Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly West Bengal University of Technology)
Syllabus for B. Tech in Textile Technology (TT)
(Applicable from the academic session 2018-2019)

Mathematics III (BS TT 401)

Name of the Course:	**Mathematics III**
Course Code: BS TT 401	**Semester: IV**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Mid Semester Exam.:15Marks
Tutorial: Nil	Assignment & Quiz: 10 (=8+2)Marks
	Attendance: 5Marks : 5
Practical: hr./week	End Semester Exam.: 70 Marks
Credit Points:3	

Objective:	
1	To gather knowledge about different numerical methods required to solve numerically different systems.
2	To have basic understanding of Laplace transform to be applied to solve different problems.
3	To understand the basic idea of partial differential equations with different solution procedure.
4	To provide understanding of basic probability theory including random variables, distribution functions.
5	To understand the basic idea of statistics including measures of central tendency, correlation and regression

Pre-Requisite:	
1	BS-M102
2	ES-CS201, BS-M202
3	ES-CS291

End Semester Examinations Scheme. Maximum Marks – 70. Time allotted – 3 hrs.

Groups	Units	Objective Questions (MCQ only with one correct answer)		Subjective Questions			
		No. of questions to be set	Total marks	No. of questions to be set	To answer`	Marks per question	Total marks
A	1 to 4	**10**	**10**				
B	1 to 4			**6**	**3**	**5**	**15**
C	1 to 4			**6**	**3**	**15**	**45**

- Only multiple choice type questions (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Unit	Content	Hrs/Unit	Marks/Unit
1	**Numerical Methods:** Approximation in numerical computation: Truncation and rounding errors,	**22**	50

	Fixed and floating-point arithmetic, Propagation of errors. (2L) Interpolation: Newton forward/backward interpolation, Lagrange's and Newton's divided difference Interpolation. (4L) Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Expression for corresponding error terms. (3L) Numerical solution of a system of linear equations: Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Seidel iterative method. (4L) Numerical solution of Algebraic equation: Bisection method, Regula-Falsi method, Newton-Raphson method.(4L) Numerical solution of ordinary differential equation: Euler's method, Runge-Kutta methods, Predictor-Corrector methods and Finite Difference method. (5L)		
2	**Laplace Transform (LT):** Definition; Existence of LT; LT of elementary functions; First and second shifting properties; Change of scale property; LT of derivative of functions. LT of $t^n f(t)$, LT of $\frac{f(t)}{t^n}$; LT of periodic function and unit step function. Convolution theorem (statement only). (4L) Inverse LT; Solution of ODE's (with constant coefficients) using LT. (3L)	**7**	15
3	**Partial Differential Equations:** Solution of one dimensional wave equation, One dimensional heat-conduction equation, Laplace equation in two dimension by the methods of 1: Separation of variables 2: Laplace Transform. (4L)	**4**	10
4	**Probability and Statistics:** Random Variable: Definition of random variable. Continuous and discrete random variables. Probability density function & probability mass function for single variable only. (2L) Probability Distributions: Distribution function and its properties (without proof), examples. Discrete distributions, some important discrete distributions: Binomial & Poisson distributions and related problems. Continuous distributions, Some important continuous distributions: Uniform, Exponential, Normal distributions and related problems. (2L) Expectation: Definitions of Expectation & Variance, properties & examples. Determination of Mean & Variance of continuous and discrete distributions. 3L Measures of Central tendency, Moments, Skewness and Kurtosis, Correlation and regression, Rank correlation. (3L) Curve fitting by the method of least squares- fitting of straight lines, second degree parabola. (2L)	**12**	25
	Total	**45**	100

Text and reference books:

1) Erwin Kreyszig, Advanced Engineering Mathematics.
2) Chandrika Prasad & Reena Garg, Advanced Engineering Mathematics (Khanna Publishing House).
3) B.S. Grewal, Higher Engineering Mathematics.
4) S. Ross, A First course in Probability.
5) J.B. Scarborough, Numerical Mathematical Analysis.
6) Jain, Iyengar& Jain, Numerical Methods (Problems and Solutions)
7) S.A. Mollah, Numerical Analysis and Computational Procedure.
8) A.P. Baisnab& M Jas, Elements of Probability and Statistics.

Course Outcome:

At the end of the course, it is expected that the students

1) Have a clear knowledge about Laplace transforms and partial differential equations.
2) Will learn the concepts of discrete and continuous random variables and the basic idea of statistics.
3) Can solve problems related to textile technology by applying different numerical techniques.

Special Remarks (If any): NIL

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Numerical Methods Lab ES TT 491

Name of the Course:		**Numerical Methods Lab**
Course Code: ES TT 491		**Semester: 4**
Duration: 6 months		**Maximum Marks: 100**
Teaching Scheme		**Examination Scheme**
Theory		**Continuous Internal Assessment:**
Tutorial: Nil		**External Assessment: 60**
Practical: 2 hr./week		**Distribution of marks: 40**
Credit Points: 1		
Course Outcomes:		
1	**Student will be able to apply the acquired knowledge ES TT 401**	
2	**Students will be able to solve the mathematical equation by numerical methods.**	
	Students will be able to handle and apply the application software.	
Pre-Requisite:		
1	BS –M 102	
2	BS TT 401	
3	ES- CS 201, ES-CS291	
Practical: 10 number of experiments		
		1) Intellectual skills- 70
		2) Motor skill- 30

Laboratory Experiment:	
1	Assignments on Newton forward /backward interpolation formula.
2	Assignment on Lagrange's interpolation formula.
3	Assignments on numerical integration using Trapezoidal rule.
4	Assignments on numerical integration using Simpson's 1/3 rule.
5	Assignments on numerical solution of a system of linear equations using Gauss elimination method
6	Assignments on numerical solution of a system of linear equations using Gauss-Seidel iteration method.
7	Assignments on numerical solution of Algebraic Equation by Regular-falsi method.
8	Assignments on numerical solution of Algebraic Equation by Newton Raphson method.
9	Assignments on ordinary differential equation: Euler's method.
10	Assignments on ordinary differential equation: Runga-Kutta method

Text and reference books:

Special Remarks (If any): NIL

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Digital Electronics & Microprocessor (ES TT 401)

Name of the Course:	Digital Electronics & Microprocessor
Course Code: ES TT 401	**Semester:IV**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 2hrs./week	Mid Semester Exam.:15Marks
Tutorial:	Assignment & Quiz: 10 (=8+2)Marks
	Attendance: 5Marks : 5
Practical:	End Semester Exam.: 70 Marks
Credit Points:2	

Objective:	
1	To enable the students to understand the basic concepts of Boolean Algebra and learn the use of the digital logic gates.
2	To familiarize the students with different combinational and sequential digital circuit designs and A/D and D/A conversion techniques.
3	To illustrate them the basic concepts of Microprocessors and Microcontrollers and enable them to implement Microprocessor- and Microcontroller-based system designs using assembly language programming.
Pre-Requisite:	
1	General physics – Class 10+ 2, BS-PH101
2	Basic Electrical Engineering ES –EE 101

End Semester Examinations Scheme. Maximum Marks – 70. Time allotted – 3 hrs.

Groups	**Units**	**Objective Questions (MCQ only with one correct answer)**		**Subjective Questions**			
		No. of questions to be set	**Total marks**	**No. of questions to be set**	**To answer`**	**Marks per question**	**Total marks**
A	**1 to 3**	**10**	**10**				
B	**1 to 3**			**6**	**3**	**5**	**15**
C	**1 to 3**			**6**	**3**	**15**	**45**

- **Only multiple choice type questions (MCQ) with one correct answer are to be set in the objective part.**
- **Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.**

Unit	Content	Hrs/Unit	Marks/Unit
1. Number Systems, Boolean Algebra and Basic Logic Gates.	**Review of Number System:** Decimal, Binary, and Hexadecimal number systems. Conversion from one system to another, Signed numbers Representation. BCD Numbers. Concept of parity.	**3**	**20**

	Boolean Algebra and Logic Simplification: Basic Binary Operations, Basic Laws of Boolean Algebra, De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh's map. **Digital Logic Gates:** Definitions, symbols and truth table of NOT, OR, AND, NAND, NOR, XOR, XNOR gates, De Morgan's theorems; Realization of basic gates using universal gates; Realization of simple Boolean equations using universal gates.		
2. Digital Logic Design and Data Conversion and Transmission Techniques.	**Combinational Logic Design:** Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer, Parity Generator, Half and Full Adder and Subtractor Circuits, Serial and Parallel Adders, Conditional Adder-Subtractor Circuit, Basic Concept on ALU Design. **Sequential Logic Design:**Latches, Flip-flops: S-R, D, J-K, T,Triggering of Flip-flops, Master/Slave Configuration,Excitation Tables and Timing Diagrams, Synchronous UP/Down Counter, Shift registers - SISO, SIPO, PIPO, PISO, Basic Memory Devices ROM and RAM: Addressing Techniques and Block Diagrams. **Data Conversion and Transmission Techniques:** A/D and D/A Converters, Serial and Parallel Data Transmission.	**12**	**40**
3. Basics of Microprocessors and Microcontrollers and their Application in Textile Industry	**Introduction to Microprocessors:** Evaluation of microprocessors, Microcomputer Organization: ALU, Memory, I/O Devices and Buses, Operating System, Assembler, Compiler. **Introduction to Intel 8085 8-bit Microprocessor:** Programming and Hardware Models of 8085, Buses, Flags and Register Organization, Pin Description, Memory Interfacing, Instruction Sets, Addressing Modes, Machine Cycles and Bus Timings, Programming in machine and assembly languages, Counters and Time Delays, Stack &Subroutines, Interrupts. **Interfacing Peripherals (I/Os):** Programmable peripheral interface (8255), Programmable Interrupt Controller (8259A), Direct Memory Access (8237), Programmable Keyboard/Display Interface (8279), Interfacing A/D and D/A convertor. **Introduction to Intel 8051 8-bit Microcontroller:** Difference between Microprocessor and Microcontrollers., 8051 Microcontroller: Architecture, Pin and Port Description. **Applications of Microprocessors/Microcontrollers in Textile Industry:** Temperature control, Water Level	**15**	**40**

	Control, Flow Control, Moisture Control, Stepper Motor Speed Control, pH Level control.		
	Total	**30**	**100**

Text and reference books:

1. M. Morris Mano - Digital Logic and Computer Design - PHI
2. Leach, Malvino et al. - Digital Principles and Applications – McGraw Hill
3. R. P. Jain – Modern Digital Electronics – McGraw Hill
4. S. Salivahanan and S. Arivazhagan – Digital Circuits and Design – Oxford
5. Floyed& Jain - Digital Fundamentals - Pearson.
6. Ramesh Gaonkar - Microprocessor Architecture, Programming and Applications with the 8085 – Penram International Publishing.
7. Kenneth J. Ayala, The 8051 Microcontroller, Penram International Publishing
8. Mazidi - The 8051 Microcontroller and Embedded Systems: Using Assembly and C - Pearson

Course Outcome:

At the end of this course students will be able to –

1. Develop digital logics to solve real life problems, and synthesize them using basic logic gates and the universal logic gates
2. Analyze, design and implement different combinational logic circuits
3. Analyze, design and implement different sequential logic circuits
4. Analyze different data transmission techniques and A/D and D/A convertor circuits
5. Draw and Describe Architecture of 8085 Microprocessor and 8051 Microcontroller
6. Write assembly language programs for 8085 microprocessors and analyze the interfacing with various I/Os.
7. Design microprocessor or microcontroller based systems for various Textile Engineering applications.

Special Remarks (If any): Nil

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Digital Electronics & Microprocessor Lab (ES TT 492)

Name of the Course:	Digital Electronics & Microprocessor Lab
Course Code: ES TT 492	**Semester: IV**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory:	**Continuous Internal Assessment:**
Tutorial: Nil	**External Assessment: 60**
Practical: 3 hr./week	**Distribution of marks: 40**
Credit Points: 1.5	

Course Outcomes:	
At the end of this course students will be able to -	
1	Apply the knowledge of digital electronics to identify the logic gates (IC), design and implement digital circuits like adder, subtractor etc.
2	Identify the use of multiplexers/demultiplexers and encoders/decoders in combinational circuit design.
3	Apply the knowledge of flip-flop to realise them with logic gates
4	Identify and demonstrate the different components present in the 8085 trainer kit
5	Develop different assembly language programs of arithmetic and logical operations
6	Apply the knowledge of digital electronics and microprocessors to solve a real life problem

Pre-Requisite:	
1	General physics - BS-PH101
2	Basic Electrical Engineering ES –EE 101

Practical: 15 number of experiments	
	3) Intellectual skills- 60 % (average)
	4) Motor skill- 40% (average)

Laboratory Experiment:	
1	Familiarization with the digital ICs and Study of basic logic gates.
2	Realization of basic logic gates using universal logic gates
3	Construction of Multiplexer and Demultiplexer circuits using logic gates.
4	Construction of Encoder and Decoder circuits using logic gates.
5	Implementation of Half Adder and Full Adder circuits using basic logic gates
6	Realisation of RS-JK & D filpflop using logic gates.
7	Introduction to the architecture of 8085 microprocessor kit
8	Write an assembly language program to move a data block without overlap.
9	Write an assembly language program to perform addition or subtraction of two 8 bit numbers using 8085 instruction set.
10	Write an assembly language program to add BCD numbers using 8085

	instruction set
11	Write an assembly language program to find the smallest and the largest number from a list of N numbers.
12	Write an assembly language program to implement multiplication of two 8-bit numbers by successive addition method.
13	Write an assembly language program to sort a list of N numbers in ascending/descending order

Text and reference books:

1. M. Morris Mano - Digital Logic and Computer Design - PHI
2. Floyed& Jain - Digital Fundamentals - Pearson.
3. Ramesh Gaonkar - Microprocessor Architecture, Programming and Applications with the 8085 – Penram International Publishing.

Special Remarks (If any): NIL

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Fabric Manufacturing I (PC TT 401)

Name of the Course:	**Fabric Manufacturing I**
Course Code: PC TT 401	**Semester: IV**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Mid Semester Exam.:15Marks
Tutorial: Nil	Assignment & Quiz: 10 (=8+2)Marks
	Attendance: 5Marks : 5
Practical: hr./week	End Semester Exam.: 70 Marks
Credit Points:3	

Objective:	
1	To introduce the basic knowledge of weaving preparatory process
2	To introduce the basic knowledge of fabric manufacturing process
3	To create interest among students and to work on their analytical ability
Pre-Requisite:	
1	Physics, Chemistry, Mathematics, Introduction to textiles, Textile fibres and yarns. BS-PH101, BS-CH201, BS-MH-102 BS MH 202, PC TT 301, PC TT 303
2	Theory textile Machine ES TT 301
3	Yarn Formation 1 PC TT 302

End Semester Examinations Scheme. Maximum Marks – 70. Time allotted – 3 hrs.

Groups	Units	Objective Questions (MCQ only with one correct answer)		Subjective Questions			
		No. of questions to be set	Total marks	No. of questions to be set	To answer`	Marks per question	Total marks
A	1 to 7	**10**	**10**				
B	1 to 7			**6**	**3**	**5**	**15**
C	1 to 7			**6**	**3**	**15**	**45**

- Only multiple choice type questions (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction to fabric manufacture Introduction to various fabric manufacturing methods like weaving, knitting, nonwoven and braiding, product range and applications. Sequence of woven fabric manufacture, Primary, secondary and auxiliary motions for weaving, Warp, weft, crimp, cover etc. Woven fabric designs, Plain, matt, rib, twill, and satin weaves and point paper representation. Warp and weft knitting, wales and courses, knitting cams and needles, loop formation during knitting, Web	5	10

	forming and bonding methods for nonwovens, dry laid, spun laid and spun laid nonwovens, needle punching, spun bonding, belt blowing and hydroentangling processes		
2	Winding 1 Objectives of winding, types of packages, parallel wound, nearly parallel wound and cross would packages, advantages and disadvantages, yarn withdrawal, definition of wind, wind per double traverse. Types of winders, drum driven or random winders, spindle driven or precision winders, expression for winding speeds, wind per double traverse and angle of wind. Package density, problems in winding, patterning, gain, step precision winder. Conditions for uniform building of cheese and cones accelerated grooved drums. Main parameters related with a winding package, Various end uses of wound packages	7	14
3	Winding 2 Yarn tensioning, objectives, additive and multiplicative tensioners, optimization of winding tension. Yarn clearing, principles of mechanical and electronic clearers, classimat faults, winding cuts and SLT channels, correlate curve, splicing and knotting. **Basic features and degree of automation in modern winding machine**	8	16
4	Warping Introduction, passage of warp, warping creels, continuous chain creel, truck creel, magazine creel, efficiency of warping. Beam warping or direct warping, machines, Yarn tension in warping, leasing and beaming. Sectional warping, objectives, passage of warp, adjustable combs, measuring and marking, machine drive. Calculations related to beam and sectional warping.	6	12
5.	Sizing Introduction, sizing-weaving curve, size ingredients, preparation of the size paste, formulation and equipments. Chemistry of starch, linear and branched starch, cooking of starch, acid treatment of starch. Sizing agents for polyester, nylon and acetate, synthesis of PVA, properties of fully and partially hydrolysed PVA. Size fibre interaction Sizing machine elements, creel, over and under creel, equal tension creel, size box, I dip and 1 nip, 2 dip and 2 nip, squeeze rollers, factors influencing the pick up of size. Drying methods and systems, head stock, stretch in sizing, tension control mechanisms. Modern trends in sizing, single end sizing, pre-wetting, control of	10	24

	sizing parameters. 4 Quality evaluation of sized yarns, criteria for assessment, tensile and abrasion properties, loom action abraders. Calculations related to production, size add on, size pick up and water evaporation. Theory of solvent sizing		
6.	Pirn Winding or Single –end Weft winding a) Introduction b) need, c) shape and build of the pirn, c) basic requirements, d) elements of the pirn winding machines, e) concept of basic terms-pirn density, cohesion, consistency of pirn diameter, bunch building, chase, winding and binding coils, yarn tails and back wind, spindle speed, direction of rotation, f) degree of automation, g) description of features of a pirn winding machine with respect to a latest commercially available machine.	6	12
7.	Introduction to primary motion of weaving machine Classification of loom. Definition of primary motions and their importance. Motion translation in cone over pick and under pick shuttle loom. Study of different parts of cone over pick loom. Concept of basic design: Plain, Twill, Satin, Sateen. Drafting plan, Lifting plan Heald, read and dent calculation in loom. The gear ratio of crank shaft, bottom shaft and auxiliary shaft as per design	5	12
		45	100

Text and reference books:

1. Textile Mathematics by J. E. Booth (Volume III).
2. Yarn winding by Banerjee and Alagirusamy (NCUTE publication).
3. Textile Sizing by Goswami, Anandjiwala and Hall.
4. Weaving mechanism by Marks and Robinson (Textile Institute).
5. Weaving: Conversion of Yarn to Fabric by Lord and Mohamed. 6. Woven cloth construction by Robinson.
6. An introduction to textile mechanisms by P. Grosberg.
7. Sizing - Materials, Methods, Machinery by Ajgoankar, Talukdar and Wadekar.
8. Weaving- Machinery, Mechanisms, management by Talukdar, Sriramalu and Ajgoankar.
9. Manual of various winding, warping machine manufacturing company

Course Outcome:

On completion of the course students will be able

PC TT 401.1 To understand the basic operations of different components of yarn preparatory machine
PC TT 401.2 To understand basic operations and laws of physics in relation to yarn preparatory mechanism
PC TT 401.3 To Understand basic motions of weaving machine.

Special Remarks (If any): NIL

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Fabric Manufacturing Lab I (PC TT 491)

Name of the Course:	**Fabric Manufacturing Lab I**
Course Code: PC TT491	**Semester: 4**
Duration: 6 months	**Maximum Marks:**
Teaching Scheme	**Examination Scheme**
Theory	**Continuous Internal Assessment:**
Tutorial: Nil	**External Assessment: 60**
Practical: 3 hr./week	**Distribution of marks: 40**
Credit Points: 1.5	

Course Outcomes:	
1	The student will be able to perform the analysis of various laws of two axis winding and
2	The student will be able to apply the acquired knowledge of PC TT 401
3	The student will be able to understand machines/ processing related to fabric manufacturing system.
Pre-Requisite:	
1	Physics, Chemistry, Mathematics, Introduction to textiles, Textile fibres and yarns. BS-PH101, BS-CH201, BS-MH-102 BS MH 202, PC TT 301, PC TT 303
2	Theory textile Machinery ES TT 301
3	Yarn Formation 1 PC TT 302

Practical: 10 number of experiments	
	5) Intellectual skills-50
	6) Motor skill-50

Laboratory Experiment:	
1	To study the path of the yarn through Winding machine and Warping machine. To study the working of an Automatic winding machine and prepare a bobbin. To study the working of a Beam warping. To study the working of a Sectional warping. To study the passage of yarn on a sizing machine and the features of various Parts/mechanisms of the sizing machine. To study the path of the warp yarn through the cone over pick, under pick loom
2	Determination of coil angle of the cylindrical package (3 methods)
3	Determination of Traverse ratio of the cylindrical package
4	Establishment of the rectangular hyperbolic relationship of Traverse Ratio and package diameter of cylindrical package build by random winding.
5	Determine the Porosity of the given cylindrical package
6	Determine the Porosity of the given frustum conical package
7	Prove that the traverse velocity changes along the length of the given cone.
8	Determine of the average coil angle of the given package.
9	Prove the theory of uniform conicity build up of an conical package
10	To Study the production of winding, warpring machine.

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Text and reference books:
Special Remarks (If any):

Textile Chemical Processing I (PC TT402)

Name of the Course:	**Textile Chemical Processing I**
Course Code: PC TT402	**Semester:**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Mid Semester Exam.:15Marks
Tutorial: Nil	Assignment & Quiz: 10 (=8+2)Marks
	Attendance: 5Marks : 5
Practical: hr./week	End Semester Exam.: 70 Marks
Credit Points: 3	

Objective:	
1	To acquire the basic knowledge of pretreatment processing of textile fibre/ material
2	To acquire the knowledge various processing machinery of textile fibre/material
3	
Pre-Requisite:	
1	Physics, Chemistry, Mathematics, Introduction to textiles, Textile fibres and yarns. BS-PH101, BS-CH201, BS-MH-102 BS MH 202, PC TT 301, PC TT 303
2	Theory textile Machinery ES TT 301
3	Yarn Formation 1 PC TT 302

End Semester Examinations Scheme. Maximum Marks – 70. Time allotted – 3 hrs.

Groups	Units	Objective Questions (MCQ only with one correct answer)		Subjective Questions			
		No. of questions to be set	Total marks	No. of questions to be set	To answer`	Marks per question	Total marks
A	1 to 11	**10**	**10**				
B	1 to 11			**6**	**3**	**5**	**15**
C	1 to 11			**6**	**3**	**15**	**45**

- Only multiple choice type questions (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction: Prelims of preparation: grey checking-grey testing-stamping-mending- stitching-shearing/cropping. Overview of preparatory, colouration and finishing of textile materials, overview of different stages of preparation	4	8

	of cotton/cellulosic materials.		
2	Chemical processing equipment: Principles of functions of different machines used in preparatory processing including padding mangle, J-box, washing machine, kiers, different mercerizing machines, equipments for water removal – contact and non-contact type of dryer, hydro-extractor, construction, schematic diagram, function, speed and capacity	4	8
3	Singeing: Objectives, materials suitable for singeing, singeing methods-mentioning of plate and roller singeing machine, details of gas singeing machine, merits, demerits, precautions, advancement, bio-singeing/biopolishing.	3	4
4	Desizing: Objective, ingredients of size, brief chemical nature and process of removal-chemistry of starch and its hydrolytic and oxidative decomposition, methods of desizing-hydrolytic & oxidative, brief glimpse of rot steep and acid steep; enzymatic desizing, classification of amylases used in desizing-according to hydrolytic action & according to origin, factors of enzymatic desizing, methods of enzymatic desizing, some commercial names of enzymes, merits and demerits over other desizing processes, precautions, bromite desizing, factors, methods of bromite desizing, advancement, if any; method of evaluation of desizing efficiency.	6	15
5.	Scouring Objective, impurities of cotton fiber-their chemical nature and possible methods of removal, merits and demerits of each process, importance of alkali scouring, surfactants, concept of micelle, critical micelle concentration, HLB value, cloud point, their classification –according to chemical nature, action, mechanisms of wetting, detergency and emulsification, factors of scouring, methods of scouring, different scouring equipment e.g., High pressure kier, combi-steamer, their construction, working principle, capacity, solvent scouring, method of evaluation of scouring efficiency, enzymatic scouring.	5	12
6.	Mercerization Objective, action of alkali on the morphological/fine structure of cellulose, methods- cold and hot, relative merits and demerits, evaluation, liquid ammonia mercerization- Objective, methods, relative merits and demerits, evaluation	4	10
7.	Bleaching Objective, classification of bleaching methods, different bleaching agents, their relative merits and demerits, hypochlorite, chlorite, peroxide bleaching, their mechanisms, bleaching parameters, methods of bleaching, role of chemicals used in bleaching, method of evaluation of bleaching efficiency	6	15

	including objective, principle/mechanism, properties, and method of application of optical whitening agents.		
8.	Preparation of coloured material - Nature of problems associated with the preparation of coloured goods, causes and remedies	3	6
9.	Preparation of silk and wool - Impurities present, degumming/scouring, bleaching, optical whitening of wool and silk.	3	6
10.	Preparation of jute - Preparation of jute Impurities present, scouring, bleaching, optical whitening	2	4
11	Preparation of synthetic fibres and blends - Impurities present, heat-setting: Objective, different setting methods, i.e., with/without swelling agents, hot air, infra-red etc., different heat-setting sequences like loom-state, intermediate and after-setting, their relative merits and demerits, singeing of manmade fibres, their blends; scouring, bleaching, optical whitening.	5	12
	Total	45	100

Text and reference books:

1. Chemical Technology in the Pre-treatment Processes of Textiles by S.R. Karmakar
2. The Preparation and Dyeing of Synthetic Fibres by H.U. Schmidlin
3. Chemical Technology of Fibrous Materials by F. Sadov, M. Korchagin and A. Matetsky
4. Mercerization by J.T. Marsh
5. Textile Scouring and Bleaching by E.R. Trotman
6. Technology of Bleaching and Mercerising by V.A. Shenai
7. Textile Chemistry, Vol. II by R.H. Peters
8. Chemical Process Technology, O.P. Gupta, Khanna Publishing House

Course Outcome:

The student will be acquainted with the basics and in depth knowledge of preparatory part of textile chemical processing.

Special Remarks (If any): NIL

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Textile Chemical Processing Lab I (PC TT 492)

Name of the Course:	**Textile Chemical Processing Lab I**
Course Code: PC TT 492	**Semester: IV**
Duration: 6 months	**Maximum Marks:**
Teaching Scheme	**Examination Scheme**
Theory	**Continuous Internal Assessment:**
Tutorial: Nil	**External Assessment: 60**
Practical: 3 hr./week	**Distribution of marks: 40**
Credit Points:1.5	

Course Outcomes:	
1	To apply the knowledge of pretreatment process of textile fabric production
2	To understand the machines related to pretreatment process
3	To understand the processing parameter according to the type of materials
4	
5	

Pre-Requisite:	
1	Physics, Chemistry, Mathematics, Introduction to textiles, Textile fibres and yarns. BS-PH101, BS-CH201, BS-MH-102 BS MH 202, PC TT 301, PC TT 303
2	Theory textile Machinery ES TT 301
3	Yarn Formation 1 PC TT 302

Practical: 8 number of experiments	
	7) Intellectual skills- 50
	8) Motor skill- 50

Laboratory Experiment:	
1	Desizing of cotton material.
2	Scouring of cotton, wool, jute materials.
3	Bleaching of cotton, wool, jute materials: a) Hypochlorite bleaching b) Chlorite bleaching c) Peroxide bleaching
4	Blueing/optical whitening of cotton material.
5	Degumming of silk material.
6	Bleaching of silk material.
7	Optical whitening of silk material.
8	Mercerisation of cotton material

Text and reference books:
Special Remarks (If any):

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Syllabus for B. Tech in Textile Technology (TT)
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Professional Elective I A : Instrumentation and Control in Textile Processing (PE TT 401 A)

Name of the Course:	**Instrumentation and Control in Textile Processing**
Course Code: PE TT 401 A	**Semester: IV**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3hrs./week	Mid Semester Exam.:15Marks
Tutorial:	Assignment & Quiz: 10 (=8+2)Marks
	Attendance: 5Marks
Practical:	End Semester Exam.: 70 Marks
Credit Points:3	

Objective:	
1	**To enable the students to understand the basic concepts instrumentation system**
2	**To familiarize the students with different measurement techniques of different process variables**
3	**To illustrate them the operation techniques of different electronics equipments.**
4	**To enable the students to understand the conventional and modern control techniques and automations in textile industries**
Pre-Requisite:	
1	General physics – 10+ 2 Physics, BS-PH101
2	Basic Electrical Engineering ES –EE 101
3.	ES TT 401

End Semester Examinations Scheme. Maximum Marks – 70. Time allotted – 3 hrs.

Groups	**Units**	**Objective Questions (MCQ only with one correct answer)**		**Subjective Questions**			
		No. of questions to be set	**Total marks**	**No. of questions to be set**	**To answer`**	**Marks per question**	**Total marks**
A	**1 to 5**	**10**	**10**				
B	**1 to 5**			**6**	**3**	**5**	**15**
C	**1 to 5**			**6**	**3**	**15**	**45**

Only multiple choice type questions (MCQ) with one correct answer are to be set in the objective part. Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Unit	Content	Hrs/Unit	Marks/Unit
1. Basic concepts of measurements.	Introduction, idea of a generalized measurement system, basic characteristics of measuring devices - accuracy, precision error, hysteresis, resolution, threshold , repeatability , reliability , span , dynamic accuracy, calibration; Transducer and Sensors: classification, basic	**2**	**6**

	requirements		
2. Different types of Measurements	**Displacement measurement:** Idea of servo potentiometers , differential inductors and transformers , capacitive , shaft encoders, hall effect devices , proximity devices and digital transducers . **Velocity measurement:** D.C.Tachogenerators, A.C. drag-cup tachogenerators, digital velocity transducers. **Temperature measurement:** Introduction, concept of transmitters, liquid in glass thermometers, liquid filled systems, Resistance type temperature sensors, thermistors, thermocouples, solid state sensors, quartz thermometers, temperature measurement by radiation method, optical pyrometers **Force and torque:** Introduction, strain gauges and load cells, concept of different configurations, digital force transducers, concept of electronic weighing systems, concept of torque measurement **Pressure measurement:** Introduction, diaphragms, capsule, Bourdon tube, potentiometric devices, strain gauges devices, LVDT & capacitive devices, solid state devices (piezo-junction & piezo-resistance) **Special measurements:** Idea of transducers for measurement of .pH, humidity, density and thickness	**18**	**40**
3. Measurement accessories and General test equipment	Brief concept of instrumentation amplifiers, signal generation and processing, data acquisition and conversion, input-output devices and displays. Brief review of general-purpose electronic test equipment - CRO, digital multimeters, signal generators, regulated power supplies.	**8**	**16**
4. Control systems and engineering	Introduction, open and closed loop systems, idea of mathematical modelling of simple physical systems, concept of transfer functions, types of control action - ON-OFF, proportional, derivative, integral and PID Digital control: PLC: Introduction, Bit logic instruction, Timers and Counters, Advance Instructions, I/O modules and Power Supply DCS and its applications Industrial Automation	**12**	**28**
5. Instrumentation and	Blow room Sequence,	**5**	**10**

Control Systems in Textile	Carding, Draw Frame Speed Frame, Ring and Rotor Spinning. Cone Winding Machine. Warping and Sizing Machine, Weaving, Knitting, Testing Instruments, Chemical Processing, Control in Garments.		
		45	**100**

Text and reference books:

1. Instrumentation & Control by Rangan, Mani & Sharma,
2. Transducers & Instrumentation by D.V.S. Murty, PHI Learning Pvt. Ltd.
3. Control Systems Engineering by Nagrath and Gopal, New Age International
4. Doeblin E. O., Measuremennt Systems : Application and Design, McGraw Hill , NewYork.
5. Patranabis D, Principle of Industrial Instrumentation, Tata McGraw Hill , NewDelhi.
6. Ogata K., Modern Control Engineering , Prentice Hall .
7. Kuo B.C., Golnaraghi F. , Automatic Control Systems, Wiley
8. Madhuchhanda Mitra, Sanarjit Sen Gupta, Programmable Logic Controllers & Industrial Automation An Introduction, Penram Inernational Publishing (India) Pvt. Ltd.
9. J. R. Leigh, Applied Digital Control, Prentice Hall International, London
10. C. L. Smith, Digital Computer Process Control, Intex Publishers, Scranton

Course Outcome:

At the end of this course students will be able to –

1. Analyze and design instrumentation system
2. Analyze different measurement techniques in industry
3. Analyze and design different conventional and modern control tecniques.

Special Remarks (If any): Nil

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Professional Elective I B : Mechanics of Textile Machines (PE TT 401B)

Name of the Course:	Mechanics of Textile Machines
Course Code: PE TT 401B	**Semester: IV**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Mid Semester Exam.:15 Marks
Tutorial: Nil	Assignment & Quiz: 15(=10+5) Marks
	Attendance: 5 Marks
Practical: nil hr./week	End Semester Exam.: 70 Marks
Credit Points:3	

Objective:	
1	To identify principles of mechanics and mechanisms in textile machines and textile processes.
2	To describe constructional details and design aspects of machine parts and mechanisms involved in machines.
3	Explanation to evaluate design parameters related to mechanisms.
4	Describe selection criterion and process of selecting mechanisms as per need.
Pre-Requisite:	
1	**General physics**
2	**Mathematics I and Mathematics II,**

End Semester Examinations Scheme. Maximum Marks – 70. Time allotted – 3 hrs.

Groups	**Units**	**Objective Questions (MCQ only with one correct answer)**		**Subjective Questions**			
		No. of questions to be set	**Total marks**	**No. of questions to be set**	**To answer`**	**Marks per question**	**Total marks**
A	**1 to 7**	**10**	**10**				
B	**1 to 7**			**6**	**3**	**5**	**15**
C	**1 to 7**			**6**	**3**	**15**	**45**

Only multiple choice type questions (MCQ) with one correct answer are to be set in the objective part.
Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Unit	Content	Hrs/Unit	Marks/Unit
1.	Frictional Drives:- Introduction, Frictional drive to cheese and cone, Belt drives – Basics, Conditions of critical slippage of belts – maximum power condition, texturising by belt and friction disc, the timing belt drive, cone drum belt drives. Positive Drives:- Chain and sprocket drive - Gear drives – types of gears – terms used in study of	**5**	**10**

	gears – pitch measurement, ratio of gear trains – features of change wheels, Epi-cyclic gear trains – velocity ratio – differential gearing in comber and Speed frame. Planetary mechanism in Coiling. Cams and Eccentric: - Introduction – Basic types of cams, types of followers, Motion of cam follower – Displacement, Velocity and Acceleration diagrams for linear, S.H.M., uniform acceleration and retardation cams. Uses of linear cam, positive cams, conjugate cams, Cylindrical Cam in Textile machines. Eccentric and its uses.		
2.	Linkage Mechanisms :- Introduction – The four bar linkage, its geometry– Equations of Displacement, Velocity and Acceleration of a point, SHM, calculation of dwell clearance on a loom with linear cam, SHM and modified SHM, Sley eccentricity, Multiple Bar Linkage – Double Beat up mechanism, Combined ratchet and linkage mechanisms, complex combined mechanism – driving of detaching rollers of comber. Intermittent Rotary Motion :- Introductions – Ratchet and pawl mechanisms – Let off and take up motions in weaving machines – variation in pick spacing – Geneva wheel.	**12**	**24**
3.	Balancing of Machines:- Introduction, Vibrations of machine, Balancing of machinery – Unbalance and its causes, Theoretical considerations in balancing – Static and Dynamic balancing, Various cases of balancing, Numerical examples based on different cases. Balancing of rotor, Card cylinder and practical aspects of balancing. Measurement and control of unbalance- Static and Dynamic balancing machines.	**5**	**10**
4	Clutches and Brakes:- Introduction – Clutches – Jaw / toothed clutches, Friction clutches, Materials for friction lining, Cone Clutches. Torque and power transmission capacity of clutches. Numerical problems. Brakes - Classification of brakes, Constructional details of band, block and differential brakes, braking torque, Internal expanding brake, Application of brakes in Textile machines. Numerical examples 4	**7**	**15**
5	Selection Mechanisms :- Introduction – methods of storing information – the grouping of machine parts for selection – converting information into movement – some mechanical switching mechanisms – Dobby selection mechanisms – high speed mechanical switching mechanisms – additional complex mechanical switches – the movement of the information store. Control Mechanisms:- Introduction – the elements of control mechanisms, open loop and closed loop system –Detection of broken ends, control of yarn tension and cloth tension, detection of full and empty packages.	**7**	**15**
6	Mechanics of Spinning and Weaving ,knitting Machines Nonwoven needling machines web preparation machines :- Construction of Beater, Card Wires, Drafting force and friction field in roller drafting, coils spacing in speed frame, Centrifugal force of flyers, Arrangement	**7**	**15**

	in two rows, Yarn tension in ring spinning, Balloon theory, Study of mechanisms in winding, Build of various packages. Screw traversing mechanism. Design of grooved drums for various packages. Design changes in Beam warping, drive for high speed. ,knitting linear cam design, needle motion, needling motion characteristics, machines characterizes of web formation		
7	Sectional warping, drum design. Mechanism of squeezing, sow box design. Review of design changes of shedding mechanism. Picking mechanism theories for different shuttle-less weaving techniques.	**2**	**0**
		45	**100**

Text and reference books:

1. Textile Mathematics, Vol-I, II and III By J.E. Booth, The Textile Institute, Publication.
2. Mechanics for Textile Students, By W.A. Hanton, The Textile Inst. Pubication.
3. Mechanics of Spinning Machines By R.S. Rengasamy, NCUTE Publication
4. Textile Mechanics Vol.I, Vol.II By K. Slater, The Textile Inst. Publication.
5. An Introduction to Textile Mechanisms By P. Grosberg, The General Publishing Company.
6. Theory of Machines by S. S. Rattan, Tata McGraw-Hill Publication.

Course Outcome:

Course Outcomes - At the end of the course students will be able to 1. Describe principles of mechanics and mechanisms in textile machines and textile processes. 2. Describe constructional details and design aspects of machine parts and mechanisms involved in machines.

Special Remarks (If any): Nil

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Environmental Sciences (MC 401)

Name of the Course:	Environmental Sciences
Course Code: MC 401	**Semester: IV**
Duration: 6 months	**Maximum Marks:**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Mid Semester Exam.: Marks
Tutorial: Nil	Assignment & Quiz: Marks
	Attendance: Marks
Practical: hr./week	End Semester Exam.: 70 Marks
Credit Points: 0	

Objective:	
1	Be able to understand the natural environment and its relationships with human activities.
2	Be able to apply the fundamental knowledge of science and engineering to assess environmental and health risk.
3	Be able to solve scientific problem-solving related to air, water, noise & land pollution
Pre-Requisite:	
1	Basic knowledge of Environmental science
2	BS 301
3	

End Semester Examinations Scheme. Maximum Marks – 70. Time allotted – 3 hrs.

Groups	**Units**	**Objective Questions (MCQ only with one correct answer)**		**Subjective Questions**			
		No. of questions to be set	**Total marks**	**No. of questions to be set**	**To answer`**	**Marks per question**	**Total marks**
A	1 to 7	**10**	**10**				
B	1 to 7			**6**	**3**	**5**	**15**
C	1 to 7			**6**	**3**	**15**	**45**

- **Only multiple choice type questions (MCQ) with one correct answer are to be set in the objective part.**
- **Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.**

Unit	Content	Hrs/Unit	Marks/Unit
1	Basic ideas of environment, basic concepts, man, society & environment, their interrelationship (1L) Mathematics of population growth and associated problems, Importance of population study in environmental engineering, definition of resource, types of resource renewable, non-renewable, potentially renewable, effect of excessive use vis-à-vis population growth, Sustainable Development. (2L) Materials balance: Steady state conservation system, steady state system with non-conservative pollutants, step function. (1L) Effects and control/management; Anthropogenic degradation like Acid rain-cause, effects and control. Nature and scope of Environmental Science and Engineering. (2L)	6	15
2	Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem- components types and function. (1L) Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem special reference to Sundar ban); Food chain , definition and one example of each food chain], Food web (2L) Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction (Oxygen, carbon, Nitrogen, Phosphate, Sulphur]. (1L) Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity.(2L)	6	15
3	Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause. (1L) Energy balance: Conductive and Convective heat transfer, radiation heat transfer, simple global temperature model [Earth as a black body, earth as albedo], Problems.(1L) Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Earth's heat budget.(1L) Lapse rate: Ambient lapse rate Adiabatic lapse rate,	11	28

	atmospheric stability, temperature inversion (radiation inversion).(2L) Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes and Gaussian plume model.(2L) Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN. (2L) Smog, Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green-house gases, effect of ozone modification. (1L) Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP. cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference). (1L)		
4	Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds. (2L) River/Lake/ground water pollution: River: DO, 5-day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river [deoxygenation, reaeration], COD, Oil, Greases, pH. (2L) Lake: Eutrophication [Definition, source and effect]. (1L) Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only) (1L) Standard and control: Waste water standard [BOD, COD, Oil, Grease], Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening] Waste water treatment system, primary and secondary treatments [Trickling filters,rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] tertiary treatment definition. (2L) Water pollution due to the toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic (1L)	9	22
5	Lithosphere; Internal structure of earth, rock and soil (1L)	3	8

	Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes; Recovery and disposal method- Open dumping, Land filling, incineration, composting, recycling. Solid waste management and control (hazardous and biomedical waste).(2L)		
6	Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighbour hood noise] (1L) Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, L10 (18hr Index) Ld_n and. Noise pollution control. (2L)	3	8
7	Environmental impact assessment, Environmental Audit, Environmental laws and protection act of India, Different International environmental treaty/ agreement/ protocol. (2L)	2	4
	Total	40	100

Text and reference books:

1. Masters, G. M., "Introduction to Environmental Engineering and Science", Prentice-Hall of India Pvt. Ltd., 1991.
2. M.P. Poonia, Environmental Studies, Khanna Publishing House, New Delhi, 2018
3. De, A. K., "Environmental Chemistry", New Age International.
4. O.P. Gupta, Elements of Environmental Pollution Control, Khanna Publishing House, New Delhi 2019

Course Outcome:

On completion of the course students will be able to
1. To understand the natural environment and its relationships with human activities.
2 To apply the fundamental knowledge of science and engineering to assess environmental and health risk.
3 To develop guidelines and procedures for health and safety issues obeying the environmental laws and regulations.
4 Acquire skills for scientific problem-solving related to air, water, noise& land pollution.

Special Remarks (If any):

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Technical Report Writing and Language Lab(HM 481)

Name of the Course:	**Technical Report Writing and Language Lab**
Course Code: HM 481	**Semester: IV**
Duration: 6 months	**Maximum Marks:100**
Teaching Scheme	**Examination Scheme**
Theory: hrs./week	**Continuous Internal Assessment:**
Tutorial: Nil	**External Assessment: 60**
Practical: 2 hr./week	**Distribution of marks: 40**
Credit Points: 1	

Course Outcomes:	
1	Develop listening, speaking, reading and writing skills.
2	Develop self-confidence and able to reach corporate expectations.
3	Answer questions successfully in interviews and take international examination.
4	Develop interpersonal skills on current problems and events.
5	Make presentations and participate in Group Discussions.
6.	Produce well versed technical report in recognized format
Pre-Requisite:	
1	English (10+2), English (HM-HU201)
2	
3	

Practical: 7 module	
	1) Intellectual skills- 70
	2) Motor skill- 30

Laboratory Experiment:	
A	Technical Report Writing: Report Types (Organizational / Commercial / Business / Project) Report Format & Organization of Writing Materials, Report Writing (Practice Sessions & Workshops)
B	
	1.Introductory Lecture to help the students get a clear idea of Technical Communication & the need of Language Laboratory Practice Sessions
	2. Conversation Practice Sessions: (To be done as real life interactions) Training the students by using Language Lab Device/Recommended Texts/cassettes /cd's to get their Listening Skill & Speaking Skill honed Introducing Role Play & honing over all Communicative Competence

	3. Group Discussion Sessions: Teaching Strategies of Group Discussion Introducing Different Models & Topics of Group Discussion Exploring Live /Recorded GD Sessions for mending students' attitude/approach & for taking remedial measure
	4. Interview Sessions: Training students to face Job Interviews confidently and successfully Arranging Mock Interviews and Practice Sessions for integrating Listening Skill with Speaking Skill in a formal situation for effective communication.
	5. Presentation: Teaching Presentation as a skill Strategies and Standard Practices of Individual /Group Presentation Media & Means of Presentation: OHP/POWER POINT/ Other Audio-Visual Aids.
	6. Competitive Examination: Making the students aware of Provincial /National/International Competitive Examinations Strategies/Tactics for success in Competitive Examinations SWOT Analysis and its Application in fixing Target

Text and reference books:

1. Nira Konar: English Language Laboratory: A Comprehensive Manual, PHI Learning, 2011
2. Kulbhushan Kumar, Effective Communication Skills, Khanna Publishing House, New Delhi, 2019
3. Sudharani: Advanced Manual for Communication Laboratories & Technical Report Writing Pearson Education (W.B. edition), 2011:

Adrian Duff et. al. (ed.): Cambridge Skills for Fluency
A) Speaking (Levels 1-4 Audio Cassettes/Handbooks)
B) Listening (Levels 1-4 Audio Cassettes/Handbooks)
Cambridge University Press 1998 Mark Hancock: English Pronunciation in Use
4 Audio Cassettes/CD'S OUP 2004

Special Remarks (If any): NIL