Uttar Pradesh Textile Technology Institute

PROPOSED STUDY & EVALUATION SCHEME

FOR

B. TECH.

(TEXTILE ENGINEERING)

3RD YEAR

On

Choice Based Credit System

Affiliated to

DR. A.P.J ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW

Uttar Pradesh textile technology Institute, Kanpur
Affiliated to Dr. APJ Abdul Kalam Technical University, Lucknow
STUDY AND EVALUATION SCHEME
B. Tech. Textile Engineering

3rd Year V-SEMESTER **Effective from SESSION-2018-19**

S. No.	Subject Code	Subject Name	L-T-P	Th./Lab Marks	Sessional		Total	Credit
				ESE	CT	TA		
1	RAS501	Managerial Economics	3-0-0	70	20	10	100	3
2	RAS502/ RUC501	Sociology/ Cyber Security	3-0-0	70	20	10	100	3
3	RTT501	Textile Testing-I	3-1-0	70	20	10	100	4
4	RTT502	Yarn Manufacture-III	3-0-0	70	20	10	100	3
5	RTT503	Fabric Manufacture-III	3-0-0	70	20	10	100	3
6	RTT011/ RTT015	Structure & Properties of Fibres/ Mechanism of machines	3-1-0	70	20	10	100	4
7	RTT551	Textile Testing-I Lab	0-0-2	50		50	100	1
8	RTT552	Yarn Manufacture-III Lab	0-0-2	50		50	100	1
9	RTT553	Fabric Manufacture-III Lab	0-0-2	50		50	100	1
10	RTT557	Structure & Properties of Fibres Lab	0-0-2	50		50	100	1
	TOTAL			620	120	260	**1000**	**24**

Department Elective I:

1. Structure & Properties of Fibres
2. Mechanism of Machines

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STUDY AND EVALUATION SCHEME
B. Tech. Textile Engineering

3rd Year VI-SEMESTER **Effective from SESSION-2018-19**

S. No.	Subject Code	Subject Name	L-T-P	Th./Lab Marks	Sessional		Total	Credit
				ESE	CT	TA		
1	RAS601	Industrial Management	3-0-0	70	20	10	100	3
2	RUC602/ RAS602	Cyber Security/ Sociology	3-0-0	70	20	10	100	3
3	RTT601	Textile Testing-II	3-1-0	70	20	10	100	4
4	RTT602	Advanced Spinning Technology	3-0-0	70	20	10	100	3
5	RTT603	Advanced Weaving Technology	3-0-0	70	20	10	100	3
6	RTT021/ RTT024	Fabric Structure / Mechanical Machine Design	3-1-0	70	20	10	100	4
7	RTT651	Textile Testing Lab	0-0-2	50		50	100	1
8	RTT652	Advanced Spinning Technology Lab	0-0-2	50		50	100	1
9	RTT653	Advanced Weaving Technology Lab	0-0-2	50		50	100	1
10	RTT654	Fabric Structure Lab	0-0-2	50		50	100	1
	TOTAL			620	120	260	**1000**	**24**

5th Semester B. Tech. Textile Engineering

1. **Managerial Economics (L T P 3-0-0 = 3): As to be decided in concerned BoS**

2. **Cyber Security/ Sociology (L T P 3-0-0 = 3) Syllabus as decided by BoS Engg & Basic Science**

3. **RTT501:Textile Testing-I (L T P 3-1-0= 4)**

Course Outcome: After completing the course student be able to:

CO1	Apply statistical techniques for collecting samples and analysis
CO2	Understand and explain significance of environmental conditions on properties of textile materials and determine moisture regain of materials
CO3	Determine various physical properties of cotton fibres such as length, diameter, maturity, fineness, colour, grade etc.
CO4	Determine various mechanical properties of cotton and synthetic fibres such as tenacity, extension, modulus, toughness etc.
CO5	Evaluate various yarn properties such as linear density, twist, strength, elongation, by using specific instruments.

Unit (1): Introduction to textile testing (1), Atmospheric conditions for testing, absolute & relative humidity, moisture regain & moisture content (1), importance of moisture in textiles, measurement of moisture regain & content (1), effect of moisture on properties of textile material, factors affecting the regain (1), correct invoice weight, oven dry weight 1(1), Shirley moisture meter (1). Dry and wet bulb hygrometer, sling, Assmann, hair hygrometers (1), control of testing room atmosphere (1),

Total Lectures Required = 8

Unit (2): Sampling, random sampling, biased sampling (1), sampling techniques for fibre yarn and fabric (1), Grading of cotton fibre with respect to staple length (1), laboratory measurement of fibre length, span length, Baer sorter (1), Shirley photo electric staple, servo fibro graph (1).

Total Lectures Required = 5

Unit (3): AFIS (1), Napping potential (1), Nep count (1), rating of neps, maturity coefficient measurement by NaOH method, fibre fineness by airflow meter & Sheffield micronaire (2), Vibroscope(1). salient features of HVI(1), Advancements in fibre testing (1)

Total Lectures Required = 8

Unit (4): Fibre bundle strength by stelometer (1), fibre quality index, linear density of man made fibres and their strength (1), spin finish, crimp analysis (1), Shirley trash analyzer (1). wrapping test for lap, sliver, roving and yarn (2),

Total Lectures Required = 6

Unit (5): Determination of yarn count, diameter (1), average & resultant count of folded yarn, relation between Ne, D, T, Nm (1). Instruments used for determination of count, quadrant balance, Knowles

balance, beesley balance and physical balance (2), Twist, classification of twist, twist measurement, direct counting method, continuous twist tester, twist-untwistmethod, (2), Twist tester, (2), R.B. twist tester, level of twist (1).

Total Lectures Required = 9

Grand total of lectures required = 42 Reference Books: -

Reference Books: -

1 **Testing and Quality Management,** Vol 1, IAFL Publications,V.K. Kothari
2. **Principle of Textile Testing** by J.E. Booth, CBS Publishers
3. **Physical testing of textiles** by B.P. Savile, Woodhead Publishing.

4. RTT502 Yarn Manufacture-III (L T P 3-0-0 = 3)

Course Outcome: After completing the course student be able to:

CO1	Understand objectives of ring spinning, twisting mechanism
CO2	Understand and explain building mechanism, role of balloon control ring, drafting system,
CO3	Determine various trpes of wastes in ring spinning, determine ring frame efficiency, causes of loss in efficiency, various causes of yarn faults & their remedies
CO4	Understand the mechanism of compact spinning, the advantages of compact spinning, fancy yarn manufacturing methods,
CO5	Estimate the requirements of sewing threads, calculate the production, draft, efficiency of ring frame & doubling frame. Calculate the resultant doubled yarn & fancy yarn count

Unit (1): Objects of ring frame (1), drafting system (1), drafting, twisting & winding on ring frame (4), yarn twist by traveller (1), propagation of twist, spinning triangle (1). Traveller forces analysis (1) **Total Lecturers Required = 8**

Unit (2): Builder motion(1), types of rings and travellers and their common uses (1) , lappet movement (1), balloon control rings, apron drafting system mechanical and actual draft (4)

Total Lecturers Required = 7

Unit (3): Ring frame wastes (1), limitation of ring spinning and factors responsible for loss in efficiency (2), yarn faults and their remedies (2), Advancements in ring spinning. (2)

Total Lecturers Required = 7

Unit 4: Compact spinning (1)**,** study of various compact spinning systems (1). Objects of doubling, ring doublers (2), TFO(2), fancy yarns manufacturing(1).

Total Lecturers Required = 7

Unit 5: Sewing thread and tyre Cord yarns (2). Reeling, yarn bundling, calculation of draft, TPI and production of ring frame & doubling frame (4).

Total Lecturers Required = 6

Grand Total of lectures required =40

Reference Books: -

1.Elements of ring frame & doubling – Dr. A.R. Khare
2.The technology of short-shape staple spinning – W. Klein
3.Cotton spinning – Taggart
4.Spun yarn technology – Oxtoby
5.Fundamentals of Spun yarn technology by C. A. Lawrence

Laboratory work: As per the lab Syllabus

5. RTT 503 Fabric Manufacture-III (L T P 3-0-0 = 3)

Course Outcome: After completing the course student be able to:

CO1	Understand the different systems of harness tie-up, developments in jacquard shedding
CO2	Understand the principle & working of automatic loom, working & setting of stop motion
CO3	Calculate the productivity at loom shed, uses of snap study, be able to understand the mechanism of drop box loom
CO4	Understanding different types of weaving,
CO5	Use the methods of card cutting,

Unit 1: Introduction to terry weaving, Classification of terry fabrics (1) Different mechanism for terry manufacturing (2), Properties and performance of terry fabric (2), Recent developments in jacquard weaving,

Total Lectures Required = 8

Unit 2: Automatic loom: pirn change, shuttle change loom, detailed study of various motions of automatic looms, mechanical warp stop motions, electro-mechanical warp stop motion

Total Lectures Required = 9

Unit 3: Multiple box motion and their types, two colours and four-colour drop box motion, brief description of pick-at will, pick and pick motion. On line process and quality control, estimation of productivity, snap study.

Total Lectures Required = 8

Unit 4: Introduction to narrow weaving manufacturing, brief description of braiding machines, brief description of needle loom, filament weaving process, industrial fabric weawing,

Total Lectures Required = 7

Unit (5): Heald and read count calculation (2), Calculation related to production and efficiency of loom shed (2), Fabric set calculations.

Total Lectures Required = 08

Grand Total of lectures required = 40

Reference Books: -

1.Weaving mechanism by Fox.
2.Weaving mechanism by N.N. Bannergy.
3.Weaving Calculation by R. Sengupta.
4.Weaving machine & mechanism by Talukdar
5.Handbook of weaving by SabitAdanur
6. Textile Mathematics by J E Booth
7.Woven Terry fabric by Singh &Verma
Laboratory work: As per the lab Syllabus

6. Departmental Elective 1

a) Structure & Properties of Fibres (RTT-011) (L T P 3 1 0) Credits = 4

Course Outcome: After completing the course student be able to:

CO1	Describe various models of physical structure of fibre and Analyze structure–property relationship
CO2	Explain various properties of fibres.
CO3	Characterize and measure various physical and chemical structure of fibres by using instrumental techniques.
CO4	Derive various mathematical models of fibre structures and properties.
CO5	Determine the effects of different factors influencing fibre properties.

Unit (1): Basic structural features of fibre, Structure of Cotton, wool, silk, and other textile fibres, relation between fibre structure and fibre, Methods of estimating molecular weight, orientation, crystallinity & crystalline orientation of fibre forming polymer, Overall orientation by "sonic modulus tester,

Total Lectures Required = 8

Unit (2): Concept of scanning electron microscope (SEM) and brief introduction of FESEM**,** Concept of transmission electron microscope (TEM) Fourier Transform Infrared Spectroscopy (FTIR), Atomic force microscopy, fibre fracture.

Total Lectures Required = 8

Unit (3): Thermal behavior of textile fibres by Differential Scanning Calorimeter (DSC) (2), Thermo-gravimetric analysis (TGA) (2), Thermomechanical Analyser (TMA) Density gradient column (2), Preparation of density gradient coloumn (2) Density by density gradient coloumn.

Total Lectures Required = 8

Unit (4): Optical properties of fibres (2), Birefringence behavior, dielectric properties, fibre friction, fibre friction measurement, fibre to fibre, yarn to yarn friction measurement

Total Lectures Required = 8

Unit (5): Creep behavior (2), concept of moisture absorption by fibres (2), (2). Moisture absorption, heat of absorption, differential heat of absorption, integral heat of absorption, Quantitative theory of heat moisture absorption, Rate of moisture absorption

Total Lectures Required = 10

Grand Total of lectures required = 42

Laboratory work: As per the lab Syllabus

Reference Book: -

1.Manufactured fibre technology by V.B. Gupta, V.K. Kothari
2.Physical properties of fibre by J.W.S. Hearle
3.Thermal behavior of material by Turi
4.Modern yarn production by Ray
5.Textile fibres by ATIRA
6.ASTM Standard books
7.Polymers by fibre & textiles encyclopedia
8.Advances in fibre source by S.K. Mukhopadhyaya

b) Mechanism of Machines (RTT015) (L T P 3-1-0 =4)

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

CO1	Understand the principles of kinematic pairs, chains and their classification, DOF, inversions, equivalent chains and planar mechanisms.
CO2	Analyze the planar mechanisms for position, velocity and acceleration.
CO3	Evaluate gear tooth geometry and select appropriate gears for the required applications.
CO4	Design cams and followers for specified motion profiles, Characterize and design flywheels.
CO5	Understand free and forced vibrations of single degree freedom.
CO6	Analyze balancing problems in rotating and reciprocating machinery.

Unit	Topics	Lectures
1.	**Introduction :** Rigid body, Mechanism and Machine, Kinematic Link, Kinematic Pair, Degrees of Freedom, Classification, Kinematic Chain, Linkage, Mechanism and Structure, Gruebler's Criterion for degrees of freedom. **Inversions of mechanism:** Four Bar Chain mechanism, Slider- Crank mechanism, Kinematic inversions, Double slider-crank mechanism, Inversions.	8
2.	**Velocity Analysis:** Instantaneous centre method, Kennedy's theorem, Locating instantaneous centres, Relative velocity method for slider-crank mechanism, and crank and slotted lever mechanism.	8

	Acceleration Analysis : Klein's construction, slider crank mechanism, Coriolis acceleration component, Crank and slotted lever mechanism	
3.	**Cam & Follower :** Definition of cam, Classification of cams, Followers and their classification, Brief description of different types of cams and followers with simple line diagram, Simple cam profile for uniform velocity, SHM and uniform acceleration and deceleration with Flat, knife edge and roller type follower. **Flywheel:** Functions of flywheel, Kinetic Energy of rotating masses, turning moment diagram, Types of flywheels, Co-efficient of energy & speed.	8
4.	**Gears & Gear Trains:** Classification of gears, Law of gearing, forms of teeth, Path of contact, Arc of contact, Interference in involute gears, Minimum number of teeth, undercutting, Differential gears, Simple gear train, Compound gear train, Reverted gear train, epicyclic gear train. Sun and planet gears. **Belt & Chain drives:** Open and cross belt drives, Action of belts on pulleys, velocity ratio, slip, crowing of pulleys, power transmitted by belt drives.	9
5.	**Vibrations:** Types of vibrations, Free longitudinal vibrations, Damped vibrations, Logarithmic decrement, Forced vibrations, Forced Damped vibrations, Vibration isolation and transmissibility, Torsional vibrations. **Balancing:** Static balancing, Dynamic balancing, Balancing of masses in different planes, Balancing of reciprocating masses.	9

Text Books:

1. Theory of Mechanisms and Machines by Ghosh and Malik.
2. Theory of Machines by S.S. Rattan.
3. Textile mechanism in spinning and weaving machines by Ganapathy Nagarajan

6th Semester B. Tech. Textile Engineering

1. **Managerial Economics (L T P 3-0-0 = 3): As per concerned BoS**

2. **Cyber Security/ Sociology (LTP 300=3) Syllabus as decided by concerned BoS**

3. **RTT 601 Textile Testing-II (LTP 310=4)**

Course Outcome: After completing the course student be able to:

Co1	Understand the mechanical properties of yarns & fabric, different methods of testing tensile properties of yarn & fabric
CO2	Understand the yarn evenness measuring principle & its importance,
CO3	Estimate the properties of fabric from yarn properties, measure bursting, tear & tensile properties & their importance
CO4	Measure, air permeability, cover factor, & different fabric properties & their application areas

Unit (1): Tensile properties of yarn and fabric, stress-strain curve, various methods for finding of yield point, methods for finding of various modulus, estimation of tenacity, and stiffness of fabric.

Total Lectures Required = 7

Unit (2): Procedure of determination of strength and elongation in the spun yarns, knowledge about the equipment used, yarn tensile strength testing machines, single yarn strength tester, lea strength tester, fabric strength tester- impact tester, Grab test, fabric B.S. Test, Scott serigraph, Instron tensile tester.

Total Lectures Required = 9

Unit(3): Principles and methods of evenness testing ,Testing of yarns evenness, nature and causes of irregularities, evaluation and interpretation of evenness diagram & spectrogram and their associated equipment, Classimat faults.

Total Lectures required =9

Unit (4): Measurement of physical properties of fabric and the knowledge of the equipment used, tensile strength, bursting strength, tearing strength, pilling, air permeability, crimp, thickness, EPI, PPI, weight and cover factor.

Total Lectures required =10

Unit (5): Measurement of water repellency, shrinkage, measurement of fastness to light and rubbing, thermal transmission, Brief introduction to FAST and KAWABATA.
Total Lectures required =7
Grand total of lectures required = 42

Text Books & Reference Books: -

1. Physical testing of textiles by B.P. Saville.
2. Quality control and testing management by Dr. V.K. Kothari.
3. Principles of textile testing by J.E. Booth.
4. Quality control by V.K. Kothari

Laboratory work: As per the lab Syllabus

4. RTT602Advance Spinning Technology (L T P 3 0 0=3)

Course Outcome: After completing the course student be able to

Co1	Understand the ring spinning limitations, principles of rotot spinning
CO2	Understand the mechanism of rotor spinning, air-jet spinning, friction spinning & other novel spinning methods
CO3	Understand the structure of different methods of spinning & correlate their properties with structure
CO4	Calculate the production, twist, draft at different spinning technology
CO5	Apply the knowledge in deciding the uses of yarn in different areas.

Unit-1: Limitation of ring spinning (1), Principles of unconventional method of yarn manufacturing (1) Classification of new spinning yarn technology (1), open-end spinning process(1), Advantages and Limitations of open-end spinning process(1),

Unit-2: Rotor spinning- Objects of rotor spinning (1), Principle of operation(1), Raw material requirements(1), opening unit, yarn formation(1) Design of rotor, Navel and yarn withdrawal tube(1) Automation in rotor spinning(2), yarn characteristics, comparison of yarn properties of ring yarn and rotor yarn (1).

Unit-3: Friction spinning- Principle(1) DREF-2 and DREF-3, yarn formation , yarn quality, yarn structure(1) fibre specifications for optimum results, merits & limitations(1) Twist less spinning-TNO process and TWILLO process(1), Traveller-less NOVA Spinning

Unit-4: Air jet Spinning-Principle(1), concept of false twist(1), Fasciated yarn, Murata jet spinning, operation principle(1) Raw material requirement, Effect of process variables on yarn twist& (1) tenacity, yarn quality, limitation of air jet yarns(1) self twist process(2)

Unit-5: Bobtex ICS process(1), Wrap spinning(1), plyfil spinning(1),SIRO spinning(1),Electrostatic spinning(1), Core spinning(1)

Grand total of lectures required = 42

Reference Book-

1. New Spinning Technology Vol. 4 & 5 –W.Klien
2. Fundamentals of Spun yarn technology by C. A. Lawrence
3. Spun yarn technology – Oxtoby

Laboratory work: As per the lab Syllabus

5. RTT603 Advance Weaving Technology (LTP 300=3)

Course Outcome: After completing the course student be able to:

CO1	Understand different principles of Shuttleless weaving,
CO2	Understand the mechanism of projectile weaving, different weft feeding mechanism,
CO3	Understand different rapier weaving mechanism, importance of control,
CO4	Understand of principle of Air-Jet weaving, mechanism of beat-up in air-jet weaving
CO5	Undesrstand water-jet weaving mechanism, uses of water-jet loom, machine parameters for water-jet loom

Unit 1: Principle of operation of shuttleless loom (2) Classification of shuttleless looms., Comparative study of various systems of weft insertion (2) advantage of shuttleless looms over shuttle looms (2) **Total of lectures required=7**

Unit-2: Basic operational principle of projectile weaving machinery, picking mechanism of Sulzer projectile loom, beating (3), Selvedge formation (2) multicolour weft feeding on projectile loom (2) **Total of lectures required=7**

Unit-3: The Rapier system of weft insertion (1) Classification of Rapier looms and its description(2) flexible and rigid rapier (2) Dewas and Gabler system of weft transfer (2) weft Control mechanism, loom timing (2,) rapier design, tip transfer mechanism of rapier loom **Total lectures required=8**

Unit-4: Working principle of Air-jet weaving (2) essential requirements of air-jet loom, weft measuring, weft tensioning devices (2) beating-up, weft gripping, weft cutting (2) weft stop motion selvedge formation (2), Tendom nozzle and relay nozzles, quality of compressed air for air jet loom, multiphase weaving **Total lectures required=8**

Unit-5: Weft insertions of water-jet loom (2), general description of the water-jet loom (2) weft supply system, tension measuring device, water stream for weft insertion (1) fundamental problems of hydraulic weft insertion (2). **Total lectures required=8**

Grand total of lectures required=38 Reference books

1.Modern development in weaving machine by Ray and Duxburg,
2.Weaving mechanism, machine and Management by Talukdar.
3.Weaving Mechanism by Robinson.
4.Modern weaving machinery Ormerd.

Laboratory work: As per the lab Syllabus

6. Departmental Elective-2

a) Fabric Structure (RTT021) (LTP 310=4)

Course Outcome: After completing the course student be able to"

Co1	Classify various types of fabrics and compare derivatives of plain and twill weaves
CO2	Explain various types of satin/sateen and twill weaves
CO3	Illustrate regular and irregular satins, various derivatives of twill, diamond, mockleno, honeycomb, huch-a-back and crepe weaves.
CO4	Design of various derivatives of hopsack, ripstop, Bedford cord weave

Unit (1): Classification of various fabrics, construction of plain weave and its derivatives

(rib and mat weave), ordinary twill, right hand twill, warp faced, weft faced & balanced twills,

Total Lectures required = 8

Unit (2): Satin regular, irregular and their extension. Combined twills, end to end and pick-to-pick combination, elongated twills, steep twills, broken twill, curved twill, Fancy twills-large diagonal shaded twills, Wave/ zig-zag,herringbone twill.

Total Lectures Required = 8

Unit (3): Regular and irregular satin, sateen base diagonals and brained twills, Diamond, mock leno, ordinary honeycomb, brighten honeycomb , Huck-a-back and crepe weave.

Total Lectures Required = 9

Unit (4): Derivatives of hopsack, barley corn stitched hopsack and twilled hopsack, Ripstop weave, Simple and wadded bed ford cords (1), weft and piques (1), principle of figuring with extra material extra warp figuring, extra weft, limitation of extra thread.

Total Lectures Required = 9
Grand Total Lectures Required = 34

Reference Book: -
1.W. Watson Textile Design & colour Longmans Greens Co. London.
2.Z.J Grosicki Watson's Textile design and colour NewnesButer Worth, London.
3.Z.J. Grosicki, Advance Textile Design Newnes Butter Worth, London.
4."Nishant" A Grammar of textile.
Laboratory work: As per the lab Syllabus

b) Mechanical Machine Design (RTT 024) (LTP 310=4)

Unit	Topics	Lectures
I	**Introduction** Definition, Design requirements of machine elements, Design procedure, Standards in design, Selection of preferred sizes, Indian Standards designation of carbon & alloy steels, Selection of materials for static and fatigue loads. **Design for Static Load:** Modes of failure, Factor of safety, Principal stresses, Stresses due to bending and torsion, Theory of failure.	**8**
II	**Design for Fluctuating Loads**: Cyclic stresses, Fatigue and endurance limit, Stress concentration factor, Stress concentration factor for various machine parts, Notch sensitivity, Design for finite and infinite life, Soderberg, Goodman & Gerber criteria. **Riveted Joints:** Riveting methods, materials, Types of rivet heads, Types of riveted joints, Caulking and Fullering, Failure of riveted joint, Efficiency of riveted joint, Design of boiler joints, Eccentric loaded riveted joint.	**8**
III	**Shafts**: Cause of failure in shafts, Materials for shaft, Stresses in shafts, Design of shafts	**8**

	subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads, Design for rigidity. **Keys and Couplings:** Types of keys, splines, Selection of square & flat keys, Strength of sunk key, Couplings, Design of rigid and flexible couplings.	
IV	**Belt rope and chain drives**: Design of belt drives, Flat & V-belt drives, Condition for Transmission of max. Power, Selection of belt, design of rope drives, and design of chain drives with sprockets **Clutches:** Various types of clutches in use, Design of friction clutches – Disc, Multidisc, Cone and Centrifugal. **Brakes:** Various types of Brakes, Design of shoe brakes – Internal & external expanding, band brakes.	**9**
V	**Spur Gears** Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash, Selection of gear materials, Gear manufacturing methods, Design considerations, Beam strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of gear tooth, Design of spur gears, AGMA and Indian standards. **Helical Gears** Terminology, Proportions for helical gears, Forces components on a tooth of helical gear, Virtual number of teeth, Beam strength& wear strength of helical gears, Dynamic load on helical gears, Design of helical gears.	**9**

Text Books

1. Design of Machine Elements – V.B. Bhandari – Tata McGraw Hill, New Delhi.
2. Design of machine elements-C S Sharma, Kamlesh Purohit, PHI.