile processes: Assumptions, Requirement of Miscellaneous Fixed Assets & Machinery Stores & Spares, Requirement & Calculations related to Electrical Power, Lighting, Water, Steam, Compressed Air and Captive power generation etc. Calculations of cost of project, Estimates of sales & production – cost of production – working Capital requirement – Profitability Projection – Break Even point – Projected cash flow statements.

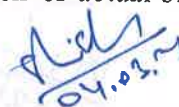
Financial Aspects in Project Formulation: Concept of taxation, types of tax, depreciation provision for building and machineries, types of depreciations, concept of DSCR ratio in project formulation.

Site Selection Aspects: Selection of site for textile mill, Criteria for site selection: Transportation facilities, Laws and regulations in industrial estate, climatic requirements etc. selection of actual site locations: Electricity requirements, soil criteria for building construction etc.


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Plant Construction Management: Structural Design aspects of textile mill building: height, ventilation aspects etc. General principles of building construction & building functions, Types of factory buildings: Saw tooth and arched structure, Types of building construction. Supportive construction materials for designing of floors, false ceilings, ducts, fire resistance, sound proof, etc. concept of contracts and tenders etc.

Machinery Selection and Calculation of Capacity Constraints: Selection of machines & machinery specifications required for the product in spinning, weaving, knitting etc. Calculation of spin and weave plan. Waste, crimp, ideal spindle/machine consideration in the calculation of spin and weave plan, selection criteria for humidification, boiler, compressor, transformer etc.

Plant Layout: Concept, objectives and principles of layouts, study of layouts and their comparisons, flow pattern, work station design, concept of line balancing, storage space requirements, plant layout procedure, factors influencing layouts, selection of layout, symptoms of bad layout. Utility and administrative consideration in plat layout.

Material Handling and Labour complements: Requirement of material handling systems, ergonomics aspects in designing of material handling systems, understanding the functions of various material handling systems, inventory management, calculation of no. of labour required for spinning, weaving and knitting mills, cost of labour, concept of fringe benefits to the staff and workers

Project implementation - Network techniques, PERT, CPM; Project Review and Administration.

Books Recommended:

1. Jain S P, Narang K L and Dhingra T R, "Cost Accounting", 6thEd., Kalyani publishers, N Delhi, 2000.
2. Charles T Horngren, George Foster and Srikant M Datar, "Cost Accounting, A Managerial Approach", 2003
3. Kerzner H, "Project Management" 1st Ed., CBS Publishers and distributors, Delhi, 1987.
4. Prasana C, "Projects- Planning, Analysis, Selection, Implementation and Review ", 6th Ed., Tata Mc Grawhill Publishing Co. Ltd., N. Delhi, 1996.
5. Ormerod A, "Textile Project Management", The Textile Institute, Manchester, UK, 1992.
6. Varma H K, "Costing in Textile Industry", Prentice Hall Inc, 1992
7. Ormorod A, "Management of Textile Production", Newnes – Butter Wortrs Publication.
8. Goal Directed Project Management by E.S. Andersen, K.V. Grude & Tor Hang, Coopers & Cybrant Publication.

TTX-805: Project –II (Phase-II)

Note: Students are expected to complete a project in groups or alone as deemed fit by the faculty and department. They should work under supervision of Faculty member/s of department, or in collaboration with other departments, or preferably with Industry. The project should demonstrate application of the fundamentals learnt during the course of study and should also be innovative.

Students will carry out major project during 8th semester as a part of curriculum as per university guidelines.

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