B.Tech. (Textile Technology)

2022 Regulations, Curriculum & Syllabi

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

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

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BANNARI AMMAN INSTITUTE OF TECHNOLOGY, SATHYAMANGALAM

REGULATIONS 2022

(CHOICE BASED CREDIT SYSTEM)

(Common to all B.E./B.Tech. Degree Programmes)

Regulations 2022 have been prepared in accordance with the guidelines given by the University Grants Commission, All India Council for Technical Education and affiliating Universities incorporating the features of the Choice Based Credit System (CBCS). The Regulations 2022 is applicable to the candidates admitted to the Bachelor of Engineering (B.E.) / Bachelor of Technology (B.Tech.) Degree Programmes of the Institution in the Academic Year 2022-2023 for Regular admission (Academic Year 2023-2024 for Lateral Entry) and subsequently.

The regulations hereunder are subjected to amendments as may be decided by the Academic Council of the Institution from time to time. Any or all such amendments will be effective from such date and to such batches of students (including those already in the middle of the programme) as may be decided by the Academic Council.

1. ADMISSION

Candidate, seeking admission to the B.E./B.Tech. Programme, shall satisfy the conditions of admission prescribed by the Directorate of Technical Education (DoTE) and Anna University, Chennai as given below.

1.1 Regular Admission

Candidates, for admission to the first semester of the eight semesters B.E./B.Tech. Degree Programmes, shall be required to have passed:

Higher Secondary Examination (10 +2) of curriculum (Regular Academic Stream) prescribed by the Government of Tamil Nadu with Mathematics, Physics, and Chemistry as three of the four subjects of the study prescribed under Part-III or any other examinations of any Board or University or authority accepted by the Syndicate of the University / DoTE, Chennai as equivalent thereto.

(or)

Should have passed Higher Secondary Examination of Vocational Stream (Engineering/Technology), prescribed by the Government of Tamil Nadu.

1.2 Lateral Entry Admission

1.2.1 The candidates who possess Diploma in Engineering / Technology awarded by the State Board of Technical Education and Training, Tamil Nadu or its equivalent are eligible to apply for lateral Entry admission to the third semester of B.E. / B.Tech. programmes in the branch of study as per the eligibility criteria prescribed by the DoTE from time to time.

(or)

The candidates who possess the Bachelor Degree in Science (B.Sc.) (10+2+3 stream) with Mathematics as a subject in B.Sc. is eligible to apply for lateral entry admission to the third semester of B.E./B.Tech. programmes, as per the eligibility criteria prescribed by the DoTE from time to time. Such candidates shall undergo two additional Engineering subject(s) one each in third and fourth semesters, as bridge courses.

2. PROGRAMMES OFFERED

A candidate may be offered admission to any one of the programmes offered by the Institution for the candidates specified in Clause 1.1 and as per the eligibility criteria of DoTE for the candidates under Clause 1.2 from the list given below:

B. E. Programmes

1. Biomedical Engineering
2. Civil Engineering
3. Computer Science and Design
4. Computer Science and Engineering
5. Electrical and Electronics Engineering
6. Electronics and Communication Engineering
7. Electronics and Instrumentation Engineering
8. Information Science and Engineering
9. Mechanical Engineering
10. Mechatronics

B. Tech. Programmes

1. Agricultural Engineering
2. Artificial Intelligence and Data Science
3. Artificial Intelligence and Machine Learning
4. Biotechnology

5. Computer Science and Business Systems
6. Computer Technology
7. Fashion Technology
8. Food Technology
9. Information Technology
10. Textile Technology

3. STRUCTURE OF THE PROGRAMME

3.1 Every programme shall have a distinct curriculum with syllabi consisting of theory, laboratory, project, soft-skills and personality development courses, as prescribed by the respective Boards of Studies, broadly categorized under:

Basic Science (BS) courses including Mathematics, Physics, Chemistry and further specialization in these subjects

Engineering Science (ES) courses including Engineering Graphics, Basics of Electrical / Electronics / Civil / Mechanical, Engineering Mechanics and Computer Programming.

Humanities and Social Sciences (HSS) courses including Language Courses, Management Courses, Soft Skills and Professional Ethics.

Professional Courses(PC) include Discipline Core Courses, Professional Electives, and Open Electives.

Employability Enhancement Courses (EEC) includes Project Work, Mini Project and /or Internship, Seminar, Industrial /Practical Training, Startup Management, Value Added, and Certificate Courses.

The medium of instruction is English for all the Courses (except Tamil), examinations, seminar presentation, projects, and any other courses that a student registers for.

3.2 Each course is normally assigned a certain number of credits based on the following.

Contact period per week	**Credit(s)**
1 Lecture / 1 Tutorial period	1
2 laboratory Periods (Laboratory / Seminar / Project Work / etc.)	1

3.3 All the B.E. / B.Tech. Students will study Communicative English I during the firstsemester. In the second semester, they will be provided an option to enroll and study Communicative English II / German / Japanese / French / Hindi. while the lower segment will study Communicative English II.

3.4 Every student shall be required to opt for 10electives from the list of electives. Students can opt for the electives (Core / Professional) from his / her own discipline courses, during IV to VII Semesters, if he/she satisfies the prerequisite for that particular course.

3.5 However, out of ten electives, every student shall be required to opt for, a minimum of one and subject to a maximum of three courses as open electives from the list of electives of the branch / branches other than his / her branch of specialization, if he/she satisfies the prerequisite for that particular course. The course / content should not be covered in their own curriculum and syllabi.

3.6 Students can also opt for **one-credit courses** of 15 to 20 hours duration, which will be offered by the experts from the industry on specialised topics. Students can opt for such **one-credit courses** during the semesters I to VI as and when these courses are offered. A student will also be permitted to register the **one-credit courses** offered by other departments, provided the student has fulfilled the necessary prerequisites or the courses that may not require any prerequisites. Under no circumstances, the same one credit course shall be repeated in subsequent semesters in any department / centre for the same batch of the students and a maximum batch size for a given course shall not exceed 40. In case of disciplines with multiple divisions (intake more than 60) multiple batches/ different course(s) shall be offered to other batch(es) of students.

On successful completion of one credit courses, credits will be indicated in the grade sheet, but will not be considered for computing the Cumulative Grade Point Average (CGPA). However, if a student wishes to avail the exemption from any one of the electives (other than open elective) of the semester VII, he / she can do so by exercising his / her option in writing to the respective Head of the Department during the beginning of the VII semester, following the equivalence norm, that one **regular elective** (in the **VII Semester**) is equivalent to **three one-credit courses** completed by the student during the previous semesters, III to VI. Details of the one credit courses offered by the department shall be forwarded to the Office of the Controller of Examinations. However, one credit courses completed during I to II semesters shall be maintained in the Grade sheet as "Additional credits earned" (not considered for the computation of SGPA/CGPA).

3.7 A student can register for Self-Study Elective(s) over and above the electives from any branch of Engineering / Technology at the rate of one per semester starting from V semester onwards provided he/she maintains a Cumulative Grade Point Average (CGPA) of 8.50 or above till the previous semesters with no current arrears. Credits will be indicated for such courses in the grade sheets (additional credits) but will not be considered for computing the CGPA.

3.8 A Student may be permitted to credit three online courses with the approval of the Departmental Consultative Committee constituted by the Head of the Department, subject to a maximum of 9 credits. The Head of the Institution shall form a 3-member committee with one of the members as HoD and two senior faculty members to ensure that the student has not studied such courses and would not repeat it again as Professional Core/Professional Elective/Open Elective courses. A student can get exemption for a maximum of 9 credits (refer amendments of R2022 approved in 29th ACM) during the entire programme (in lieu of core elective or open elective). These online courses shall be chosen from the SWAYAM NPTEL platform, provided the offering organisation conducts regular examination and provides marks. The credits earned shall be transferred and the marks earned shall be converted into grades and transferred, provided the student has passed in the examination as per the norms of the offering organisation.

For online courses the following grading pattern is applicable in case of credit transfer and CGPA calculations

Range of percentage of total marks	**Letter Grade**	**Grade Point**
91 - 100	O	10
81 - 90	A+	9
71 - 80	A	8
61 - 70	B+	7
51 - 60	B	6
40-50	C	5
< 40	U	0

3.9 Industrial Training / Internship

The students may undergo Industrial training / Internship optionally for a period as specified in the table during summer / winter vacation and the credits earned will be indicated in the grade sheet. If the student earns three credits in Industrial Training / Internship, the student may drop Professional Elective subjected to a maximum of one. In such cases, Industrial Training / Internship need to be undergone continuously from one organization only. However, if the number of credits earned is 1 or 2, these credits shall not be considered for classification of the degree. The students may also undergo Internship at Research organization / University (after due approval from the Department Consultative Committee) during summer / winter vacation.

Duration of Training / Internship	Credit(s)
2 Weeks	1
4 Weeks	2
6 Weeks	3

3.10 Socially Relevant Projects

A student may be permitted to carry out socially relevant projects during semester II to semester VI in consultation with the faculty guide and submit the project report, in the prescribed format, at the end of the Semester for valuation.

On successful completion of socially relevant project work, one credit will be indicated in the grade sheet (Additional credits), but these credits will not be considered for computing the CGPA.

3.11 Mandatory courses

The student shall study the mandatory courses prescribed by the institute which will be mentioned in the Grade Sheet. However, it will not be considered for computation of CGPA.

For the students who complete the Mandatory Course satisfying the attendance requirement, the title of the Mandatory Course will be mentioned in the Grade Sheet.

3.12 Choice of Professional Elective Courses

The professional Elective Courses are listed in the Curriculum in Table format as verticals (Specialisation groups). A student can choose all the Professional Elective

Courses either from one of the verticals or a combination of courses from all verticals in a semester. However, students irrespective of enrolling for additional Insertion of New Clause 6.3 are not permitted to choose more than one course from a row. Students are permitted to enroll in more than one elective course from the same vertical in a semester. In the subsequent semesters students are permitted to enroll one more course in a row, provided if he/she has cleared the earlier course of the same row. For a professional elective course and open elective course, the minimum number of students enrolment permitted shall be 10. However, the minimum number is not applicable for students enrolling B.E. / B. Tech. (Hons) and B.E. / B. Tech. Minor. For the offer of each professional elective at least two choices shall be offered.

4. VALUE ADDED COURSES

A student can opt for the Value Added Courses offered by the various departments from semester II to VII.A separate certificate will be issued on successful completion of the value added course by the competent authority.

5. DURATION OF THE PROGRAMME

5.1 A regular student (admitted after 10+2) or equivalent is normally expected to satisfactorily fulfil the requirements for award of the degree B.E. / B.Tech. within four academic years (8 semesters) from the date of admission but in any case not more than 7 years (14 Semesters); lateral entry students shall fulfil such requirements within three academic years (6 semesters) from the date of admission but in any case not more than six years (12 semesters) leading to the award of Degree of Bachelor of Engineering (B.E.) / Bachelor of Technology (B.Tech.) of Anna University, Chennai.

5.2 The total period for completion of the programme from the commencement of the semester, to which the student was admitted, shall not exceed the maximum period (Clause 5.1), regardless to the break-of-study (vide Clause 15) or period of prevention in order.

5.3 Each semester shall consist of minimum 75 working days. Head of the Department shall ensure that every faculty member teaches the course as prescribed in the approved curriculum and syllabi.

5.4 Special Theory / Practical Sessions may be conducted for students who require additional inputs (remedial classes) over and above the number of periods normally specified, as decided by the Head of the Department, within the specified duration of the semester / programme.

6. COURSE ENROLLMENT AND REGISTRATION

6.1 Each student, on admission shall be assigned to a faculty advisor (vide Clause 8) who shall advise / counsel the student about the details of the academic programme and the choice of course(s) considering the student's academic background and career objectives.

6.2 Each student shall register for all courses to be undergone in the curriculum of a particular semester (with the facility to drop courses to a maximum of 8 credits (vide clause 6.6)). The courses dropped in earlier semesters can be registered in the subsequent semesters when offered.

Every student shall enrol for the courses of the succeeding semester, in the current semester. However, the student shall confirm the enrolment by registering for the courses within the first five working days after the commencement of the semester concerned.

6.3 The courses that a student registers in a particular semester may include

i. Courses of the current semester.

ii. Courses dropped in the lower semesters

6.4 The maximum number of credits that can be registered in a semester is 30. However, this does not include the number of Re-appearance (RA) and Withdrawal (W) courses registered by the student for the appearance of the examination.

6.4.1 From the V to VIII semesters, the student has the option of registering for additional courses in a semester. With regard to enrolling for B.E. / B. Tech. (Hons) or B.E. / B. Tech. Minor. Maximum number of credits enrolled in a semester (Honours and Minor) shall not exceed 36. The online courses registered for B.E. / B. Tech. (Hons.) and B.E. / B. Tech. minor shall be over and above this 36 credits.

6.5 Flexibility to Drop Courses

6.5.1 A student has to earn the total number of credits specified in the curriculum of the respective programme of study in order to be eligible to obtain the degree. However, if a student wishes, the student is permitted to earn more than the total number of credits prescribed in the curriculum by opting for one credit courses, self-study electives, or additional courses.

6.5.2 From the III to VII semesters (from IV to VII semesters in case of lateral entry students), the student has the option for dropping existing courses. The number of courses a student can drop is limited to 2 in a given semester. The student is permitted to drop the course(s) within 30 days of the commencement of the academic schedule. In such cases, the attendance requirement as stated in Clause 7 is mandatory.

6.5.3 The student shall register Project work I in semester VII and Project work II in semester VIII only.

6.6 Reappearance Registration

6.6.1 If a student fails in a theory course, the student shall do reappearance registration (examination) for that course in the subsequent semesters or when it is offered next.

6.6.2 On registration, a student may attend the classes for the reappearance registration courses, if the student wishes, and the attendance requirement (vide Clause 7) is not compulsory for such courses.

6.6.3 If the theory course, in which the student has failed, is either a professional elective or an open elective, the student may register for Semester End Examinations of the same professional elective or open elective course, respectively in the subsequent semesters.

6.6.4 In this case (Clause 6.6.3), the student shall attend the classes, satisfy the attendance requirements (vide Clause 7), earn Continuous Assessment marks and appear for the Semester End Examination.

6.6.5 The student who fails in any continuous assessment courses shall register for the same in the subsequent semesters or when offered next, and **repeat** the course as per Clause 6.6.4.

6.6.6 If a student is prevented from writing the Semester End Examination of courses due to lack of attendance, the student has to repeat the semester when it is offered next time.

7. REQUIREMENTS FOR APPEARING FOR THE SEMESTER END EXAMINATIONS OF A COURSE

A student who has fulfilled the following conditions (vide Clause 7.1 and 7.2) shall be deemed to have satisfied the attendance requirements for appearing for Semester End Examination of a particular course.

7.1 Every student is expected to attend all the periods and earn 100% attendance. However, a student shall secure not less than 80% overall attendance.

7.2 If a student, secures overall attendance between 70% and less than 80%) in the current semester due to medical reasons (prolonged hospitalization / accident / specific illness) or participation in Institution/ University/ State/ National/ International level extra and co-curricular activities, with prior permission from the Head of the Department, shall be permitted to appear for the current semester examinations subject to the condition that the student shall submit the medical certificate / participation certificate attested by the Head of the Institution (along with condonation form). Such certificates along with the condonation forms shall be forwarded to the Office of the Controller of Examinations for verification and permission to attend the examinations. However, during the entire programme of study, a student can avail such condonation in any two semesters only.

7.3 A student shall normally be permitted to appear for Semester End Examination of the course(s) if the student has satisfied the attendance requirements (vide Clause 7.1 – 7.2) and has registered for examination in those courses of that semester by paying the prescribed fee.

7.4 Students who do not satisfy Clause 7.1 and 7.2 and who secure less than 70% overall attendance would not be permitted to move to the higher semester and has to repeat the current semester in the next academic year as per the norms prescribed.

7.5 In the case of reappearance (Arrear) registration for a course, the attendance requirement as mentioned in Clauses 7.1 - 7.3 is not applicable. However, the student has to register for examination in that course by paying the prescribed fee.

7.6 A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course for improvement of grades.

8. FACULTY ADVISOR

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a faculty member of the department who shall function as faculty advisor for those students. The faculty advisor shall advise and guide the students in registering of courses, reappearance of courses, monitor their attendance and progress and counsel them periodically. The faculty advisor also discusses with or informs the parents about the progress / performance of the students concerned.

The responsibilities of the faculty advisor are:

- To inform the students about the various facilities and activities available to enhance the student's curricular and co-curricular activities.
- To guide student enrolment and registration of the courses.
- To authorize the final registration of the courses at the beginning of each semester.

- To monitor the academic and general performance of the students including attendance and to counsel them accordingly.

9. COMMITTEES

9.1 Common Course Committee

9.1.1 A theory course handled by more than one faculty member including the discipline with multiple divisions (greater than or equal to 2) shall have a "Common Course Committee" comprising of all members of faculty teaching that course with one of the members as the Course Coordinator, nominated by the Head of the Institution (Head of the Department in the case of multiple divisions of a discipline) and student representatives (one per specialization or division) registered for that course in the current semester. First meeting of the Common Course Committee shall be held within fifteen days from the date of commencement of the semester. Two subsequent meetings in a semester may be held at suitable intervals. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to all the students.

9.1.2 In addition to this, Common Course Committee (without the student representatives) shall meet to ensure uniform evaluation through the common question papers during continuous assessment and Semester End Examinations.

9.2 Class Committee Meeting

For all the courses taught, prescribed in the curriculum, Class Committee meeting shall be convened thrice in a semester (first meeting within 15 days from the commencement of the semester and other two meetings at equal interval after the first meeting) comprising members of the faculty handling all the courses and two student representatives from the class.

One of the members of the faculty (preferably not handling any courses to that class), nominated by the Head of the Department, shall coordinate the activities of the committee. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to all other students.

10. SYSTEM OF EXAMINATION

10.1 Performance in each course of study shall be evaluated based on (i) Continuous Assessment throughout the semester and (ii) Semester End Examination at the end of the semester for the regular courses or as given in the Clause 17.

10.2 Each course, both theory, theory with lab component and laboratory including project work, shall be evaluated as per the scheme of assessment given in Clause 17.

10.3 The Semester End Examinations shall normally be conducted after satisfying the Clause 5.2.

10.4 For the Semester End Examinations, both theory, theory with lab component the internal and external examiners (from Academia) shall be appointed by the Controller of Examinations as per the guidelines given by the Examination cum Evaluation committee of the Institute.

11. PASSING REQUIREMENTS AND PROVISIONS

11.1 The Passing requirement for a student in a course is determined based on the marks obtained both in continuous assessment and Semester End Examinations. A student who secures not less than 50% of total marks prescribed for the course [Continuous Assessment + Semester End Examinations] with a minimum of 45% of the marks prescribed for the Semester End Examinations, shall be declared to have passed the course and acquired the relevant number of credits.

11.1.1 If a student fails to secure a pass in a particular course, i.e., failing to obtain minimum marks, as stated above, it is mandatory that he/she shall reappear for the examination in that course in the subsequent semester(s) whenever the examinations are conducted for that course, till he / she secures a 'Pass'.

Continuous Assessment (CA) marks obtained by the student in the first appearance shall be retained and considered valid for one subsequent attempt, except Clause 6.6.4, 6.6.5, 6.6.6 and 6.6.7. However, from the third attempt onwards, the student shall be declared to have passed the course if he/she secures a minimum of 50% in the course prescribed during the Semester End Examinations.

11.2 If a candidate fails in the seventh semester examinations of Project work I, he/she has to resubmit the Project Report within 30 days from the date of declaration of the results. If he / she fails in the Semester End examination of Project work II, he/she shall resubmit the Project Report within 60 days from the date of declaration of the results. The resubmission of the project report and the subsequent viva-voce examination will be considered as reappearance with payment of exam fee. In case a student fails in the resubmission of a project report and subsequent viva-voce examination, the student shall register for the course again, when offered next.

11.3 The passing requirement for the courses which are assessed only through continuous assessment (Laboratory and EEC courses except project work), shall be fixed as minimum 50% and the remaining grades are decided as per clause 12.4. If a candidate fails in EEC courses (Except Project work), he/she has to register and repeat the course within 30 days from the date of declaration of the results. In case a student fails to register within 30 days, he/she shall register for the course again, when offered next.

11.4 The minimum number of total credits to be earned by a student to qualify for the award of degree in the various branches of study as prescribed by the respective Boards of Studies is given below:

Branch of Study	**Minimum Credits**	
	Regular Admission	**Lateral Entry**
B.E. Programmes		
Biomedical Engineering	163	121
Civil Engineering	164	122
Computer Science and Design	163	119
Computer Science and Engineering	163	119
Electrical and Electronics Engineering	163	121
Electronics and Communication Engineering	163	121
Electronics and Instrumentation Engineering	163	121
Information Science and Engineering	162	118
Mechanical Engineering	164	122
*Mechatronics / #Mechatronics Engineering	165	123
B.Tech. Programmes		
Artificial Intelligence and Data Science	165	121
Artificial Intelligence and Machine Learning	163	119
Biotechnology	165	123

Computer Science and Business Systems	163	123
Computer Technology	163	119
Fashion Technology	163	121
Food Technology	163	121
Information Technology	163	119
Textile Technology	163	121

*-applicable to candidates admitted during the AY.:2022-2023

#-applicable to candidates admitted during the AY.:2023-2024 onwards

11.5 Total number of credits to be earned by the student shall be more than or equal to the total number of credits prescribed in the curriculum in force. If the credit assigned for L T P of the courses are not same in two Regulations under consideration, then equivalence shall be arrived as per the credit assignment followed in the Regulations in force.

11.6 Student Migration and Credit Transfer: Normalization of the credits will be carried out in consultation with the Board of Studies of the programme concerned and approved by the Head of the Institution, if a student migrates from other affiliated institutions to Bannari Amman Institution of Technology or rejoins from previous regulation to this regulation.

11.7 A student shall be declared to have qualified for award of B.E/B.Tech. degree if he/she successfully completes the course requirements (vide Clause 7, 10 and 11) and passed all the prescribed courses of study of the respective programme (listed in Clause 2), within the duration specified in Clause 5.1.

12. ASSESSMENT AND AWARD OF LETTER GRADES

12.1 The assessment shall be based on the performance in the Semester End Examinations and/or Continuous Assessments, carrying marks as specified in Clause 17. Letter Grades (based on Credits and Grades) are awarded to the students based on the performance in the evaluation process.

12.2 Credit Point is the product of Grade Point and the number of credits for a course and Grade Point is a numerical weight allotted to each letter grade on a 10-point scale (as specified in Clause 12.4), while the Letter Grade is an index of the performance of a student in a said course.

12.3 Condition for Relative Grading

The students' strength is greater than 30, the relative grading method shall be adopted. If the students' strength is less than or equal to 30 then the absolute grading system shall be followed with the grade range as specified below. The relative grading system shall not be applicable for laboratory, project works and continuous assessment courses.

O	A+	A	B+	B	C	U
91-100	81- 90	71- 80	61-70	56- 60	50–55	<50

12.4 The performance of a student will be reported using Letter Grades, each carrying certain points as detailed below: A student who earns a minimum of 5 grade points in a course is declared to have successfully passed the course.

Description	Letter Grade	Grade Points
Outstanding	O	10
Excellent	A +	9
Very Good	A	8
Good	B +	7
Average	B	6
Satisfactory	C	5
Reappearance	U	0
Withdrawal	W	0
Absent	AB	0
Shortage of Attendance	SA	0

'U' ---Reappearance is required for that particular course

'SA' --- shortage of attendance (Clause 7) and hence prevented from writing end semester examination.

12.5 After completion of the evaluation process, Semester Grade Point Average (SGPA), and the Cumulative Grade Point Average (CGPA) are calculated using the formula:

$$SGPA/CGPA = \frac{\sum_1^n C_i * g_i}{\sum_1^n C_i}$$

Where

C_i : Credit allotted to the course.

g_i : Grade Point secured corresponding to the course.

n : number of courses successfully cleared during the particular semester in the case of SGPA and all the semesters, under consideration, in the case CGPA.

RA grades will be excluded for calculating SGPA and CGPA.

12.6 A student who does not appear for the Semester End Examinations in a course, after registering for the same, shall be deemed to have appeared for that examination for the purpose of classification (Subject to Clause 14 and 15).

12.7 For the non-credit courses grades shall be indicated as given in Clause 17 and shall not be counted for the computation of SGPA/CGPA.

For the co-curricular activities such as NCC / NSS / NSO / YRC etc.., a completed status will appear in the grade sheet. Every student shall put in a minimum of 75% attendance in the training and attend the camp compulsorily. The training and camp shall be completed before registering for the fifth semester courses. A completed status in the co-curricular activities is compulsory for the award of a degree.

12.8 **Revaluation:** A student, who seeks the revaluation of the answer script, is directed to apply through proper application to the Office of the Controller of Examinations in the prescribed format through the Head of the Department. The Office of the Controller of Examinations shall arrange for the revaluation and declare the results. Revaluation is not permitted for the courses other than theory courses. In the case of theory courses with laboratory component, a student can seek revaluation for the theory component only, following the procedure stated above.

12.9 **Eligibility for the Award of Degree**

A student shall be declared to be eligible for the award of the B.E. / B.Tech. degree provided the student has

i. Successfully gained the required number of total credits as specified in the curriculum corresponding to the student's programme within the stipulated time.

ii. Successfully completed the course requirements, appeared for the Semester End Examinations and passed all the courses prescribed in all the 8 semesters within a maximum period of 7 years for regular / 6 years for lateral reckoned from the commencement of the first semester to which the candidate was admitted.

iii. Successfully completed the NCC / NSS / NSO / YRC / Extra-curricular/ Co-curricular requirements.

iv. No disciplinary action is pending against the student.

v. The award of degree must have been approved by the Syndicate of the University.

12.10 Conduct of Academic Audit

The purpose of the academic audit is to encourage departments to evaluate the quality of their education processes, thereby assure and regularly improve the quality of teaching learning process and the outputs. A regular academic audit is conducted in the Institute to evaluate the performance of various departments so that the issues that need attention can be identified to improve the overall quality of curriculum design, teaching learning process, and evaluation. The academic audits are conducted by internal and external academic experts.

12.11 Conduct of Special Examination

The special or makeup exams may be conducted for the students who missed the regular examination due to participation / representing the institute in various activities and the schedule may be included in the academic calendar. The special or makeup exams may be conducted after the completion of Semester End Examinations and prior to publishing the results of semester end examinations.

12.12 In the consolidated grade sheet the CGPA earned shall be convertedinto Percentage of marks as follows: Percentage of Marks = CGPA × 10

13. CLASSIFICATION OF THE DEGREE AWARDED

For the purpose of the 'Award of Degree', the duration of completion of the programme shall be the total duration taken by a student for completing first time registration of all the required courses and satisfying Clause 11, regardless of the period of Break of study as per Clause 15 and satisfy any one of the conditions required as given below.

13.1 First Class with Distinction: A student who satisfies the following conditions shall be declared to have passed the examination in **First class with Distinction**:

- Should have passed the examination in all the courses of all the eight semesters (six semesters for lateral entry students) in the student's First Appearance within five years / four years for lateral, which includes authorised break of study of one year. Withdrawal from examination (vide Clause 15) will not be considered as an appearance.

- Should have secured a CGPA of **not less than 8.50**
- Should **NOT** have been prevented from writing Semester End Examination due to lack of attendance.

13.2 **First Class:** A student who satisfies the following conditions shall be declared to have passed the examination in **First class**:

- Should have passed the examination in all the courses of all eight semesters (six semesters for lateral entry students) within five years / four years for lateral, which includes one year of authorized break of study (if availed) or prevention from writing the Semester End Examination due to lack of attendance (if applicable).
- Should have secured a CGPA of **not less than 6.50**

13.3 **Second Class:** All other students (not covered in clauses 13.1 and 13.2) who qualify for the award of the degree shall be declared to have passed the examination in **Second class.**

14. WITHDRAWAL FROM THE EXAMINATION

14.1 A student may, for valid reasons, be granted permission by the Head of the Department to withdraw from appearing in the examination in any course(s) only once during the entire duration of the degree programme. The application shall be sent to the office of the Controller of Examinations through the Head of the Institution with required documents.

14.2 Withdrawal application shall be valid only, if the student is eligible to write the examination as per Clause 7 and, if it is made within 10 working days before the commencement of the Semester End Examination in that course or courses and also recommended by the Head of the Department.

14.3 Notwithstanding the requirement of mandatory 10 working days notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.

14.4 If a student withdraws a course or courses from writing Semester End Examinations, he/she shall register the same in the subsequent semester and write the Semester End Examination(s).

14.5 Withdrawal shall not be considered as an appearance in the examination for the eligibility of a student for First Class with Distinction or First Class.

14.6 Withdrawal is permitted for the Semester End Examinations in the final semester, only if the period of study of the student concerned does not exceed 5 years (for regular) / 4 years (for lateral) as per clause 13.1 & 13.2.

15. AUTHORIZED BREAK OF STUDY FROM A PROGRAMME

15.1 A student is permitted to go on break of study for a fixed period of one year as a single break in the entire course of study.

15.2 A student is normally not permitted to break the period of study temporarily. However, if a student happens to discontinue the programme temporarily during the middle of programme of study, for reasons such as personal accident or hospitalization due to ill health or in need of health care, he/she shall apply to the Head of the Institution in advance, in any case, not later than the last date for registering for the semester examination, through the Head of the Department stating the reasons for the break of study. However, a student detained for want of minimum attendance requirement as per Clause 7 shall not be considered as permitted 'Break of Study' and Clause 15.3 is not applicable for such case.

15.3 The student is permitted to re-join the programme after the break / prevention due to lack of attendance, shall be governed by the curriculum and regulations in force at the time of rejoining. The students re-joining in new regulations shall apply to the Academic In charge in the prescribed format through the Head of the Department at the beginning of the readmitted semester itself for prescribing additional/equivalent courses, if any, from any semester of the regulations in force, so as to bridge the curriculum in force and the old curriculum.

15.4 Authorized break of study will be counted towards the duration specified for passing all the courses (vide Clause 5.1 and 5.2) and for the purpose of classification of degree (vide Clause 13).

15.5 The total period for completion of the programme reckoned from the commencement of the first semester to which the student is admitted shall not exceed the maximum period specified in Clause 5.1, irrespective of the period of break of study in order that he / she may be eligible, for the award of the degree (vide Clause 13).

15.6 In case of valid reasons (as stated in Clause 15.2) extended break of study may be granted by the Head of the Institution for a period not more than one year in addition to the earlier authorized break of study.

15.7 If a student does not report back to the Institute, even after the extended break of study, the student's name shall be permanently deleted from the college enrollment. Such students are not entitled to seek readmission under any circumstances.

16. IMPLEMENTATION OF HONOURS / MINOR DEGREE

16.1 B.E. / B.Tech. (Hons.)

- The students should have earned additionally a minimum of 18 credits from more than one vertical of the same programme.
- Should have passed all the courses in the first attempt.
- Should have earned a minimum CGPA of 7.50.

16.2 B.E. / B.Tech. Minor in another discipline

The student should have earned additionally a minimum of 18 credits in any one of the verticals of other B.E/B.Tech. programmes.

- B.E / B.Tech. (Hons.) and B.E./B.Tech. Minor in another discipline will be optional for students and the students shall be permitted to select any of them only.
- B.E/B.Tech. (Hons.) or B.E./ B.Tech. Minor shall be offered by the Department irrespective of the number of students enrolled.

If the student has failed in the additional courses or faced a shortage of attendance, they will not be printed in the grade sheet and will not be considered for CGPA calculation and classification of degree.

16.3 Students can earn a maximum of 6 credits in online mode (SWAYAM NPTEL platform), out of these 18 credits with the approval of the Departmental Consultative Committee constituted by the Head of the Department.

16.4 B.E./ B. Tech. (Honours) in the same discipline, B.E. / B.Tech. Honours and B.E. / B.Tech. Minor in another discipline degrees will be optional for students.

16.5 For category 16.1, the students will be permitted to register for the courses from V Semester onwards provided the CGPA earned by the students until semester III should be of 7.50 and above and cleared all the courses in the first attempt.

16.6 For category 16.2, the students will be permitted to register the courses from semester V onwards provided the CGPA earned by the students until semester III is 7.50 and above.

16.7 If a student decides not to opt for Honours, after completing a certain number of additional courses, the additional courses studied shall be considered instead of the professional elective courses which are part of the curriculum. If the student has studied more number of such courses than the number of Professional Elective courses required as per the curriculum, the courses with higher grades shall be considered for the calculation of CGPA. Remaining courses shall be printed in the grade sheet, however, they will not be considered for the calculation of CGPA.

16.8 If a student decides not to opt for Minor degree, after completing a certain number of courses, the additional courses studied shall be considered instead of open elective courses which are part of the curriculum. If the student has studied more of such courses than the number of open electives required as per the curriculum, the courses with higher grades shall be considered for calculation of CGPA. Remaining courses shall be printed in the grade sheet, however, they will not be considered for the calculation of CGPA.

16.9. If a student successfully completes all the requirements of the programme and also meets the requirements of B.E. / B. Tech. (Hons) or B.E. / B. Tech. Minor but desires not to opt for the additional qualification, then he/she has to submit a declaration with regard to the same 30 days before the completion of VIII semester.

16.10 Classification of the Degree Awarded

The conditions for First Class with Distinction, First Class, and Second Class are the same as Clause 13.1, 13.2 and 13.3 except the following classification.

First Class: A student who satisfies the following conditions shall be declared to have passed the examination in First class for the purpose of the 'Award of Degree', of **B.E. / B.Tech.** Honors should have secured a CGPA of not less than 7.50.

17. SCHEME OF ASSESSMENT

Courses offered under B.E. / B.Tech. Programmes are assessed as given below:

I CO- CURRICULAR /EXTRACURRICULAR ACTIVITY

a. CO-CURRICULAR ACTIVITY

Component	Applicable from academic year 2024-2025 onwards
	Marks
Continuous Internal Assessment (CIA)	**100**
Distribution of marks for CIA	
Programme Organization / Participation	20
Member of Technical society (International / National repute like IEEE, IET etc.)	20
Brief Report of event	20
Sharing of Views / Presentation / Seminar	20
Attendance	10
Coordinator Assessment	10
Total Marks	**100**

b. EXTRACURRICULAR ACTIVITY (NCC/NSS/ NON-TECHNICAL CLUBS)

Component	Applicable from academic year 2024-2025 onwards
	Marks
Continuous Internal Assessment (CIA)	**100**
Distribution of marks for CIA	
Activity plan and Programme Organization	20
Participation (National / State / Regional /Institute)	20
Activity Report	20
Achievements	20
Attendance	10
Coordinator Assessment	10
Total Marks	**100**

c. EXTRA CURRICULAR ACTIVITY (SPORTS AND GAMES)

Component	**Applicable from academic year 2024-2025 onwards**
	Marks
Continuous Internal Assessment (CIA)	**100**
Distribution of marks for CIA	
Participation (National / State / Regional /Institute)	20
Regular practice	20
Skill Development	20
Sportsmanship (sports ethics) and Teamwork	20
Achievements	10
Coordinator Assessment	10
Total Marks	**100**

II COMPREHENSIVE WORK

Component	**Applicable till academic year 2022-2023**
	Marks
Concept Application	50
Comprehensive Interview	50
Total Marks	**100**

III ENGINEERING DRAWING

Component	**Applicable till academic year 2023-2024**	**Applicable from academic year 2024-2025 onwards**
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**100**	**50**

Distribution of marks for CIA		
Exercise (Minimum 10 Exercises /Modelling)	60	-
Model Examinations	40	25
Class work	-	05
Assignments (Minimum 8)	-	20
Semester End Examinations (SEE)	**-**	**50**
Total Marks	**100**	**100**

IV ENVIRONMENTAL SCIENCE

Component	**Applicable till academic year 2023-2024**	**Applicable from academic year 2024-2025 onwards**
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**100**	**100**
Distribution of marks for CIA		
Periodical Test I	25	25
Periodical Test II	25	25
Innovative Practices / Case studies (50)	50	-
Assignments / Case studies	-	50
Total Marks	**100**	**100**

V HOSPITAL TRAINING

Component	**Applicable till academic year 2023-2024**	**Applicable from academic year 2024-2025 onwards**
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**100**	**60**
Distribution of marks for CIA		
Assessment by Industry	30	-

Viva-voce	20	-
Presentation	30	-
Case Study / Report	20	-
Daily Work log	-	30
Workplace learning report (1 page)	-	10
Trainer Assessment	-	20
Semester End Examinations (SEE) *a. Presentation* *b. Report* *c. Viva voce*	-	**40** *20* *10* *10*
Total Marks	**100**	**100**

VI HUMAN VALUES AND ETHICS

Component	Applicable till academic year 2023-2024	Applicable from academic year 2024-2025 onwards
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**100**	**40**
Distribution of marks for CIA		
Periodical Test I	25	15
Periodical Test II	25	15
Innovative Practices / Case studies	50	-
Assignments / Case studies	-	10
Semester End Examinations (SEE)	-	**60**
Total Marks	**100**	**100**

VII INDUSTRIAL TRAINING/ INTERNSHIP

Component	Marks
Midterm Review	30
Final Presentation	30
Viva-voce	20

Case Study / Report	20
Total Marks	**100**

VIII LABORATORY COURSES

Component	**Applicable till academic year 2023-2024**	**Applicable from academic year 2024-2025 onwards**
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**100**	**60**
Distribution of marks for CIA		
Preparation	20	10
Experiment and Analysis of Results	20	10
Record	10	10
Test – Cycle I	25	15
Test – Cycle II	25	15
Semester End Examinations (SEE)	-	**40**
Total Marks	**100**	**100**

IX LANGUAGE COURSES

a. LANGUAGE ELECTIVES - COMMUNICATIVE ENGLISH II / HINDI / GERMAN / JAPANESE / FRENCH)

Component	**Applicable till academic year 2023-2024**	**Applicable from academic year 2024-2025 onwards**
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**100**	**50**
Distribution of marks for CIA		
Test1 *a. Listening* *b. Speaking* *c. Reading* *d. Writing*	**25** *5* *10* *5* *5*	**25** *5* *5* *5* *10*
Test 2	**25**	**25**

a. Listening *b. Speaking* *c. Reading* *d. Writing*	*5* *10* *5* *5*	*5* *5* *5* *10*
Oral Exam	**50**	**-**
Semester End Examinations (SEE)	**-**	**50**
Total Marks	**100**	**100**

b. TAMIL COURSES

Component	Applicable till academic year 2023-2024	Applicable from academic year 2024-2025 onwards
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**100**	**40**
Distribution of marks for CIA		
Periodical Test	50	**-**
Quiz/ Assignment	50	20
Case study report	**-**	20
Semester End Examinations (SEE)	**-**	**60**
Total Marks	**100**	**100**

c. FOUNDATIONAL ENGLISH / SOFT SKILLS & EFFECTIVE COMMUNICATION / ADVANCED ENGLISH AND TECHNICAL EXPRESSION

Component	Applicable till academic year 2023-2024	Applicable from academic year 2024-2025 onwards
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**100**	**60**
Distribution of marks for CIA		
Test	**50**	**-**
Quiz/ Assignment	**50**	**-**
Test 1 *a. Listening* *b. Speaking*	**-**	**30** *5* *10*

c. Reading *d. Writing*		*5* *10*
Test 2 *a. Listening* *b. Speaking* *c. Reading* *d. Writing*	-	**30** *5* *10* *5* *10*
Semester End Examinations (SEE)	-	**40**
Total Marks	**100**	**100**

d. BUSINESS COMMUNICATION AND VALUE SCIENCE COURSES

Component	Applicable from academic year 2024-2025 onwards
	Marks
Continuous Internal Assessment (CIA)	**50**
Distribution of marks for CIA	
Periodical Tests	25
Laboratory Assessment	25
Semester End Examinations (SEE) *Laboratory Assessment only*	**50**
Total Marks	**100**

X MINI PROJECT I & II

Component	Applicable till academic year 2023-2024	Applicable from academic year 2024-2025 onwards
	Marks	Marks
Continuous Internal Assessment (CIA)	**100**	**60**
Distribution of marks for CIA		
Review I	25	30
Review II	25	30
Final Presentation and Viva-voce	30	-
Report	20	

Semester End Examinations (SEE) *a. Report* *b. Presentation & Viva Voce*	**-**	**40** *20* *20*
Total Marks	**100**	**100**

XI PROJECT WORK I

Component	Applicable till academic year 2023-2024	Applicable from academic year 2024-2025 onwards
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**50**	**60**
Distribution of marks for CIA		
Review I *a. Literature Survey* *b. Identification of topic and Justification* *c. Work plan* *d. Problem Statement and Literature Survey* *e. Contribution to the work* *f. Viva voce*	**20** *5* *5* *10* - - -	**30** - - *10* *5* *10* *5*
Review II *a. Approach & Results* *b. Conclusion* *c. Methodology & Results* *d. Conclusion with report* *e. Publication* *f. Viva voce*	**30** *15* *15* - - - -	**30** - - *10* *10* *5* *5*
Semester End Examinations (SEE) *a. Report* *b. Presentation* *c. Viva voce*	**50** *20* *20* *10*	**40** *15* *15* *10*
Total Marks	**100**	**100**

XII PROJECT WORK II

Component	Applicable till academic year 2023-2024	Applicable from academic year 2024-2025 onwards
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**50**	**60**

Distribution of marks for CIA		
Review I *a. Progress* *b. Problem Statement and Literature Survey* *c. Methodology* *d. Work Contribution* *e. Viva voce*	**10** *10* - - - -	**20** - *5* *5* *5* *5*
Review II *a. Approach & Results* *b. Work Contribution* *c. Viva voce*	**10** *10* - -	**20** *10* *5* *5*
Review III *a. Conclusion & Final Presentation* *b. Report* *c. Publication of Paper in Conferences / Journals* *d. Results & Discussions* *e. Report and Contribution* *f. Publication* *g. Viva voce*	**30** *10* *15* *5* - - - -	**20** - - - *5* *5* *5* *5*
Semester End Examinations (SEE) *a. Presentation* *b. Viva voce* *c. Report*	**50** *30* *20* -	**40** *15* *10* *15*
Total Marks	**100**	**100**

XIII SOCIALLY RELEVANT PROJECT

Component	**Applicable from academic year 2024-2025 onwards**
	Marks
Continuous Internal Assessment (CIA)	**100**
Distribution of marks for CIA	
Field Survey	20
Problem Statement / Problem Identification and Social Relevance	20
Approach to the Problem / Methodology	20
Presentation / Seminar	10
Sustainable solutions and Future Plans	10
Report	10

Novelty	10
Total Marks	**100**

XIV STARTUP MANAGEMENT

Component	**Applicable till academic year 2023-2024**	**Applicable from academic year 2024-2025 onwards**
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**100**	**50**
Distribution of marks for CIA		
Conduct of Fieldwork / Case Studies & Report	60	25
Model Examination	40	-
Assignments / Experiments & Report	-	25
Semester End Examinations (SEE)	**-**	**50**
Total Marks	**100**	**100**

XV THEORY COURSES

Component	**Marks**
Continuous Internal Assessment (CIA)	**40**
Distribution of marks for CIA	
Periodical Test I	12
Periodical Test II	12
Innovative Practices	16
Semester End Examinations (SEE)	**60**
Total Marks	**100**

XVI THEORY COURSES WITH LAB COMPONENT

<table>
<tr><th rowspan="2">Component</th><th>Applicable till academic year 2023-2024*</th><th>Applicable from academic year 2024-2025 onwards#</th></tr>
<tr><th>Marks</th><th>Marks</th></tr>
<tr><td>Continuous Internal Assessment (CIA)</td><td>50</td><td>50</td></tr>
<tr><td colspan="3">Distribution of marks for CIA</td></tr>
<tr><td>Periodical Test I</td><td>15</td><td rowspan="2">25</td></tr>
<tr><td>Periodical Test II</td><td>15</td></tr>
<tr><td>Innovative Practices
(Laboratory Assessment & Report)</td><td>20</td><td>25</td></tr>
<tr><td>Semester End Examinations (SEE) *
(QP pattern as per (I))</td><td>50</td><td>50</td></tr>
<tr><td>Semester End Examinations (SEE) #
Courses with L T P C: 2 0 2 3
a. Theory Examinations
b. Laboratory Assessment</td><td>-</td><td>25
25</td></tr>
<tr><td>Semester End Examinations (SEE) #
Courses with L T P C: 3 0 2 4, 2 1 2 4, 3 1 2 5
a. Theory Examinations
b. Laboratory Assessment</td><td>-</td><td>35
15</td></tr>
<tr><td align="right">Total Marks</td><td>100</td><td>100</td></tr>
</table>

XVII VALUE-ADDED / CERTIFICATE COURSES

Component	Marks
Daily Assessment	50
Final Evaluation / Test	50
Total Marks	**100**

Optional Test: A student becomes eligible to appear for an optional test conducted after the Periodical Test II, only under the following circumstances: (i) absent for Test I or Test II or both on account of medical reasons (hospitalization / accident / specific illness), or (ii) participation in the College / University / State / National / International level Sports events with prior permission from the Head of the Institution and (iii) on satisfying the conditions (i) or (ii), the student should have registered for the Optional Test, through the concerned member of faculty who handles the course or through the respective Head of the Department, submitted to the Controller of Examinations. Such Optional Tests are conducted for the courses under the categories I and II courses listed above.

18. FIELD / INDUSTRIAL VISIT / INTERNSHIP

In order to provide the experiential learning to the students, Head of the Department shall take efforts to arrange at least two industrial visits / field visits. The students may also undergo in-plant training / internship during summer / winter vacation between III and VII semesters.

19. PERSONALITY AND CHARACTER DEVELOPMENT

Every student shall be required to undergo a minimum of 40 hours of Personality Development Programmes viz, NSS / NCC / YRC / YOGA / Sports and Games / Technical and Non-technical Club activities. The attendance of the personality and character development courses / events shall be maintained on the regular basis by the club coordinator and made available in the Office of the Controller of Examinations before the commencement of Semester examinations of Semester I to Semester IV.

20. DISCIPLINE

A student is expected to follow the rules and regulations laid down by the Institute and the affiliating University, as published from time to time. Any violations, if any, shall be treated as per the procedures stated thereof.

If a student indulges in malpractice in any of the Semester End Examination / Continuous Assessments, he / she shall be liable for punitive action as prescribed by the Institution / University from time to time.

21. REVISION OF REGULATIONS, CURRICULUM AND SYLLABI

The Institution reserves the right to revise/amend/change the Regulations, Curriculum, Syllabi, Scheme of Examinations through the Academic Council.

CONTENTS

VISION OF THE DEPARTMENT

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

MISSION OF THE DEPARTMENT

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

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

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

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

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

PROGRAMME OUTCOMES (POs)

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

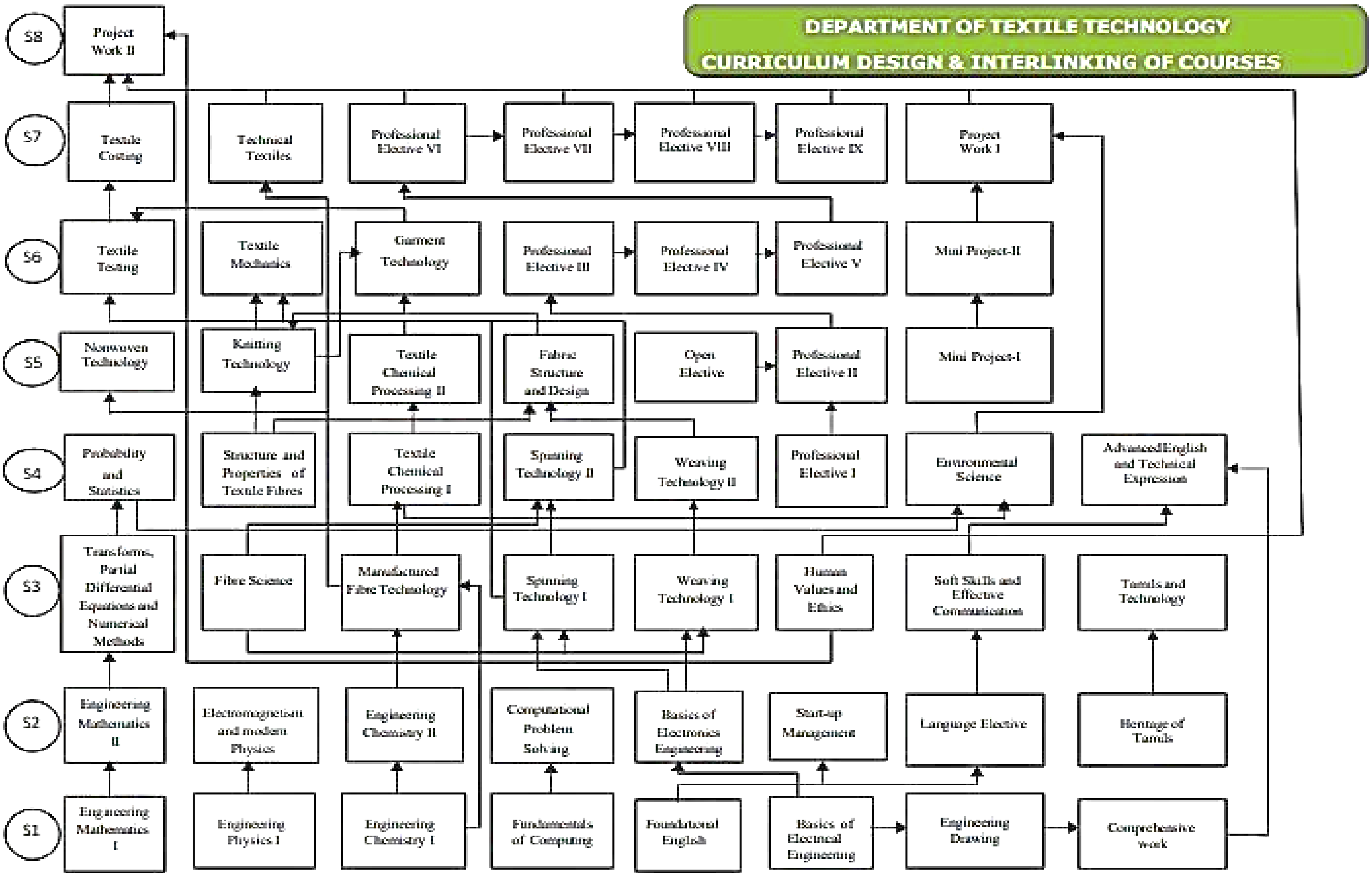
10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

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

MAPPING OF PEOs AND POs

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


DEPARTMENT OF TEXTILE TECHNOLOGY
CURRICULUM DESIGN & INTERLINKING OF COURSES
S8
Project Work II
S7
Textile Costing
Technical Textiles
Professional Elective VI
Professional Elective VII
Professional Elective VIII
Professional Elective IX
Project Work I
S6
Textile Testing
Textile Mechanics
Garment Technology
Professional Elective III
Professional Elective IV
Professional Elective V
Mini Project-II
S5
Nonwoven Technology
Knitting Technology
Textile Chemical Processing II
Fabric Structure and Design
Open Elective
Professional Elective II
Mini Project-I
S4
Probability and Statistics
Structure and Properties of Textile Fibres
Textile Chemical Processing I
Spinning Technology II
Weaving Technology II
Professional Elective I
Environmental Science
Advanced English and Technical Expression
S3
Transforms, Partial Differential Equations and Numerical Methods
Fibre Science
Manufactured Fibre Technology
Spinning Technology I
Weaving Technology I
Human Values and Ethics
Soft Skills and Effective Communication
Tamils and Technology
S2
Engineering Mathematics II
Electromagnetism and modern Physics
Engineering Chemistry II
Computational Problem Solving
Basics of Electronics Engineering
Start-up Management
Language Elective
Heritage of Tamils
S1
Engineering Mathematics I
Engineering Physics I
Engineering Chemistry I
Fundamentals of Computing
Foundational English
Basics of Electrical Engineering
Engineering Drawing
Comprehensive work

DEPARTMENT: B. TECH TEXTILE TECHNOLOGY
R2022 CURRICULUM
Minimum Credits to be Earned: 163

I SEMESTER

Code No.	Course	L	T	P	C	Hours / Week	Maximum Marks			Category
							CIA	SEE	Total	
22MA101	ENGINEERING MATHEMATICS I	3	1	0	4	4	40	60	100	BS
22PH102	ENGINEERING PHYSICS	2	0	2	3	4	50	50	100	BS
22CH103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
22GE001	FUNDAMENTALS OF COMPUTING	3	0	0	3	3	40	60	100	ES
22HS001	FOUNDATIONAL ENGLISH	1	0	2	2	3	100	0	100	HSS
22GE003	BASICS OF ELECTRICAL ENGINEERING	2	0	2	3	4	50	50	100	ES
22GE005	ENGINEERING DRAWING	1	0	2	2	3	100	0	100	ES
22TT108	COMPREHENSIVE WORK	0	0	2	1	2	100	0	100	EEC
Total		**14**	**1**	**12**	**21**	**27**	-	-	-	-

II SEMESTER

Code No.	Course	L	T	P	C	Hours / Week	Maximum Marks			Category
							CIA	SEE	Total	
22MA201	ENGINEERING MATHEMATICS II	3	1	0	4	4	40	60	100	BS
22PH202	ELECTROMAGNETISM AND MODERN PHYSICS	2	0	2	3	4	50	50	100	BS
22CH203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
22GE002	COMPUTATIONAL PROBLEM SOLVING	3	0	0	3	3	40	60	100	ES
22GE004	BASICS OF ELECTRONICS ENGINEERING	2	0	2	3	4	50	50	100	ES
22HS002	START-UP MANAGEMENT	1	0	2	2	3	100	0	100	EEC
	LANGUAGE ELECTIVE	1	0	2	2	3	100	0	100	HSS
*22HS003	தமிழர்மரபு HERITAGE OF TAMILS	1	0	0	1	1	40	60	100	HSS
Total		**15**	**1**	**10**	**21**	**26**	-	-	-	-

* The lateral entry students have to complete these courses during III and IV semesters.

III SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours / Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22TT301	TRANSFORMS, PARTIAL DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS	3	1	0	4	4	40	60	100	BS
22TT302	FIBRE SCIENCE	3	0	2	4	5	50	50	100	PC
22TT303	MANUFACTURED FIBRE TECHNOLOGY	4	0	0	4	4	40	60	100	PC
22TT304	SPINNING TECHNOLOGY I	3	0	2	4	5	50	50	100	PC
22TT305	WEAVING TECHNOLOGY I	3	0	2	4	5	50	50	100	PC
22HS004	HUMAN VALUES AND ETHICS	2	0	0	2	2	40	60	100	HSS
22HS005	SOFT SKILLS AND EFFECTIVE COMMUNICATION	0	0	2	1	2	60	40	100	HSS
22HS006	தமிழரும் ததொழில் நுட்பமும் TAMILS AND TECHNOLOGY	1	0	0	1	1	40	60	100	HSS
Total		**19**	**1**	**8**	**24**	**28**	-	-	-	-

IV SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours / Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22TT401	PROBABILITY AND STATISTICS	3	1	0	4	4	40	60	100	BS
22TT402	STRUCTURE AND PROPERTIES OF TEXTILE FIBRES	3	0	0	3	3	40	60	100	PC
22TT403	TEXTILE CHEMICAL PROCESSING I	3	0	2	4	5	50	50	100	PC
22TT404	SPINNING TECHNOLOGY II	3	0	2	4	5	50	50	100	PC
22TT405	WEAVING TECHNOLOGY II	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE I	3	0	0	3	3	40	60	100	PE
22HS007	ENVIRONMENTAL SCIENCE	2	0	0	-	2	100	0	100	HSS
22HS008	ADVANCED ENGLISH AND TECHNICAL EXPRESSION	0	0	2	1	2	60	40	100	HSS
Total		**20**	**1**	**8**	**23**	**29**	-	-	-	-

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22TT501	NONWOVEN TECHNOLOGY	3	0	0	3	3	40	60	100	PC
22TT502	KNITTING TECHNOLOGY	3	0	2	4	3	50	50	100	PC
22TT503	TEXTILE CHEMICAL PROCESSING II	3	0	2	4	5	50	50	100	PC
22TT504	FABRIC STRUCTURE AND DESIGN	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE II	3	0	0	3	3	40	60	100	PE
	OPEN ELECTIVE	3	0	0	3	3	40	60	100	PE
22TT507	MINI PROJECT I	0	0	2	1	2	60	40	100	EEC
Total		**18**	**0**	**8**	**22**	**24**	-	-	-	-
VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22TT601	TEXTILE TESTING	3	0	2	4	5	50	50	100	PC
22TT602	TEXTILE MECHANICS	3	1	0	4	4	40	60	100	PC
22TT603	GARMENT TECHNOLOGY	3	0	0	3	3	40	60	100	PC
	PROFESSIONAL ELECTIVE III	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE IV	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE V	3	0	0	3	3	40	60	100	PE
22TT607	MINI PROJECT II	0	0	2	1	2	60	40	100	EEC
Total		**18**	**1**	**4**	**21**	**23**	-	-	-	-

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours / Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22TT701	TEXTILE COSTING	3	1	0	4	4	40	60	100	PC
22TT702	TECHNICAL TEXTILES	3	0	0	3	3	40	60	100	PC
	PROFESSIONAL ELECTIVE VI	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE VII	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE VIII	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE IX	3	0	0	3	3	40	60	100	PE
22TT707	PROJECT WORK I	0	0	4	2	4	60	40	100	EEC
Total		**18**	**1**	**4**	**21**	**23**	-	-	-	-

VIII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours / Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22TT801	PROJECT WORK II	0	0	20	10	20	60	40	100	EEC
Total		**0**	**0**	**20**	**10**	**20**	-	-	-	-

ELECTIVES

LANGUAGE ELECTIVES

Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours / Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22HS201	COMMUNICATIVE ENGLISH II	1	0	2	2	3	100	0	100	HSS
22HSH01	HINDI	1	0	2	2	3	100	0	100	HSS
22HSG01	GERMAN	1	0	2	2	3	100	0	100	HSS
22HSJ01	JAPANESE	1	0	2	2	3	100	0	100	HSS
22HSF01	FRENCH	1	0	2	2	3	100	0	100	HSS

ELECTIVES

PROFESSIONAL ELECTIVES

Code No.	Course	L	T	P	C	Hours / Week	Maximum Marks			Category
							CIA	SEE	Total	
VERTICAL I TEXTILE & CLOTHING SCIENCE										
22TT001	COLOUR SCIENCE	3	0	0	3	3	40	60	100	PE
22TT002	TEXTURIZING TECHNOLOGY	3	0	0	3	3	40	60	100	PE
22TT003	THEORY OF SPINNING	3	0	0	3	3	40	60	100	PE
22TT004	HIGH PERFORMANCE FIBRES	3	0	0	3	3	40	60	100	PE
22TT005	THEORY OF WEAVING	3	0	0	3	3	40	60	100	PE
22TT006	CLOTHING SCIENCE	3	0	0	3	3	40	60	100	PE
VERTICAL II TEXTILE MACHINERY AND MAINTENANCE										
22TT007	COSTING AND FINANCIAL MANAGEMENT	3	0	0	3	3	40	60	100	PE
22TT008	MAINTENANCE MANAGEMENT	3	0	0	3	3	40	60	100	PE
22TT009	MANAGERIAL PRACTICES IN TEXTILE INDUSTRIES	3	0	0	3	3	40	60	100	PE
22TT010	UTILITIES ENGINEERING	3	0	0	3	3	40	60	100	PE
22TT011	INDUSTRIAL ENGINEERING	3	0	0	3	3	40	60	100	PE
22TT012	PROCESS CONTROL IN SPINNING AND WEAVING	3	0	0	3	3	40	60	100	PE
VERTICAL III ADVANCES IN TEXTILE AND CHEMICAL PROCESSING										
22TT013	ADVANCES IN CHEMICAL PROCESSING TECHNOLOGY	3	0	0	3	3	40	60	100	PE
22TT014	PROCESS AND QUALITY CONTROL IN TEXTILE CHEMICAL PROCESSING	3	0	0	3	3	40	60	100	PE
22TT015	ENVIRONMENTAL ASPECTS OF DYEING	3	0	0	3	3	40	60	100	PE
22TT016	TEXTILE EFFLUENT TREATMENT	3	0	0	3	3	40	60	100	PE
22TT017	ADVANCED KNITTING TECHNOLOGY	3	0	0	3	3	40	60	100	PE
22TT018	QUANTITATIVE METHODS IN TEXTILE INDUSTRY	3	0	0	3	3	40	60	100	PE

VERTICAL IV GARMENT MANUFACTURING										
22TT019	APPAREL PRODUCTION PLANNING AND CONTROL	3	0	0	3	3	40	60	100	PE
22TT020	PATTERN ENGINEERING	3	0	0	3	3	40	60	100	PE
22TT021	GARMENT PRODUCTION MACHINERY AND EQUIPMENT	3	0	0	3	3	40	60	100	PE
22TT022	MANAGEMENT OF APPAREL UNITS	3	0	0	3	3	40	60	100	PE
22TT023	APPAREL MARKETING AND MERCHANDISING	3	0	0	3	3	40	60	100	PE
22TT024	SUSTAINABILITY IN TEXTILES AND FASHION	3	0	0	3	3	40	60	100	PE
VERTICAL V TECHNICAL TEXTILES										
22TT025	HOME TEXTILES	3	0	0	3	3	40	60	100	PE
22TT026	MEDICAL TEXTILES	3	0	0	3	3	40	60	100	PE
22TT027	TEXTILE COMPOSITES	3	0	0	3	3	40	60	100	PE
22TT028	SPECIALITY TEXTILES	3	0	0	3	3	40	60	100	PE
22TT029	COATED AND LAMINATED TEXTILES	3	0	0	3	3	40	60	100	PE
22TT030	NANO TEXTILES	3	0	0	3	3	40	60	100	PE

HONOURS DEGREE (With Specialization)										
VERTICAL V TECHNICAL TEXTILES										
22TTH25	HOME TEXTILES	3	0	0	3	3	40	60	100	PE
22TTH26	MEDICAL TEXTILES	3	0	0	3	3	40	60	100	PE
22TTH27	TEXTILE COMPOSITES	3	0	0	3	3	40	60	100	PE
22TTH28	SPECIALITY TEXTILES	3	0	0	3	3	40	60	100	PE
22TTH29	COATED AND LAMINATED TEXTILES	3	0	0	3	3	40	60	100	PE
22TTH30	NANO TEXTILES	3	0	0	3	3	40	60	100	PE

MINOR DEGREE (Other than TXT Students)									
VERTICAL V TECHNICAL TEXTILES									
22TTM25	HOME TEXTILES	3	0	3	3	3	40	60	100	PE
22TTM26	MEDICAL TEXTILES	3	0	0	3	3	40	60	100	PE
22TTM27	TEXTILE COMPOSITES	3	0	0	3	3	40	60	100	PE
22TTM28	SPECIALITY TEXTILES	3	0	0	3	3	40	60	100	PE
22TTM29	COATED AND LAMINATED TEXTILES	3	0	0	3	3	40	60	100	PE
22TTM30	NANO TEXTILES	3	0	0	3	3	40	60	100	PE

ONE CREDIT COURSES										
22TT0XA	ENERGY MANAGEMENT IN TEXTILE INDUSTRY	1	0	0	1	-	100	0	100	EEC
22TT0XB	RECYCLING OF TEXTILE MATERIALS	1	0	0	1	-	100	0	100	EEC
22TT0XC	ECO-FRIENDLY DYEING TECHNIQUES	1	0	0	1	-	100	0	100	EEC
22TT0XD	SUSTAINABLE DENIM PROCESSING AND FINISHING	1	0	0	1	-	100	0	100	EEC
22TT0XE	ECO-FRIENDLY HOME TEXTILE PRODUCTS	1	0	0	1	-	100	0	100	EEC

OPEN ELECTIVES

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22OCE01	ENERGY CONSERVATION AND MANAGEMENT	3	0	0	3	3	40	60	100	OE
22OCS01	OBJECT ORIENTED PROGRAMMING	3	0	0	3	3	40	60	100	OE
22OCS02	JAVA FUNDAMENTALS	3	0	0	3	3	40	60	100	OE
22OCS03	KNOWLEDGE DISCOVERY IN DATABASES	3	0	0	3	3	40	60	100	OE
22OCS04	E-LEARNING TECHNIQUES	3	0	0	3	3	40	60	100	OE
22OCS05	SOCIAL TEXT AND MEDIA ANALYTICS	3	0	0	3	3	40	60	100	OE
22OME01	DIGITAL MANUFACTURING	3	0	0	3	3	40	60	100	OE
22OME02	INDUSTRIAL PROCESS ENGINEERING	3	0	0	3	3	40	60	100	OE
22OME03	MAINTENANCE ENGINEERING	3	0	0	3	3	40	60	100	OE
22OME04	SAFETY ENGINEERING	3	0	0	3	3	40	60	100	OE
22OBT01	BIOFUELS	3	0	0	3	3	40	60	100	OE
22OFD01	TRADITIONAL FOODS	3	0	0	3	3	40	60	100	OE
22OFD02	FOOD LAWS AND REGULATIONS	3	0	0	3	3	40	60	100	OE

22OFD03	POST HARVEST TECHNOLOGY OF FRUITS AND VEGETABLES	3	0	0	3	3	40	60	100	OE
22OFD04	CEREAL, PULSES AND OIL SEED TECHNOLOGY	3	0	0	3	3	40	60	100	OE
22OFT01	FASHION CRAFTSMANSHIP	3	0	0	3	3	40	60	100	OE
22OFT02	INTERIOR DESIGN IN FASHION	3	0	0	3	3	40	60	100	OE
22OFT03	SURFACE ORNAMENTATION	3	0	0	3	3	40	60	100	OE
22OPH01	NANOMATERIALS SCIENCE	3	0	0	3	3	40	60	100	OE
22OPH02	SEMICONDUCTOR PHYSICS AND DEVICES	3	0	0	3	3	40	60	100	OE
22OPH03	APPLIED LASER SCIENCE	3	0	0	3	3	40	60	100	OE
22OPH04	BIO-PHOTONICS	3	0	0	3	3	40	60	100	OE
22OPH05	PHYSICS OF SOFT MATTER	3	0	0	3	3	40	60	100	OE
22OCH01	CORROSION SCIENCE AND ENGINEERING	3	0	0	3	3	40	60	100	OE
22OCH02	POLYMER SCIENCE	3	0	0	3	3	40	60	100	OE
22OCH03	ENERGY STORING DEVICES	3	0	0	3	3	40	60	100	OE
22OMA01	GRAPH THEORY AND COMBINATORICS	3	0	0	3	3	40	60	100	OE
22OGE01	PRINCIPLES OF MANAGEMENT	3	0	0	3	3	40	60	100	OE
22OGE02	ENTREPRENEURSHIP DEVELOPMENT I	3	0	0	3	3	40	60	100	OE
22OGE03	ENTREPRENEURSHIP DEVELOPMENT II	3	0	0	3	3	40	60	100	OE
22OGE04	NATION BUILDING, LEADERSHIP AND SOCIAL RESPONSIBILITY	3	0	0	3	3	40	60	100	OE
22OAI01	FUNDAMENTALS OF DATA SCIENCE	3	0	0	3	3	40	60	100	OE
22OAM01	COMPUTER VISION IN HEALTHCARE APPLICATION	3	0	0	3	3	40	60	100	OE
22OAM02	NEURAL NETWORKS	3	0	0	3	3	40	60	100	OE
22OBM01	OCCUPATIONAL SAFETY AND HEALTH IN PUBLIC HEALTH EMERGENCIES	3	0	0	3	3	40	60	100	OE
22OBM02	AMBULANCE AND EMERGENCY MEDICAL SERVICE MANAGEMENT	3	0	0	3	3	40	60	100	OE
22OBM03	HOSPITAL AUTOMATION	3	0	0	3	3	40	60	100	OE
22OIT01	DATA STRUCTURES	3	0	0	3	3	40	60	100	OE
22OIT02	C++ PROGRAMMING	2	0	2	3	3	50	50	100	OE
22OIT03	PROGRAMMING USING JAVA	2	0	2	3	3	50	50	100	OE
22OAG01	RAIN WATER HARVESTING TECHNIQUES	3	0	0	3	3	40	60	100	OE
22OEE01	VALUE ENGINEERING	3	0	0	3	3	40	60	100	OE
22OEE02	ELECTRICAL SAFETY	3	0	0	3	3	40	60	100	OE
22OIT04	FUNDAMENTALS OF DATABASE MANAGEMENT SYSTEMS	2	0	2	3	3	50	50	100	OE
22OCB01	INTERNATIONAL BUSINESS MANAGEMENT	3	0	0	3	3	40	60	100	OE
22OCE02	COST MANAGEMENT OF ENGINEERING PROJECTS	3	0	0	3	3	40	60	100	OE

22MA101 ENGINEERING MATHEMATICS I 3 1 0 4

Course Objectives

- To impart mathematical modelling to describe and explore real-world phenomena and data.
- To provide basic understanding on Linear, quadratic, power and polynomial, exponential, and multivariable models.
- Summarize and apply the methodologies involved in framing the real-world problems related to fundamental principles of polynomial equations.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Implement the concepts of mathematical modelling based on linear functions in Engineering.
2. Assess the real-world problems as a quadratic function model.
3. Execute the real-world phenomena and data into Power and Polynomial functions.
4. Apply the concept of mathematical modelling of exponential functions in Engineering.
5. Create the identification of multivariable functions in the physical dynamical problems.

Articulation Matrix

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

UNIT I **9 Hours**

MATHEMATICS MODELING OF LINEAR FUNCTIONS

The geometry of linear equations - Formation of linear equations: Method of least squares and method of regression - Vector spaces: Basic concepts with examples - Linear combination - Eigen values and vectors

UNIT II **9 Hours**

MATHEMATICAL MODELING OF QUADRATIC FUNCTIONS

General form of a quadratic function - Basic relationships between the equation and graph of a quadratic function - Sum of squares error and the quadratic function of best fit - Quadratic forms: Matrix form - Orthogonality - Canonical form and its nature

UNIT III **9 Hours**

MATHEMATICAL MODELING OF POWER AND POLYNOMIAL FUNCTIONS

Characteristics of the graphs of power and polynomial functions - Fitting of power and polynomial functions using the method of least squares - Local maxima and local minima of power and polynomial functions - Power series of functions with real variables, Taylors series, radius and interval of convergence - Tests of convergence for series of positive terms - comparison test, ratio test

UNIT IV **9 Hours**

MATHEMATICAL MODELING OF EXPONENTIAL FUNCTIONS

Concept of exponential growth - Graphs of exponential functions - Relationship between the growth factor and exponential growth or decline - Exponential equations have a variable as an exponent and take the form $y = ab^x$ through least square approximation - Calculus of exponential functions - Exponential series - Characteristics

UNIT V **9 Hours**

MATHEMATICAL MODELING OF MULTIVARIABLE FUNCTIONS

Graphing of functions of two variables - Partial derivatives - Total derivatives - Jacobians - Optimization of multivariable functions with constraints - Optimization of multivariable functions without constraints

Tutorial: 15 Hours
Total: 60 Hours

Reference(s)

1. Erwin Kreyszig, Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi, 2016.
2. B. S. Grewal, Numerical Methods in Engineering & Science: With Programs in C, C++ & MATLAB, Khanna Publishers, 2014.
3. S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2020.
4. Thomas and Finney, Calculus and Analytic Geometry, Fourteenth Edition, By Pearson Paperback, 2018.

22PH102 ENGINEERING PHYSICS 2 0 2 3

Course Objectives

- Understand the concept and principle of energy possessed by mechanical system
- Exemplify the propagation and exchange of energy
- Identify the properties of materials based on the energy possession

Programme Outcomes (POs)

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

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

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

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

Course Outcomes (COs)

1. Implement the concept and principles of energy to understand mechanical systems
2. Execute the types of mechanical oscillations based on vibrational energy
3. Analyse the concept of propagation of energy as transverse and longitudinal waves
4. Analyze the exchange of energy and work between the systems using thermodynamic principles
5. Apply the concept of energy and entropy to understand the mechanical properties of materials

Articulation Matrix

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

UNIT I **6 Hours**

CONSERVATION OF ENERGY

Concept of energy - types of energy - conservation of energy Mechanical energy: - translation - rotation - vibration - Kinetic and potential energies - conservation - work and energy - laws of motion - minimization of potential energy - equilibrium - dissipative systems - friction

UNIT II **5 Hours**

VIBRATIONAL ENERGY

Periodic Motion - Simple Harmonic Motion - Energy of the SHM - Pendulum types - Damped oscillations - forced oscillations - natural frequency - resonance

UNIT III **6 Hours**

PROPAGATION OF ENERGY
Transfer of energy - material medium - Transverse wave - Longitudinal wave - standing wave - interference - Doppler effect. Sound waves and its types - characteristics - human voice - reflection - refraction - beats

UNIT IV **7 Hours**

EXCHANGE OF ENERGY
Energy in transit - heat - Temperature - measurement - specific heat capacity and water - thermal expansion - Heat transfer processes. Thermodynamics: Thermodynamic systems and processes - Laws of thermodynamics - Entropy - entropy on a microscopic scale - maximization of entropy

UNIT V **6 Hours**

ENERGY IN MATERIALS
Elastic energy - Structure and bonding - Stress-strain - Tension and compression - elastic limit - Elastic Modulus - Stress - strain diagram - ductility - brittleness - rubber elasticity and entropy

EXPERIMENT 1 **5 Hours**
Determination of resultant of system of concurrent coplanar forces - Parallelogram law of forces.

EXPERIMENT 2 **5 Hours**
Determination of moment of inertia - Torsional pendulum.

EXPERIMENT 3 **5 Hours**
Determination of thickness of a thin wire using interference of light - Air wedge method

EXPERIMENT 4 **4 Hours**
Determination of AC frequency using Meldes apparatus

EXPERIMENT 5 **3 Hours**
Determination of thermal conductivity of a bad conductor using Lees disc method

EXPERIMENT 6 **4 Hours**
Wavelength of ultrasonics in a liquid medium
(ii) velocity of ultrasonic waves in the given liquid
(iii) compressibility of the given liquid using the ultrasonic interferometer

EXPERIMENT 7 **4 Hours**
Determination of Youngs modulus of a given material- Non uniform bending method

Total: 60 Hours

Reference(s)

1. C J Fischer, The energy of Physics Part I: Classical Mechanics and Thermodynamics, Cognella Academic Publishing, 2019.
2. P G Hewitt, Conceptual Physics, Pearson education, 2017.
3. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2019.
4. J Walker, D Halliday and R Resnick, Principles of Physics, John Wiley and Sons, Inc, 2018.
5. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017.

22CH103 ENGINEERING CHEMISTRY I 2 0 2 3

Course Objectives

- Understand the origin of elements from the universe
- Outline the properties of elements in the periodic table
- Analyse the different types of bonds formed during chemical reactions and its reaction thermodynamics
- Summarize different states of matter based on atomic arrangement

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Resolve the nuclear transmutation reactions that lead to the formation of elements in the universe
2. Assess atomic structure of elements in the periodic table and interpret the periodic trends in properties of elements with its anomaly
3. Apply the conditions for the formation of different types of chemical bonds and predict the minimum energy required for a reaction to occur
4. Analyse endothermic and exothermic processes and exchange of energy during chemical reactions
5. Analyse whether the given matter is a solid, liquid, gas, or plasma and interpret the arrangement of atoms

Articulation Matrix

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

UNIT I **5 Hours**

ORIGIN OF ELEMENTS

Hydrogen - Elements and Sun - fusion - hypernova - supernova - dying stars - man-made elements

UNIT II **7 Hours**

ATOMIC STRUCTURE AND PERIODICITY

Atomic Structure - Electronic configuration - Periodic Table - Periodic trends in properties of elements - Anomalous behaviour in periodicity

UNIT III **6 Hours**

CHEMICAL BONDING
Octet rule & its limitations - types of chemical bonds - bond energy - bond cleavage - activation energy of reactions

UNIT IV **6 Hours**

REACTION THERMODYNAMICS
Conservation of energy - Endothermic reactions & exothermic reactions - Exchange of energy involved in chemical reactions

UNIT V **6 Hours**

STATES OF MATTER
Solid - liquid - gas - plasma - quantum dots - arrangement of atoms/ions/molecules in different phases

EXPERIMENT 1 **2 Hours**
Lab safety rules and guidelines for students - OSHA Guidelines

EXPERIMENT 2 **3 Hours**
Estimation of dissolved oxygen content in a water sample(s) by Winkler's method

EXPERIMENT 3 **4 Hours**
Determination of Fe(II) in a sample using a spectrophotometer

EXPERIMENT 4 **3 Hours**
Estimation of chromium content in a water sample by volumetric analysis

EXPERIMENT 5 **3 Hours**
Estimation of chloride present in the given water sample by argentometric method

EXPERIMENT 6 **3 Hours**
Conductometric titration of mixture of acids

EXPERIMENT 7 **4 Hours**
Estimation of magnesium ions in given solution by EDTA method

EXPERIMENT 8 **4 Hours**
Preparation of salt of fatty acid by saponification process

EXPERIMENT 9 **4 Hours**
Recrystallization of aspirin from water/ethanol

Total: 60 Hours

Reference(s)

1. Peter Atkins, Physical Chemistry, Oxford University Press, 2019.
2. Rose Marie Gallagher and Author Paul Ingram, Complete Chemistry Cambridge IGCSE, Oxford University Press, 2020.
3. P L Soni, Textbook of inorganic chemistry, Chand Publishers, New Delhi, 2017.
4. J.D. Lee, Concise inorganic chemistry, Blackman Science Ltd, France, Wiley-India, 5^{th} edition (Reprint), 2016.
5. Gareth Price, Thermodynamics of chemical processes, Oxford University Press, 2019.
6. D Tabor, Gases, liquids and solids and other states of matter, Oxford University Press, 2018.

22GE001 FUNDAMENTALS OF COMPUTING 3 0 0 3

Course Objectives

- Understand the fundamental digital logics behind computations of computer systems.
- Develop simple assembly language programs with respect to arithmetic operations.
- Understand the program execution process and basics of software development methodologies.

Programme Outcomes (POs)

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

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

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

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

Course Outcomes (COs)

1. Execute the hidden languages and inner structures of computer hardware and software through codes and combinations.
2. Implement the organizational and architectural issues of a digital computer with concepts of various data transfer techniques in digital computers and the I/O interfaces.
3. Analyse programming problems and apply assembly instructions to solve simple problems.
4. Analyse the fundamentals of operating system and System programs basics.
5. Apply the software development methodologies to various real-life scenarios.

Articulation Matrix

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

UNIT I **8 Hours**

CODES AND COMBINATIONS

Communication using Mores and Braille binary codes - Digitizing letters, numbers and objects using binary codes - Performing simple operations: addition through binary codes.

UNIT II **9 Hours**

COMPUTATION USING COMPUTER

Communication to computing devices through various input sources - Computational operation - flow, functions and controls - communication to output devices - Basic communication protocol.

UNIT III **11 Hours**

ASSEMBLY LANGUAGE PROGRAMMING

Little Man Computing (LMC) Model - Instruction Set - Labels - Calculation -Branching - Input - Output - Loops - Simple programs.

UNIT IV **9 Hours**

OPERATING SYSTEM AND APPLICATION GENERATION

BIOS - Device Drivers - Resources - Scheduler - Applications Generation and Creation - Stages of Compilation - Linkers, Loaders and Libraries.

UNIT V **8 Hours**

SOFTWARE DEVELOPMENT

Phases of application life cycle management - Software Development Methodologies - Web Page development.

Total: 45 Hours

Reference(s)

1. Charles Petzold, "Code: The Hidden Language of Computer Hardware and Software", Microsoft Press books, 2009.
2. David D. Riley, Kennya. Hunt, "Computational thinking for the modern problem Solver", CRC Press Taylor & Francis Group, 2014.
3. Andrew Eliaz, "Little Man Computer Programming: For the Perplexed from The Ground Up", The Internet Technical Bookshop; 1st edition, 2016.
4. Abraham Silberschatz, "Peter Baer Galvin and Greg Gagne, Operating System Concepts", 9^{th} Edition, John Wiley & Sons Pvt. Ltd, 2015.
5. Roger S. Pressman, "Software Engineering: A Practitioner’s Approach", McGraw Hill International edition, Seventh edition, 2010.

22HS001 FOUNDATIONAL ENGLISH 1 0 2 2

Course Objectives

- Heighten awareness of grammar in oral and written expression
- Improve speaking potential in formal and informal contexts
- Improve reading fluency and increased vocabulary
- Prowess in interpreting complex texts
- Fluency and comprehensibility in self-expression
- Develop abilities as critical readers and writers
- Improve ability to summarize information from longer text, and distinguish between primary and supporting ideas

Programme Outcomes (POs)

PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Course Outcomes (COs)

1. Express themselves in a professional manner using error-free language
2. Express in both descriptive and narrative formats
3. Interpret and make effective use of the English Language in Business contexts
4. Actively read and comprehend authentic text
5. Express opinions and communicate experiences.

Articulation Matrix

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

UNIT I **15 Hours**

SELF-EXPRESSION

Self-Introduction-Recreating Interview Scenarios (with a focus on verbal communication)-Subject Verb Concord - Tenses - Common Errors in verbal communication Be-verbs Self-Introduction-Recreating interview scenarios-Haptics-Gestures-Proxemics-Facial expressions- Paralinguistic/ Vocalic- Body Language- Appearance-Eye Contact-Artefacts Self-Introduction-Powerful openings and closings at the interview-Effective stock phrases - Modified for spontaneity and individuality-Question tags, framing questions including WH- questions- Prepositions-Listening to Ted talks-Listening for specific information.

UNIT II **15 Hours**

CREATIVE EXPRESSION

Descriptive Expression-Picture Description and Blog Writing -Vocabulary-One-word substitution-Adjectives-Similes, Metaphors, Imagery & Idioms -Link words - Inclusive language Narrative Expression- Travelogue and Minutes of Meeting -Verbal Analogy-Sequence & Time order words - Jumbled paragraph, sentences, Sequencing-Text & Paragraph Completion-Past tense -Using quotation marks.

UNIT III **15 Hours**

FORMAL EXPRESSION

Formal Letters and Emails-Writing: E-mails and Letters of apology, Requisition and Explanation, and Letters to newspapers-Speaking: Tendering verbal apologies, and explanations, persuading a listener/ audience-Hierarchy in Business correspondence- Subject of a mail, Header, Body (Salutation) and Footer of a mail- Conjunctional clause Punctuation-Formal Idioms-Phrases-Articles - Definite & Indefinite-Types of sentences-Modal verbs Precision in comprehension, Summary writing, Selective summary-Reading: Active reading- short paragraphs, excerpts, articles and editorials-Skimming and Scanning Reading comprehension & analysis- Tenses, QP/ PQ approach. Identifying the central themes/ crux-Interpreting tone - formal/informal/semi-formal-Note-taking-Listening: Listening for data, for specific information, for opinion-Active and passive Listening-Transcription-Paraphrasing and summarizing information-Agreeing & disagreeing-Note-taking-Writing: Summary writing, selective summary, paraphrasing, note-making, opinion pieces-Finding synonyms in the context Paraphrasing-Sentence Transformation - simple, compound, complex. Sentence Substitution-Sentence completion-Interpreting paragraphs

Total: 45 Hours

Reference(s)

1. Sasikumar, V, et.al. A Course in Listening & Speaking Foundation Books, 2005.
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
3. Prasad, Hari Mohan. A Handbook of Spotting Errors. McGraw Hill Education, 2010.
4. Reynolds, John. Cambridge IGCSEÃ‚Â® First Language English. 18th edition., Hodder Education, 2018.
5. Wiggins, Grant P., and Jay McTighe. Understanding by Design. Association for Supervision and Curriculum Development, 2008.

22GE003 BASICS OF ELECTRICAL ENGINEERING 2 0 2 3

Course Objectives

- To understand the basic concepts of electrical charge and its properties
- To interpret the formation of electric field due to electric charges
- To illustrate the concept of magnetic fields due to revolving electron
- To illustrate the force on moving charges in electric and magnetic field
- To understand the energy transfer in electro mechanical conversion

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Execute the behaviour of electric charges in different medium using coulombs law.
2. Analyse the electric field due to different charge distributions.
3. Assess the magnetic field intensity due to long conductor, solenoid, toroid and magnetic dipoles.
4. Analyse the force on conductors due to the moving charges.
5. Apply the energy conversion concepts in electromagnetic fields.

Articulation Matrix

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

UNIT I **5 Hours**

ELECTRIC CHARGE

Properties of charge, additivity of charges, quantization of charge, conservation of charge, Forces between multiple charges, Electric charge in conductors, Drift of Electrons, Charges in Clouds.

UNIT II **7 Hours**

ELECTRIC FIELD

Electric field due to system of charges, Significance of Electric field line. Electric Dipole and its significance, Continuous charge distribution, Field in infinite long uniform straight conductors, field in uniform charged uniform infinite plane sheet, field due to uniform thin spherical sheet.

UNIT III **7 Hours**

MAGNETIC FIELDS

Concept of magnetic field, magnetic fields in infinitely long straight wire, straight and toroidal solenoids, Magnetic dipole moment of a revolving electron, Magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to axis, Induced Electric field due to changing Magnetic Field.

UNIT IV **6 Hours**

FORCE ON CHARGES

Force on a moving charge in uniform magnetic and electric fields, Force on a current carrying conductor in a uniform magnetic field, Force between two parallel current carrying conductors.

UNIT V **5 Hours**

ELECTRO MECHANICAL ENERGY CONVERSION

Energy transfer in electromagnetic fields, Energy storage in magnetic field, Electromagnetic induction, induced emf, Eddy currents. Self and mutual inductance Linear Momentum and Angular Momentum carried by Electromagnetic Fields.

EXPERIMENT 1 **15 Hours**

Analyse and design of Electromechanical energy conversion system.

EXPERIMENT 2 **15 Hours**

Develop an electrical machine and analyse its performance with supplied input of AC from 0 V to 230V.

Total: 60 Hours

Reference(s)

1. Mathew N. O. Sadiku, Principles of Electromagnetics, 6^{th} Edition, Oxford University, 2020.
2. William H. Hayt and John A. Buck, Engineering Electromagnetics, McGraw Hill, 2020.
3. Kraus and Fleisch, Electromagnetics with Applications, McGraw Hill International Editions, 2017.
4. S.P.Ghosh, Lipika Datta, Electromagnetic Field Theory, First Edition, McGraw Hill Education(India) Private Limited, 2017.

22GE005 ENGINEERING DRAWING 1 0 2 2

Course Objectives

- To provide knowledge on fundamentals of engineering drawings and conic sections.
- To impart skill on orthographic projections of points and lines.
- To familiarize on projection of planes and simple solids.
- To provide knowledge on section of solids and development of surfaces of simple solids.
- To impart skill on conversion of isometric view to orthographic projection and vice versa.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PSO1: Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **7 Hours**

FUNDAMENTALS OF ENGINEERING DRAWING

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

UNIT II **9 Hours**

PROJECTION OF POINTS AND LINES

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

UNIT III **9 Hours**

PROJECTION OF PLANES AND SOLIDS
Projection of simple planes and projection of simple solids - parallel - perpendicular and inclined to one plane using change of position method - inclined to both the planes.

UNIT IV **9 Hours**

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES
Section of Solids - simple position with cutting plane parallel - perpendicular and inclined to one plane with true shape of section. Development of surfaces - simple and truncated solids.

UNIT V **11 Hours**

ORTHOGRAPHIC PROJECTIONS AND ISOMETRIC VIEW
Orthographic projections and isometric view of components used in engineering applications.

Total: 45 Hours

Reference(s)

1. N. D. Bhatt and V. M. Panchal, Engineering Drawing, Charotar Publishing House Pvt. Limited, 2019.
2. K.V. Natarajan, A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 2013.
3. K Venugopal, Engineering Drawing and Graphics, Sixth edition, New Age International, 2013.
4. Basant Agarwal, Mechanical drawing, Tata McGraw-Hill Education, 2013.
5. Engineering Drawing Practice for Schools & Colleges, Bureau of Indian Standards - Sp46, 2013.

22MA201 ENGINEERING MATHEMATICS II 3 1 0 4

Course Objectives

- To impart and analyse the concepts of differential equations to describe in real-world phenomena.
- To provide basic understanding on differential equation models and vector field models.
- Summarize and apply the methodologies involved in framing the real-world problems related to fundamental principles of complex functions.

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Apply the concept of differential equations through mathematical modelling and analyse its applications in engineering
2. Execute the real-world problems as second order linear differential equations and give solutions for the same
3. Create the real-world phenomena with magnitude and direction in the form of vector functions
4. Apply the concept of vector fields and line integrals through mathematical modelling in engineering
5. Resolve complex functions and apply them to formulate problems arising in engineering

Articulation Matrix

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

UNIT I **9 Hours**

FIRST ORDER LINEAR DIFFERENTIAL EQUATIONS

Formation of differential equations- Solutions of first order linear ODE: Leibnitz's and method of separation of variables - Cooling/Heating of an object - A falling object - Modelling of electric circuits: RL and RC circuits - Modelling of population dynamics: Exponential growth and decay - Logistic growth model.

UNIT II **9 Hours**

SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS

Methods of solving second order linear ordinary differential equations - Models for linear oscillators: Simple harmonic motion - Mechanical vibrations with and without damping - Electric circuit system: RLC circuits.

UNIT III **9 Hours**

VECTOR DIFFERENTIAL CALCULUS

Vector and scalar functions - Fields - Derivative of a vector function and geometrical interpretation - Velocity and acceleration - Gradient and its properties - Tangent and normal vectors - Directional derivative - Divergence of a vector field - Curl of a vector field - Projectile motion.

UNIT IV **9 Hours**

VECTOR INTEGRAL CALCULUS

Line integrals of vector point functions - Surface integral of vector point functions - Applications of line and surface integrals - Greens theorem in a plane - Stokes theorem - Gauss divergence theorem.

UNIT V **9 Hours**

COMPLEX FUNCTIONS

Basic concepts of Complex numbers- Geometrical representation of complex number - Analytic functions and its properties - Construction of Analytic functions: Fluid flow and Electric flow - Mapping of complex functions.

Tutorial: 15 Hours
Total: 60 Hours

Reference(s)

1. Richard E. Williamson, Introduction to Differential Equations and Dynamical Systems, McGraw Hill Companies. Inc, 1997.
2. Michael Greenberg, Advanced Engineering Mathematics, Second Edition, Pearson Education, 2018.
3. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, Thirteenth Edition, Pearson Education, 2013.
4. Erwin Kreyszig, Advanced Engineering Mathematics, Tenth Edition, Wiley, 2015.
5. J. Stewart, Essential Calculus, Second Edition, Cengage, 2017.

22PH202 ELECTROMAGNETISM AND MODERN PHYSICS

2 0 2 3

Course Objectives

- Understand the principles and mechanisms of electricity and magnetism
- Infer the classification of electromagnetic waves
- Analyse the theory of relativity and energy bands

Programme Outcomes (POs)

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

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

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

Course Outcomes (COs)

1. Execute the principles and mechanism of electrostatics and current.
2. Implement the principles and mechanism of magneto statics.
3. Organize electromagnetic waves and infer the characteristics of visible light.
4. Outline the importance of theory of relativity and analyse the wave nature of particles.
5. Analyze the electrical properties of semiconductor based on the band theory.

Articulation Matrix

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

UNIT I **6 Hours**

ELECTRICITY

Electric monopoles - Electric field - Electric flux - Electric potential - Electrical energy- Capacitor- Conductors and Insulators - Electric dipole and polarization - Electric current - Voltage sources - Resistance

UNIT II **6 Hours**

MAGNETISM

Sources of magnetism - Monopoles - Magnetic field and force - magnetic field and current distribution - Magnetic dipole - Magnetic potential energy - Inductor - Electric and magnetic field comparison

UNIT III **6 Hours**

ELECTROMAGNETIC WAVES AND LIGHT

Electromagnetism: Basic laws - Electromagnetic energy - radiation. Electromagnetic waves: Origin, nature and spectrum - Visible light. Principle of least time - Geometrical Optics-Human eye - Diffraction - Interference - Polarization - LASER

UNIT IV **6 Hours**

MODERN PHYSICS
Special theory of relativity - Simultaneity and time dilation - Length contraction - Relativistic mass variation. Matter waves - De-Broglie hypothesis - Wave nature of particles

UNIT V **6 Hours**

ENERGY BANDS IN SOLIDS
Band theory of solids - Classification of materials - Semiconductors - Direct and indirect semiconductor - Fermi energy - Intrinsic and extrinsic semiconductor - Carrier concentration - Electrical conductivity

EXPERIMENT 1 **5 Hours**

Analysis of I-V characteristics of a solar cell for domestic applications.

EXPERIMENT 2 **5 Hours**

Investigate the photonic behavior of laser source for photo copier device.

EXPERIMENT 3 **5 Hours**

Implement the principle of stimulated emission of laser for grain size distribution in sediment samples.

EXPERIMENT 4 **4 Hours**

Assess the variation of refractive index of glass and water for optical communication.

EXPERIMENT 5 **3 Hours**

Evaluate the band gap energy of semiconducting materials for display device applications.

EXPERIMENT 6 **8 Hours**

Determine the carrier concentration of charge carriers in semiconductors for automotive applications.

Total: 60 Hours

Reference(s)

1. C J Fischer, The Energy of Physics Part II: Electricity and Magnetism, Cognella Academic Publishing, 2019.
2. P G Hewitt, Conceptual Physics, Pearson Education, 2017.
3. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2019.
4. J Walker, D Halliday and R Resnick, Principles of Physics, John Wiley and Sons, Inc, 2018.
5. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017.

22CH203 ENGINEERING CHEMISTRY II 2 0 2 3

Course Objectives

- Understand the concept of electrochemistry for determination of electrode potential, pH and applications as energy storage devices
- Outline the chemistry of metal corrosion and analyse the methods of corrosion control
- Understand the role of catalyst in the rate of reaction
- Summarize the variation in properties and reactivity of isotopes.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Apply the electrochemical concepts to determine the electrode potential of a metal.
2. Analyse the working of batteries for the energy storage devices.
3. Execute the mechanism of corrosion and suggest a method to control the corrosion.
4. Implement reaction mechanisms and assess the role of catalyst in a chemical reaction.
5. Analyse various types of nuclear transmutation including decay reactions.

Articulation Matrix

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

UNIT I **6 Hours**

ELECTROCHEMISTRY

Origin of potential - Electromotive force - Electrical double layer - Transport of charge within the cell - Cell description - Prediction of cell potentials

UNIT II **6 Hours**

ENERGY STORING DEVICES

Relation between electrical energy and energy content of a cell - Reversible and irreversible cell - Charging and discharging reactions in a reversible cell - Current challenges in energy storage technologies

UNIT III **6 Hours**

METAL CORROSION AND ITS PREVENTION

Oxidation of metals: Electrochemical origin of corrosion - Electromigration - Electron transfer in the presence and absence of moisture - Galvanic series. Strategies for corrosion control: Galvanic anode and impressed current.

UNIT IV **6 Hours**

CATALYSIS

Energy profile diagram for a chemical reaction - activation energy - role of catalyst - homogeneous and heterogeneous catalysis - types

UNIT V **6 Hours**

NUCLEAR REACTIONS

Radioactive and stable isotopes - Variation in properties between isotopes - Radioactive decay (alpha, beta and gamma) - Half-life period - Nuclear reactions - Radiocarbon dating

EXPERIMENT 1 4 Hours

Measure industrial effluent water pH and assess water quality against allowed standards.

EXPERIMENT 2 4 Hours

Iron (Fe^{2+}) in Bhavani River water: Potentiometric Analysis & Pollution Assessment (CPCB Standards).

EXPERIMENT 3 4 Hours

Construct a Zn-Cu electrochemical cell and validate the output by connecting the LED light.

EXPERIMENT 4 5 Hours

Evaluate the corrosion percentage in concrete TMT bars.

EXPERIMENT 5 4 Hours

Determination of the percentage of corrosion inhibition in plain-carbon steel using natural inhibitors using natural inhibitors.

EXPERIMENT 6 4 Hours

Electroplating of copper metal on iron vessels for domestic application.

EXPERIMENT 7 5 Hours

Determination of acid-catalyzed hydrolysis kinetics in locally sourced fruit extracts.

Total: 60 Hours

Reference(s)

1. Jain and Jain, Engineering Chemistry, 16^{th} Edition, Dhanpat Rai Publishing Company, New Delhi, 2013.
2. P.H. Rieger, Electrochemistry, Second Edition (Reprint), Springer, Netherland, 2012.
3. E. McCafferty, Introduction to Corrosion Science, Springer; 2010 Edition, January 2010.
4. S. Vairam, Engineering Chemistry, John Wiley & Sons, 2014.
5. H.J. Arnikar, Essentials of Nuclear Chemistry, 4^{th} edition, (revised) New Age International Publishers, 2011.
6. U. Hanefeld, L. Lefferts, Catalysis: An Integrated Textbook for Students, Wiley- VCH, 2017.

22GE002 COMPUTATIONAL PROBLEM SOLVING 3 0 0 3

Course Objectives

- Analyse the algorithm design techniques and development principles in solving the real-life problems.
- Illustrate the different ways of organizing and storing the data in computing systems.
- Understand the basic network configuration and setup connections among different device systems.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Analyse a problem and formulate algorithms, pseudocodes and flowcharts.
2. Create algorithmic solutions to simple computational problems and explore algorithmic approaches to problem solving.
3. Design and apply appropriate data structures for solving computing problems.
4. Compare the various storage devices used in a computer system.
5. Analyse the requirements for a given organizational structure and establish the connection between two or more computers to form a network.

Articulation Matrix

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

UNIT I 6 Hours

VISUAL PROCESS MODELING

Scenario decomposition - Logical sequencing - Drawing flowchart - Preparation of visual process model.

UNIT II 12 Hours

ALGORITHMIC DESIGN THINKING

Analysis - Verification - Brute force - Divide and conquer - Greedy - Backtracking.

UNIT III **12 Hours**

DATA ORGANIZATION
Elementary Data Organization - Abstract Data Types - Fundamentals of Linear and Non-Linear Data Structures.

UNIT IV **7 Hours**

DATA STORAGE
Flat File and Relational database - Data Read & Write in Local Storage, Server Storage and Cloud Storage - Database Query Methods.

UNIT V **8 Hours**

NETWORKING ESSENTIALS
Networking Components and Services - IP Addressing - Configuring and Managing the Campus Network - Network Security - Firewalls.

Total: 45 Hours

Reference(s)

1. David D. Riley, Kennya. Hunt, "Computational thinking for the modern problem Solver", CRC Press Taylor & Francis Group, 2014.
2. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education Asia, 2011.
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2016.
4. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, "Database System Concepts", McGraw Hill, 2015.
5. Behrouz A. Forouzan, "Data Communication and Networking", 5th Edition, Tata McGraw-Hill, 2014.

22GE004 BASICS OF ELECTRONICS ENGINEERING

2 0 2 3

Course Objectives

- To understand the concept of energy transmission through mechanical, electrical and electromagnetic forms.
- To analyse the use of PN Junction Diode and BJT for signal conditioning.
- To apply the working principle of PN Junction Diode and BJT for the design of basic Digital Logic.
- To analyse the working and characteristics of Special Purpose Semiconductor Electronic Devices.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Execute the need for electrical and electromagnetic signal transmission.
2. Analyse the working principle and characteristics of PN junction diode.
3. Analyse the working principle and characteristics of Bipolar Junction Transistor.
4. Apply the working principle of PN Junction diode and BJT for designing basic Digital Logic functions.
5. Analyse the energy conversion needs and working principle of Special purpose electronic devices.

Articulation Matrix

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

UNIT I **6 Hours**

ENERGY TRANSFER AND SIGNALS

Energy Transmission through Mechanical, Electrical and Electromagnetic means, Signal as Energy Transmission, Complexity in signal transmission (Volume of Information, Distance and Time taken), Limitations of Mechanical Energy Transmission, Electrical and Electromagnetic Signal Transmission, Need for Conversion between Electrical and Mechanical Signals.

UNIT II **8 Hours**

SIGNAL CONDITIONING USING DIODE

Need for Vacuum Tubes in the Evolution of Electronics, Overview of Vacuum Tubes, Diode and Triode, Limitations of Vacuum Tubes. Semiconductor Group in Periodic Table, Overview of Semiconductor Materials, Flow of electrical energy through PN Junction Diode, Signal Clipping, Signal Clamping and Signal Multiplication using PN Junction Diode, Limitations of PN Junction Diode.

UNIT III **6 Hours**

SIGNAL CONDITIONING USING TRANSISTOR

Need for controlling electrical signals, Principle of Bipolar Junction Transistor operation, Signal Switching and Amplification using BJT, Limitations of BJT, Principle of Field Effect Transistor operation.

UNIT IV **6 Hours**

LOGIC SYNTHESIS USING DIODE AND TRANSISTORS

Overview of Logic Gates, PN Junction and BJT as electronic switches, Digital Logic Synthesis using Diode and Transistor: Diode Logic, Resistor Transistor Logic, Diode Transistor Logic, Transistor Logic.

UNIT V **4 Hours**

DEVICES FOR SPECIAL REQUIREMENTS

Voltage Regulation using Zener Diode, Variable Capacitance using Varactor Diode, Electrical Energy to Light Energy conversion using Light Emitting Diode, Light to Energy to Electrical Energy conversion using Solar Cell.

EXPERIMENT 1 **4 Hours**

Design a voltage multiplier to convert the low voltage from the mains power supply to the high voltage to operate the microwave oven.

EXPERIMENT 2 **14 Hours**

Design and construct regulated DC power supply for Mobile phone charger.

EXPERIMENT 3 **4 Hours**

Design and construct an audio amplifier circuit to play the mobile music in a huge speaker.

EXPERIMENT 4 **4 Hours**

Design and construct Switching circuit for the Pump to control over flow and drain condition for overhead tank using PN junction diode.

EXPERIMENT 5 **4 Hours**

Design and construct BJT based circuit to implement two-way connection for stair case light application.

Total: 60 Hours

Reference(s)

1. Thomas L. Floyd, Electronic Devices: Electron Flow Version, Ninth Edition, Prentice Hall, 2012.
2. J Millman, C. Halkias & Satyabrata JIT, Electronic Devices and Circuits, Tata McGraw-Hill, 2007.
3. L Robert Boylestead, Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education 2006.
4. David A. Bell, Electronic Devices and Circuits, Prentice Hall of India, 2003.
5. Adel S. Sedra & Kenneth C. Smith, Micro Electronic Circuits Theory and Applications, 6th Edition, Oxford University Press, 2013.
6. Behzad Razavi, Microelectronics, Wiley India Pvt. Ltd.; 2nd edition, 2018.

22HS002 STARTUP MANAGEMENT 1 0 2 2

Course Objectives

- Promote entrepreneurial spirit and motivate to build startups
- Provide insights on markets and the dynamics of buyer behaviour
- Train to develop prototypes and refine them to a viable market offering
- Support in developing marketing strategies and financial outlay
- Enable to scale up the prototypes to commercial market offering

Programme Outcomes (POs)

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

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

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

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

PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Generate valid and feasible business ideas.
2. Create Business Model Canvas and formulate positioning statement.
3. Create prototypes that fulfills an unmet market need.
4. Implement business strategies and create pitch decks.
5. Choose appropriate strategies for commercialization.

Articulation Matrix

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

UNIT I **3 Hours**

BUSINESS MODELS AND IDEATION

Startups: Introduction, Types of Business Modes for Startups. Ideation: Sources of Ideas, Assessing Ideas, Validating Ideas, Tools for validating ideas, Role of Innovation and Design Thinking.

UNIT II **3 Hours**

UNDERSTANDING CUSTOMERS

Buyer Decision Process, Buyer Behaviour, Building Buyer Personas, Segmenting, Targeting and Positioning, Value Proposition (Business Model Canvas), Information Sourcing on Markets, Customer Validation

UNIT III **3 Hours**

DEVELOPING PROTOTYPES

Prototyping: Methods - Paper and Digital, Customer Involvement in Prototyping, Product Design Sprints, Refining Prototypes

UNIT IV **3 Hours**

BUSINESS STRATEGIES AND PITCHING

Design of Marketing Strategies and Campaigns, Go-To-Market Strategy, Financial KPIs Financial Planning and Budgeting, Assessing Funding Alternatives, Pitching, Preparing Pitch Decks

UNIT V **3 Hours**

COMMERCIALIZATION

Implementation: Prototype to Commercialization, Test Markets, Institutional Support, Registration Process, IP Laws and Protection, Legal Requirements, Type of Ownership, Building and Managing Teams, Defining role of investors

EXPERIMENT 1 **1 Hour**

Analysis of various business sectors

EXPERIMENT 2 **2 Hours**

Developing a Design Thinking Output Chart

EXPERIMENT 3 **1 Hour**

Creating Buyer Personas

EXPERIMENT 4 **3 Hours**

Undertake Market Study to understand market needs and assess market potential

EXPERIMENT 5 **2 Hours**

Preparation of Business Model Canvas

EXPERIMENT 6 **15 Hours**

Developing Prototypes

EXPERIMENT 7 **2 Hours**

Organizing Product Design Sprints

EXPERIMENT 8 **2 Hours**

Preparation of Business Plans

EXPERIMENT 9 **2 Hours**

Preparation of Pitch Decks

Reference(s)

1. Rashmi Bansal, Connect the Dots, Westland and Tranquebar Press, 2012.
2. Pavan Soni, Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-solving, Penguin Random House India, 2020.
3. Ronnie Screwvala, Dream with Your Eyes Open: An Entrepreneurial Journey, Rupa Publications, 2015.
4. Stephen Carter, The Seed Tree: Money Management and Wealth Building Lessons for Teens, Seed Tree Group, 2021.
5. Kotler Philip, Marketing Management, Pearson Education India, 15th Edition, 2000.
6. Elizabeth Verkey and Jithin Saji Isaac, Intellectual Property, Eastern Book Company, 2nd Edition, 2021.

22HS003 HERITAGE OF TAMILS 1 0 0 1

Course Objectives

- Describe the linguistic diversity in India, highlighting Dravidian languages and their features.
- Summarize the evolution of art, highlighting key transitions from rock art to modern sculptures.
- Examine the role of sports and games in promoting cultural values and community bonding.
- Discuss the education and literacy systems during the Sangam Age and their impact.
- Outline the importance of inscriptions, manuscripts, and the print history of Tamil books in preserving knowledge and culture.

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Implement the concept of language families in India, with a focus on Dravidian languages.
2. Create the evolution of art from ancient rock art to modern sculptures in Tamil heritage.
3. Execute and differentiate various forms of folk and martial arts in Tamil heritage.
4. Assess the concepts of Flora and Fauna in Tamil culture and literature.
5. Evaluate the contributions of Tamils to the Indian Freedom Struggle.

Articulation Matrix

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

UNIT I **3 Hours**

LANGUAGE AND LITERATURE

Language Families in India - Dravidian Languages - Tamil as a Classical Language- Classical Literature in Tamil- Secular Nature of Sangam Literature- Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II **3 Hours**

HERITAGE - ROCK ART PAINTINGS TO MODERN ART- SCULPTURE

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III **3 Hours**

FOLK AND MARTIAL ARTS

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV **3 Hours**

THINAI CONCEPT OF TAMILS

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V **3 Hours**

CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India - Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine - Inscriptions & Manuscripts - Print History of Tamil Books.

Total: 15 Hours

References

1. Dr. K. K. Pillay, Social Life of Tamils, A joint publication of TNTB & ESC and RMRL.
2. Dr. S. Singaravelu, Social Life of the Tamils - The Classical Period, International Institute of Tamil Studies.
3. Dr. S. V. Subramanian, Dr. K. D. Thirunavukkarasu, Historical Heritage of the Tamils, International Institute of Tamil Studies.
4. Dr. M. Valarmathi, The Contributions of the Tamils to Indian Culture, International Institute of Tamil Studies.
5. Keeladi, Sangam City Civilization on the banks of river Vaigai, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu.
6. Dr. K. K. Pillay, Studies in the History of India with Special Reference to Tamil Nadu.

22HS003 **தமிழர் மரபு** **1 0 0 1**

பாடத்திட்டத்தின் நோக்கம்

1. இந்திய மொழிக்குடும்பத்துள் திராவிட மொழிகள் தனித்து இயங்கும் தன்மையை அதன் சிறப்புகள் வழி அறிதல்.
2. தொன்றுதொட்டு தமிழர், கலையில் அடைந்த வளர்ச்சியை இயம்புதல்.
3. சங்ககால தமிழரின் கற்றல் திறத்தை இலக்கியங்கள் வழி ஆராய்தல்.

கற்றலின் விளைவு

1. இந்திய மொழிக்குடும்பத்துள் திராவிட மொழிகள் தனித்து இயங்கும் தன்மையை அதன் சிறப்புகள் வழி அறிதல்.
2. தொன்றுதொட்டு தமிழர், கலையில் அடைந்த வளர்ச்சியை இயம்புதல்.
3. சங்ககால தமிழரின் கற்றல் திறத்தை இலக்கியங்கள் வழி ஆராய்தல்.
4. தமிழ் மொழியின் சிறப்புகளை அதன் படைப்பிலக்கியங்கள் மூலம் அறிந்து கொள்ளுதல்.
5. கற்காலம் தொடங்கி, இக்காலம் வரை சிற்பக்கலை அடைந்த வளர்ச்சியை கண்டுகொள்ளல் .
6. தமிழர் தம் வாழ்வில் எங்கனம் இயற்கையை வணங்கி போற்றினர் என்பதை திணை கோட்பாட்டின் வழி தெளிதல்.
7. இந்திய விடுதலை போரில் தமிழர் ஆற்றிய பங்கினை தெரிந்து கொள்ளுதல்.

அலகு I மொழி மற்றும் இலக்கியம்: **3**

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை: **3**

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள்: 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

22TT301 TRANSFORMS, PARTIAL DIFFERNTIAL EQUATIONS AND NUMERICAL METHODS **3 1 0 4**

Course Objectives

- To understand the concepts of Fourier series, Transforms and formation of partial differential equations, which will enable them to model and analyze the physical phenomena.
- To understand the methods to solve polynomial equations and implement the ideas of numerical interpolation.
- To apply the numerical techniques to offer an approximate solution for the differential equations in a real-world situation.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Apply Fourier series for the periodic functions to formulate as a combination of sine and cosine functions.
2. Analyse different techniques of Fourier transforms for non- periodic functions.
3. Execute the formation of partial differential equations through various methods.
4. Assess the solution of system of linear equations through various numerical techniques.
5. Implement the numerical solution of initial and boundary value problems of differential equations through different methods.

Articulation Matrix

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

UNIT I **9 Hours**

FOURIER SERIES

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

UNIT II **9 Hours**

FOURIER TRANSFORM

Fourier Integral Theorem- Fourier Transforms and Inverse Fourier Transform -Fourier Sine and Cosine Transforms - Properties - Transforms of Simple Functions - Convolution Theorem -Parseval’s Identity.

UNIT III **9 Hours**

PARTIAL DIFFERENTIAL EQUATIONS

Formation of Partial Differential Equations by eliminating arbitrary constants and functions - Solutions of Standard types of first-order partial differential equations - LaGrange's linear equation - Linear partial differential equations of second order with constant coefficients of homogeneous type.

UNIT IV **9 Hours**

NUMERICAL SOLUTION OF SYSTEM OF EQUATIONS, DIFFERENTIATION AND INTEGRATION

Solution of algebraic and transcendental equations: Newton- Raphson method -Solution of a system of linear equations: Gauss elimination method - Inverse of a matrix: Gauss-Jordan method- Eigenvalues of a matrix by Power method -Interpolation: LaGrange's interpolation formula - Approximation of derivatives using interpolation polynomials - Numerical integration using Simpsons rule.

UNIT V **9 Hours**

NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS

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

Tutorial: 15 Hours

Total: 60 Hours

Reference(s)

1. Erwin Kreyszig, Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi, 2016.
2. Peter V O Neil., Advanced Engineering Mathematics, Seventh Edition, TBH Publishers, 2013.
3. James Glyn, Advanced Modern Engineering Mathematics, Third Edition, Pearson Education, 2014.
4. Sankara Rao. K, Numerical Methods for Scientists and Engineers, Third Edition, Eastern Economy Edition, 2009.
5. Jain M.K, Iyengar S.R.K and Jain R.K, Numerical Methods for Scientific and Engineering Computation, New Age International (P) Ltd, New Delhi, 2005.

22TT302 FIBRE SCIENCE 3 0 2 4

Course Objectives

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

Programme Outcomes (POs)

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

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

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

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

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

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

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

PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

NATURAL FIBRES I

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

UNIT II **9 Hours**

NATURAL FIBRES II

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

UNIT III **9 Hours**

REGENERATED CELLULOSIC AND PROTEIN FIBRES

Viscose rayon: Principle of manufacture - Physical properties - Chemical properties &End uses. Modification of viscose rayon - Bamboo -Tencel - Modal. Principle of manufacture: Casein fibre- Vicara fibre - Ardil fibre - properties.

UNIT IV **9 Hours**

SYNTHETIC FIBRES

Nylon fibre - Physical and chemical properties - End uses -Polyester - Physical and chemical properties - End uses. Acrylic - Physical and chemical properties - End uses. Polypropylene- Physical and chemical properties. - End uses.

UNIT V **9 Hours**

SPECIALITY FIBRES AND IDENTIFICATION OF FIBRES

Classification of Speciality fibres - Aromatic polyamides - Glass Fibre, Carbon fibres, Super absorbent fibres, elastomeric fibres, ultra-fine fibres, electro spun nano fibres Properties and end uses. Feeling Test - Burning test - microscopic test - Chemical test - Density measurement.

EXPERIMENT 1 **4 Hours**

Analyse the physical characteristics and identification of cotton, and silk fibres for Men's sutings.

EXPERIMENT 2 **4 Hours**

Analyse the physical characteristics and identification of wool, hemp, and silk fibres for Men's shirting.

EXPERIMENT 3 **8 Hours**

Analyse the physical and surface characteristics and also identification of Hemp, Wool, Ramie, Flax, and Silk fibres for Medical Textiles.

EXPERIMENT 4 **4 Hours**

Analyse the density of cotton, nylon, carbon, glass, and polyester blended fibres for Industrial applications.

EXPERIMENT 5 **4 Hours**

Analyze the cellulosic composition and function groups of cotton, jute, and flax fibres for Kitchen textiles.

EXPERIMENT 6 **6 Hours**

Analyze the keratin, fibroin, sericin, and polymeric side chains of wool, silk, polyester, and nylon fibres for fishing nets and women's sarees.

Total: 75 Hours

Reference(s)

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

22TT303 MANUFACTURED FIBRE TECHNOLOGY 4 0 0 4

Course Objectives

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

Programme Outcomes (POs)

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

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **12 Hours**

SPINNING OF MAN-MADE FIBRES

Selection and homogenization of polymers-mechanical and thermal properties and polymer structure-Fibre spinning techniques based on thermoset, thermoplastic polymer-Melt spinning, Solution spinning (Wet, dry, dry jet wet, liquid crystal, and gel spinning) and their features, Zones of spinning process.

UNIT II **12 Hours**

STRUCTURE FORMATION DURING SPINNING

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

UNIT III **12 Hours**

POST SPINNING OPERATIONS

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

UNIT IV **12 Hours**

MASS COLOURATION, TEXTURING AND TOW TO TOP CONVERSION

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

UNIT V **12 Hours**

SPECIALITY FIBRES

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

Total: 60 Hours

Reference(s)

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

22TT304 SPINNING TECHNOLOGY I 3 0 2 4

Course Objectives

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

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1: Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

GINNING

Ginning: Objectives of ginning, Principles of ginning process and Baling. Different types of ginning machineries: on the basis of product type, technology and feeding. Pre and post ginning operations, ginning faults, Latest developments in ginning

UNIT II **9 Hours**

BLOWROOM

Blowroom: blowroom line- sequence of machines, different types of mixing and blending, Principles of opening and cleaning, Design, constructional features and working principles of fine cleaning, blending and card feeding machines, working principles of modern blow room machines, Problems /Faults /Defects in blowroom, blowroom cleaning efficiency, Technological developments.

UNIT III **9 Hours**

CARDING

Objectives of carding process, Conventional vs. modern carding machine; Design, Constructional Features and working principles of a modern card and card feeding systems. Processing of cotton, manmade fibres and blends. Mechanism of carding: wire point disposition - fibre configuration, blending, levelling, fibre breakage, hook formation - web formation fibre transfer efficiency and factors affecting fibre transfer. Card settings. Card clothing. Card wire grinding. Principles of autolevellers. Reasons and Remedies of Carding Faults in Spinning, cleaning efficiency, Technological developments.

UNIT IV **9 Hours**

DRAWFRAME AND COMBER

Objectives of draw frames Roller arrangements in draw frames and fibre control devices. Top and bottom roller arrangements in drafting systems, characteristics and maintenance - Principles of doubling, roller drawing and drafting. Draft distribution, Periodic mass variation in drawn sliver; Draw frame Autoleveller; Defects of Draw Frame, Technological developments. Comber: Comber preparatory processes: Methods of lap preparation - Lap forming machines. Comber: Objectives, types of combers, Combing cycle - Design, constructional features and working principles of comber machine; Process parameters. Charles Gegauf's Noil Theory. Disposition of the hooks, waste removal, Noil percentage, influence of combing operation on quality, Technological developments.

UNIT V **9 Hours**

SPEED FRAME

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

EXPERIMENT 1 **4 Hours**

Analyze the production calculation of cotton ginning operation on the ginning machine.

EXPERIMENT 2 **8 Hours**

Analyze the process parameters and calculate the production calculation and cleaning efficiency of the cotton fibres in the blow room.

EXPERIMENT 3 **8 Hours**

Analyze the process parameters and calculate the production calculation and cleaning efficiency of the cotton fibre in lap form processed in the carding machine.

EXPERIMENT 4 **4 Hours**

Analyze the process parameters and calculate the draft calculation, production calculation and cleaning efficiency of the card sliver processed in the draw frame machine.

EXPERIMENT 5 **3 Hours**

Analyze the process parameters and calculate the production calculation and Noil% of the Drawframe sliver processed in the comber machine.

EXPERIMENT 6 **3 Hours**

Analyze the process parameters and calculate the draft calculation, production calculation of the Drawframe sliver in the speed frame machine.

Total: 75 Hours

Reference(s)

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

22TT305 WEAVING TECHNOLOGY I 3 0 2 4

Course Objectives

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

Programme Outcomes (POs)

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

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

PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

WINDING

Winding - objectives, random and precision winders, elements and functions-unwinding accelerator, tension device, yarn clearer, splicer, waxing, anti-patterning, drum type, link coner, automation. Package types, faults-causes and remedies, Calculations. Winding synthetic and blended yarns, winding for colouration. Pirn winding-objectives, elements and functions.

UNIT II **9 Hours**

WARPING AND DRAWING-IN

Warping - objectives, direct and section warping, elements and functions - creel, stop motion, tension device, warper reed, automation. Section warping-section building and traverse, leasing. process control in warping-control of end breaks, hard waste and beam defects, Speed.

UNIT III **9 Hours**

SIZING

Sizing-objectives, size recipe, elements and functions-creel, sow box, drying zone, yarn splitting, automation. Single-end sizing, Calculations. Sizing of filament yarns, energy conservation in sizing. Beam gaiting, tyeing-in. Process Control in Sizing: Controls - temperature, level, moisture, stretch. Size pick up and end breaks. combined dyeing and sizing, dead loss in sizing

UNIT IV **9 Hours**

PRIMARY MOTIONS IN SHUTTLE WEAVING

Loom types, timing diagram. Shedding-tappet, dobby and jacquard. Shed geometry, shed types, reversing motions. Picking-over pick and under pick, shuttle flight and timing, shuttle checking. Beat-up-sley kinematics and eccentricity.

UNIT V **9 Hours**

SECONDARY AND AUXILLARY MOTIONS

Take up, let off, warp stop, weft stop, warp protector, weft feelers and Pirn change motions, Dropbox motion. Production and efficiency calculations.

EXPERIMENT 1 — 4 Hours

Analyze the yarn fault in cone and cheese packages. to avoid defects in the shirting fabric.

EXPERIMENT 2 — 4 Hours

Analyze the tensile properties of the yarn before and after sized yarn to withstand the tensile strength during using of shirting fabric.

EXPERIMENT 3 — 4 Hours

Analyze the production and efficiency calculation for course yarn and fine yarn.

EXPERIMENT 4 — 3 Hours

Analyze the cone and pirn characteristics before and after inorder to produce a quality shirting fabric.

EXPERIMENT 5 — 3 Hours

Develop a small section in sectional warping for striped fabric.

EXPERIMENT 6 **3 Hours**

Develop a small section in sectional warping for checked design.

EXPERIMENT 7 **9 Hours**

Dismantling, assembling and setting of picking and take up mechanism used during weaving for weft thread insertion and winding the fabric in roller respectively to produce a suiting fabric.

Total: 75 Hours

Reference(s)

1. D. B. Ajgaonkar, M. K Talukdar and Wedekar, Sizing: Material Methods and Machineries, Mahajan Publications Ahmedabad, 2001.
2. P. K. Sriramalu, D. B. Ajgaonkar and M. K. Talukdar, Weaving Machines Mechanisms, Management Mahajan publishers, Ahmedabad, 2000.
3. M. K. Talukdar, An Introduction to Winding and Warping Testing Trade Press, Mumbai, 2002.
4. Anon., Woven Fabric Production I, NCUTE Publication, IIT, New Delhi, 2002.
5. Anon., Woven Fabric Production II, NCUTE Publication, IIT, New Delhi, 2002.
6. P. Marks and A. T. C. Robinson Principles of Weaving, The Textile Institute, 2000.

22HS004 HUMAN VALUES AND ETHICS 2 0 0 2

Course Objectives

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

Programme Outcomes (POs)

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

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

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

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

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

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

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

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

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

PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **6 Hours**

COURSE INTRODUCTION - NEED, BASIC GUIDELINES AND ANALYSIS

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

UNIT II **6 Hours**

EMBRACING THE COMMON ETIQUETTE

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

UNIT III **6 Hours**

CONTINUOUS HAPPINESS AND PROSPERITY

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

UNIT IV **6 Hours**

UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS

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

UNIT V **6 Hours**

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

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

Total: 30 Hours

Reference(s)

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

22HS005 SOFT SKILLS AND EFFECTIVE COMMUNICATION **0 0 2 1**

Course Objectives

- Communicate proficiently in formal discussions at the workplace.
- Describe experiences and events, and briefly give reasons and explanations for opinions and plans.
- Interact with a degree of fluency and spontaneity that results in efficacious communication
- Convey agreement and disagreement in a polite but firm manner
- Communicate with coherence and imagination in both written and spoken formats

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Enhance confidence in expressing thoughts in grammatically proper language and etiquette in waiting for the opportunity to provide input.
2. Effectively communicate in English on formal occasions and proficiency in the use of link words and other discourse markers.
3. Provide constructive feedback and file logical complaints.
4. Analyse the understanding of oral and written communication in real-world situations.
5. Apply the improved spelling and punctuation in writing and heightened understanding of tone, pitch and stress in oral formats.

Articulation Matrix

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

UNIT I **10 Hours**

SELF-EXPRESSION

Group discussion/ Peer discussion - Communicating decisions and opinions - Tone, Pitch, Stress - Agreeing, Disagreeing, Suggesting, Speculating - Comparing and Contrasting - Comparatives and Superlatives - Discourse markers – Interjections - Decision making - Synthesis - Higher order thinking Group discussion/Peer discussion - Effective Communication Types of communication - Written vs Spoken - Contractions Intonation Stress Active voice - Question tags - Confidence and body language Guided writing- Outlining Main Points - Group discussion/Peer discussion - Avoiding common errors Reduction of MTI - Common errors - Barriers to communication Accent

UNIT II **10 Hours**

CREATIVE EXPRESSION

JAM, Debate, Review writing, Social media posts Synonyms - Antonyms Cloze test Phrasal verbs Spotting errors Collocation - Commonly mispronounced

UNIT III **10 Hours**

FORMAL EXPRESSION

Writing: Giving written feedback, Review writing, and Letter of complaint. Speaking: Giving constructive feedback and offering suggestions, asking for inputs, commenting politely on appropriate phrases - Giving written feedback, Review writing, and Letter of complaint. Critical reasoning - Modal verbs - Polite ways to express negatives.

Total: 30 Hours

Reference(s)

1. Word Power Made Easy by Norman Lewis, W. R. Goyal Pub. & Distributors, 2009.
2. Sasikumar, V, et al., A Course in Listening & Speaking Foundation Books, 2005.
3. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
4. Prasad, Hari Mohan. A Handbook of Spotting Errors, McGraw Hill Education, 2010.
5. Personality Development & Soft Skills, Barun K. Mitra, Oxford University Press, 2012.
6. Business English by Ken Taylor, Orient Blackswan, 2011.

22HS006 TAMILS AND TECHNOLOGY 1 0 0 1

Course Objectives

- Analyse graffiti on potteries as a form of historical and cultural documentation during the Sangam Age.
- Investigate the building materials and the historical context of Hero stones during the Sangam Age by analysing the details of stage constructions in Silappathikaram and their cultural significance.
- Examine ancient knowledge of oceans and its impact on Tamil society.

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Implement the significance of the weaving industry during the Sangam Age and its cultural importance.
2. Create the significance of dams, tanks, ponds, and sluices in the agricultural and irrigation practices of the Chola Period.
3. Analyse the architectural designs and structural construction methods used in household materials during the Sangam Age.
4. Implement the art of ship building in ancient Tamil culture and its role in maritime trade and transportation.
5. Execute the development of scientific terminology and vocabulary in Tamil language.

Articulation Matrix

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

UNIT I **3 Hours**

WEAVING AND CERAMIC TECHNOLOGY

Weaving Industry during Sangam Age - Ceramic technology - Black and Red Ware Potteries (BRW) - Graffiti on Potteries.

UNIT II **3 Hours**

DESIGN AND CONSTRUCTION TECHNOLOGY

Designing and Structural construction House and designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age - Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple) - Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period

UNIT III **3 Hours**

MANUFACTURING TECHNOLOGY

Art of Ship Building-Metallurgical Studies-Iron Industry-Iron smelting, steel-Copper and gold-Coins as source of history-Minting of Coins-Beads making-industries Stone beads -Glass Beads-Terracotta beads-Shell beads-bone beats-Archaeological evidences-Gem stone types described in Silappathikaram.

UNIT IV **3 Hours**

AGRICULTURE AND IRRIGATION TECHNOLOGY

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry-Wells designed for cattle use- Agriculture and Agro Processing-Knowledge of Sea-Fisheries-Pearl-Conche Diving-Ancient Knowledge of Ocean-Knowledge Specific Society.

UNIT V **3 Hours**

SCIENTIFIC TAMIL

Development of Scientific Tamil-Tamil Computing-Digitalization of Tamil Books-Development of Tamil Software-Tamil Virtual Academy-Tamil Digital Library-Online Tamil Dictionaries-Sorkuvai Project.

Total: 15 Hours

Reference(s)

1. Dr. K. K. Pillay, Social Life of Tamils, A joint publication of TNTB & ESC and RMRL.
2. Dr. S. Singaravelu, Social Life of the Tamils - The Classical Period, International Institute of Tamil Studies.
3. Dr.S.V. Subramanian, Dr.K.D. Thirunavukkarasu, Historical Heritage of the Tamils, International Institute of Tamil Studies.
4. Dr. M. Valarmathi, The Contributions of the Tamils to Indian Culture, International Institute of Tamil Studies.
5. Keeladi - Sangam City Civilization on the banks of river Vaigai, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu.
6. Dr. K. K. Pillay, Studies in the History of India with Special Reference to Tamil Nadu.

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம்: 3

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் – கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

அலகு III உற்பத்தித் தொழில் நுட்பம்: 3

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சானறுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்: 3

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு V அறிவியல் தமிழ் மற்றும் கணித்தமிழ்: 3

அறிவியல் தமிழின் வளர்ச்சி –கணித்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi – 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

22TT401 PROBABILITY AND STATISTICS 3 1 0 4

Course Objectives

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

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

PROBABILITY THEORY

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

UNIT II **9 Hours**

TWO DIMENSIONAL RANDOM VARIABLES

Joint distributions - Marginal and Conditional distributions -Covariance - Correlation and Regression analysis in textile manufacturing.

UNIT III **9 Hours**

TESTING OF HYPOTHESIS

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

UNIT IV **9 Hours**

DESIGN OF EXPERIMENTS

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

UNIT V **9 Hours**

STATISTICAL QUALITY CONTROL

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

Tutorial: 15 Hours
Total: 60 Hours

Reference(s)

1. Milton J. S. and Arnold Jesse C., Introduction to Probability and Statistics: Principles and Applications for Engineering and the Computing Sciences, Third Edition, McGraw Hill Inc, 1995.
2. S.C. Gupta, V. K. Kapoor, Fundamentals of Statistics, Sultan Chand & sons, 1R, 2010.
3. Johnson Richard A, Probability and Statistics for Engineers, Sixth Edition, Prentice hall of India, 2002.
4. S. Bhasker, S. Narayana Moorthy, Statistical Quality Control and Reliability Engineering, First Edition, Anuradha Agencies, 2000.

22TT402 STRUCTURE AND PROPERTIES OF TEXTILE FIBRES

3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

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

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

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

PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

PHYSICAL STRUCTURE OF FIBRES

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

UNIT II **9 Hours**

MOISTURE ABSORPTION PROPERTIES OF FIBRES

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

UNIT III **9 Hours**

MECHANICAL PROPERTIES OF FIBRES

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

UNIT IV **9 Hours**

OPTICAL AND FRICTIONAL PROPERTIES

Refractive index of fibres - Measurement and factors influencing the results. Birefringence and optical orientation factor. Reflection of light, Lustre index, factors influencing lustre. Absorption of light - dichroism, dichroic ratio. Structural colour. Fibre friction. Measurement of friction and factors influencing fibre friction. Friction in wool - theory of directional frictional effect.

UNIT V **9 Hours**

ELECTRICAL AND THERMAL PROPERTIES

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

Total: 45 Hours

Reference(s)

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

22TT403 TEXTILE CHEMICAL PROCESSING I 3 0 2 4

Course Objectives

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

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Outline process parameters for singeing, desizing and scouring.
2. Implement suitable bleaching and mercerizing methods.
3. Assess the concepts of colour science and methods of measurement of colour parameters.
4. Execute the principles of dyeing and dyeing machines.
5. Create dye recipe, choose dyeing parameters and evaluate fastness properties.

Articulation Matrix

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

UNIT I **9 Hours**

SINGEING, DESIZING AND SCOURING

Singeing: methods and application-Desizing: methods and application-Scouring: Saponification-emulsification, detergency-Scouring of cotton-Wool: scouring, Crabbing, Milling and carbonization-Silk: Degumming-Scouring of synthetic materials and blends-working principles of kier-Physical and chemical methods of assessing desized & scoured fabrics-Measurement of residual impurities.

UNIT II **9 Hours**

BLEACHING AND MERCERIZING

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

UNIT III **9 Hours**

COLOUR AND MEASUREMENT

Colour theory, Concepts and communication of colour-Beer-Lambert Law-Colour Primaries and Colour mixing-Eye and Brain system on colour perception-colour vision tests-C.I.E Method of determining the Tristimulus values-Colour difference equation and measurement-Metamerism-Dichroism- Application of C.C.M. in textile industry-Shade sorting Technique-Whiteness and Yellowness Index. Dyes-properties-Auxochrome, chromophore and common dye structure-dye-fibre interactions- Substantivity-Affinity-Adsorption isotherms. Rate of dyeing and half dyeing time.

UNIT IV **9 Hours**

DYEING

Classification-Properties, Mechanism and Application of Direct, Reactive, Acid, Basic, Vat, Disperse, Sulphur, Azoic and Metal complex dyes. Dyeing of PET, Nylon, Acrylic, Triacetate and protein fibres-Dyeing of blends. Sustainable method of dyeing.

UNIT V **9 Hours**

DYEING MACHINES AND DYE FASTNESS

Construction and working of loose stock, hank and package processing machines, J-box-jigger-winch-jet and soft-over-flow machines-continuous dyeing ranges. Drying cylinders, drying range, IR dryers and relax dryer. Assessment of dyed materials: colour fastness to washing-rubbing (wet and dry)- light-perspiration-sublimation.

EXPERIMENT 1 **5 Hours**

Assess the weight loss in the given desired and scoured fabric.

EXPERIMENT 2 **5 Hours**

Analyze the barium activity number of the given mercerized fabric.

EXPERIMENT 3 **4 Hours**

Analyze the whiteness present in the given hydrogen peroxide and sodium hypochlorite bleached fabric.

EXPERIMENT 4 **4 Hours**

Analyze the rubbing and perspiration fastness of the given direct dyed and reactive dyed fabric.

EXPERIMENT 5 **4 Hours**

Analyze the light fastness of the vat-dyed and Sulphur-dyed fabric.

EXPERIMENT 6 **4 Hours**

Analyze the color fastness of the wool and silk-dyed fabric.

EXPERIMENT 7 **4 Hours**

Analyze the sublimation fastness of the given polyester fabric dyed with dispersed dyes.

Total: 75 Hours

Reference(s)

1. S. R. Karmakar, Chemical Technology in the Pre-Treatment Processes of Textiles, Elsevier, 2000.
2. E.R. Trotman., Dyeing and Chemical Technology of Textile Fibers, B.I. Publishing Pvt ltd, New Delhi 2002.
3. C. V. Kaushik, Chemical Processing of Textiles, NCUTE, 2004.
4. V. A. Shenai, Technology of Bleaching and Mercerisation, Sevak Publication, Bombay, 2002.
5. A. D. Sule., Computer Colour Analysis, New age international publishers, 2000.
6. V. A. Shenai, Evaluation of Textile Chemicals, Sevak publications, Mumbai, 2005.

22TT404 SPINNING TECHNOLOGY II   3 0 2 4

Course Objectives

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

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
PSO1: Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I   **9 Hours**

RING SPINNING

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

UNIT II **9 Hours**

ROTOR SPINNING

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

UNIT III **9 Hours**

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

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

UNIT IV **9 Hours**

CORE YARN SPINNING, SIRO AND SOLO SPINNING, WRAP SPINNING

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

UNIT V **9 Hours**

FRICTION SPINNING, ADHESIVE SPINNING AND POST SPINNING PROCESS

Types - Principles of yarn formation - Fibre feed - Fibre assembly - Twist insertion - Yarn withdrawal. Yarn structure - Raw material requirements - Influence of process parameters. Adhesive spinning systems: Twilo and Bobtex processes. Yarn conditioning - Doubling - ring doubling - Two for one twister. Process parameters. Reeling: plain reeling and cross reeling. Bundling and Baling. Structure-property relationship in ring, compact, rotor, air-jet and friction spun yarns.

EXPERIMENT 1 **4 Hours**

Assess the measurement and calculation of Speed, draft, twist, and production calculations in 30s ring yarn for sportswear.

EXPERIMENT 2 **4 Hours**

Assess the effect of ring frame builder motion parameters on different ring yarn package characteristics for a single jersey fabric.

EXPERIMENT 3 **4 Hours**

Assess the effect of roller pressure on producing 30's ring yarn quality for saree fabric.

EXPERIMENT 4 **4 Hours**

Assess the setting modifications and end breakage studies in the ring frame for 30s count yarn for tablecloths.

EXPERIMENT 5 **4 Hours**

Assess the effect of process parameters for producing 10's rotor yarn in rotor-spinning for denim fabric.

EXPERIMENT 6 **4 Hours**

Evaluate the measurement and calculation of production and twist calculation of Two-For-One twister for producing 2-ply yarn in (TFO) for bedsheet material.

EXPERIMENT 7 **3 Hours**

Assess the effect of process variables of TFO on producing multiple on two-fold yarn quality for home furnishing fabric.

EXPERIMENT 8 **3 Hours**

Calculation of Producing three different counts 6s, 10s and 12s in rotor spinning after changing process parameters for carpet fabric.

Total: 75 Hours

Reference(s)

1. W. Klein, Rieter Manual of Spinning Volume 4-6, Rieter, 2010.
2. Carl A. Lawrence, Fundamentals of Spun Yarn Technology, CRC Press publication, New York, 2002.
3. W. Klein, New Spinning Systems, The Textile Institute, Manchester, U.K., 2001.
4. W. Klein, New Spinning Systems, The Textile Institute, Manchester, U.K., 2003.
5. R. V. M. Gowda, New Spinning Systems, NCUTE Publication, New Delhi, 2005.
6. Peter R. Lord, Handbook of Yarn Production, Technology, Science and Economics, CRC Press publication, New York, 2002.

22TT405 WEAVING TECHNOLOGY II 3 0 2 4

Course Objectives

- To import knowledge and advantages of using the shuttleless loom.
- To study the various shuttleless machine operations and its working principles.
- To give input on selvedge and storage device functions.

Programme Outcomes (POs)

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

AUTOMATIC LOOMS

Automatic Loom - Different types - Pirn changing mechanism - Temple and eye cutters - Loom Drives. Types of sheds - Tappet shedding - Dobby shedding: Climax - Cam paper - Rotary -Electronic. Jacquard shedding - Single lift - Double lift - Cross-border - Vincenzi Verdol - electronic jacquard.

UNIT II **9 Hours**

PROJECTILE AND RAPIER WEAVING

Projectile Weaving Machine: Yarn quality requirements for shuttleless looms - Gripper projectile machines - Working elements and weft insertion cycle in projectile machine - Torsion bar picking mechanism. Rapier Weaving Machines: Types: Rigid and flexible, Single and double rapiers. Principle of tip and loop transfer, Weft insertion cycles. Rapier drives - salient features. Timing diagrams.

UNIT III **9 Hours**

AIR JET WEAVING

Requirements for sley drive in shuttle less weaving - Air-jet machines - Principle of weft insertion, Nozzle types, Weft Insertion cycle, Profile reed, Yarn and Air quality requirements, Air consumption. Weft selection, measuring and storage devices and working principles.

UNIT IV **9 Hours**

WATER JET AND MULTI PHASE WEAVING

Water-jet machines: Yarn quality requirements - Principle of weft insertion - Weft insertion cycle - Water quality and quantity requirements. Working principle - Shedding and beat-up mechanisms. Multiphase weaving principle and types - Circular and flat multiphase weaving machine. Shed formation, filling insertion, beat-up.

UNIT V **9 Hours**

SPECIAL WEAVING TECHNIQUES

Carpet weaving mechanism, 3D weaving mechanism and its types, Narrow width weaving. Braiding: Types and mechanisms. Leno weaving mechanism. Selvedges: Half cross leno - Full cross leno - Twisted - Tuck-in - Bonded and fused.

EXPERIMENT 1 **4 Hours**

Development of Motif design fabric for Saree cloths.

EXPERIMENT 2 **6 Hours**

Development of Dobby design fabric for tablecloths.

EXPERIMENT 3 **4 Hours**

Development of Jacquard Design fabric, Peg plan, and Draft in Point paper.

EXPERIMENT 4 **4 Hours**

Development of Jacquard design fabric for home textiles.

EXPERIMENT 5 **8 Hours**

Development of woven fabric in different weave densities for casual wear.

EXPERIMENT 6 **4 Hours**

Development of high EPI/ PPI fabric for suiting cloth.

Total: 75 Hours

Reference(s)

1. P. K. Sriramulu, D. B. Ajgaonkar and M. K. Talukdar, Weaving Machines, Mechanisms and Management, Mahajan Publishers, Ahmedabad 2002.
2. Sabit Adanur, Handbook of Weaving, CRC press, Washington, 2001.
3. R. Marks and A. T. C. Robinson, Principles of Weaving, The Textile Institute, Manchester 2001.
4. J. J. Vincent, Shuttleless Loom, The Textile Institute 2000.

22HS007 ENVIRONMENTAL SCIENCE 2 0 0 0

Course Objectives

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

Programme Outcomes (POs)

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **6 Hours**

NATURAL RESOURCES

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

UNIT II **6 Hours**

ECOSYSTEMS AND BIODIVERSITY

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

UNIT III **6 Hours**

ENVIRONMENTAL POLLUTION

Pollution: Definition - causes - effects - control measures of air pollution - Water pollution - Sewage water treatment by activated sludge and trickling filter process - Noise pollution - Thermal pollution. Disaster management - causes - effects - control measures of floods – Earthquake.

UNIT IV **7 Hours**

SOCIAL ISSUES AND ENVIRONMENT

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

UNIT V **5 Hours**

HUMAN POPULATION AND ENVIRONMENT

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

Total: 30 Hours

Reference(s)

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

22HS008 ADVANCED ENGLISH AND TECHNICAL EXPRESSION

0 0 2 1

Course Objectives

- To enable students to achieve proficiency in academic writing.
- Effectively use the language to persuade others.
- Appreciate the nuances of the language and engage an audience.
- Use advanced tools of language to improve communicative competence.
- Prepare for professional demands at the workplace.
- Give concrete expression to the plans and goals.

Programme Outcomes (POs)

PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Infer the clarity in articulating the objectives and aims and improved proficiency in using the English language.
2. Communicate effectively and with good interpersonal skills; speak in public, engage the audience, and lead a group discussion.
3. Critically evaluate the ethics of persuasive appeals and confidence to influence opinion.
4. Analyse a specific piece of information; take in what is read, and use good writing techniques with proper grammar and syntax in all formal situations.
5. Create awareness and empathy to emotional signals in communication.

Articulation Matrix

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

UNIT I **15 Hours**

CREATIVE EXPRESSION

Proposals & Grant applications, Argumentative essays & editorials, Sales Pitches, Campaigning, Commercials/advertisements, effectively answering the famous interview question: ‘Why should we hire you?’ Sentence and paragraph formation - Rhetorical questions - Emphasis & effective repetition - Empathetic expression, knowing the audience, capturing attention - Creating Memes, Comic Strips, Stand-up comedy, Caption writing, and Limericks, Vocabulary and slang words for comedy - Similes & Metaphors - Homophones, homonyms, alliteration, word play.

UNIT II **15 Hours**
FORMAL EXPRESSION

Writing: Action plans, Cover letters, Mind-Mapping, Paragraph writing Logical reasoning - SVA - Advanced level - Style: Clarity, Concision, Coherence, Evocativeness, Efficacious Vocabulary - Conditional Clause - Be verbs- Tenses- advanced - Opening and closing sentences - Action plans, Anecdotal references, order of communication/ narration, complete communication- Wh-questions - Effective beginning and closing - Rhetorical questions - Appraising target audience - Pronunciation, Enunciation, Tone, Pace and Volume. - Writing: SOPs, Research Objectives, Thesis Statement, Indexing, Scholarly Articles, Academic Writing, Executive Summary, Survey Questionnaires, Citations and Bibliography - Reading: Quantitative & qualitative analysis, Analysis and paraphrasing of reference materials Speaking: Commentate live events, give instructions to operate machines/ conduct experiments Listening: Informational listening, Reflective listening, - Discriminative listening - Connective words - Prefixes and Suffixes - Quoting and paraphrasing Proofreading - Directed writing and writing formats - Note taking - Active verbs.

Total: 30 Hours

Reference(s)

1. Sangeeta Sharma et.al. Communication Skills for Engineers and Scientists, PHI Learning Pvt. Ltd, 2011.
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
3. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001.
4. Personality Development, Harold R. Wallace & L. Ann Masters, Cengage Learning, New Delhi
5. Developing Communication Skills by Krishna Mohan, Meera Bannerji-Macmillan India Ltd. 1990, Delhi.
6. English Grammar, Composition and Usage by N. K. Agrawal & F. T. Wood, Macmillan India Ltd., New Delhi.

22TT501 NONWOVEN TECHNOLOGY 3 0 0 3

Course Objectives

- To understand the fundamentals of various production processes in the manufacture of nonwovens.
- To acquire knowledge on the different methods of finishing nonwoven products.
- To understand the various applications of nonwovens.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Resolve the nonwoven manufacturing processes using natural and chemical fibres.
2. Differentiate different bonding methods used in nonwoven manufacturing process.
3. Implement suitable finishing methods of nonwoven meant for different applications.
4. Evaluate the nonwovens in terms of physical properties.
5. Outline the applications of nonwovens for hygiene and household products.

Articulation Matrix

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

UNIT I **9 Hours**

WEB FORMATION

Definition of Nonwoven - nonwoven manufacturing processes - nonwoven properties and applications including environmental considerations. Raw materials for the production of nonwoven: natural fibres -animal fibres -chemical fibres. Web forming - Lay process - spun laying. Spun bonding web formation.

UNIT II **9 Hours**

BONDING

Needling: principle - needle characteristics - process variables- fabric properties. Loop formation processes: types - Process variables -fabric properties. Hydro-entanglement process: principle - process variables -Fabric properties. Bonding: Hot air - Heat setting - Thermal calendar -Ultrasound -Chemical - saturation - print. Foam and spray bonding.

UNIT III **9 Hours**

FINISHING

Mechanical finishing: splitting and winding - perforating -drying - compressive finishes, Surface finishes: singeing - shearing - flocking - raising - polishing -softening, Wet finishes: washing - colouration -printing - Application of chemical finishes: types - antistatic agents - antimicrobial or biocidal finishes -flameproof finishes - waterproof finishes - softeners- stiffeners. UV stabilizers.

UNIT IV **9 Hours**

TESTING

Sampling and statistics - Testing conditions -Standards and specifications. Testing of raw materials - finished fabrics. Testing process related to end use: hygiene and medical products - household textiles. Protective clothing and filter fabrics.

UNIT V **9 Hours**

APPLICATIONS

Hygiene - medical-safety -cleaning - household products - home textiles - apparels - technical. Re- utilization of nonwovens - recycling of nonwovens. Techno economic in nonwovens.

Total: 45 Hours

Reference(s)

1. Wilhelm Albrecht, Nonwoven Fabrics, WILEY-VCH Verlag GMBH & Company, Germany, 2003.
2. S. Russell, Handbook of Nonwovens, The Textile Institute Publication, 2007.
3. O. Irsak, Nonwoven Textiles, Textile Institute, Manchester, 2001.
4. R. Krcma, Manual of Nonwovens, Textile Trade Press, Manchester, 2003.
5. Patel, B. M., & Bhrambhatt, D. Nonwoven technology. 2008.

22TT502 KNITTING TECHNOLOGY 3 0 2 4

Course Objectives

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

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

KNITTING FUNDAMENTALS

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

UNIT II **9 Hours**

WEFT KNITTING

Basic weft knitting machines, needle operation, fabrics and their characteristics: Plain - Rib - Purl - Interlock and derivatives. Notations and needle gaiting. Intelligent yarn delivery systems - open width fabric production - computerized knitting machines. Quality control-Faults in knitted fabrics and their causes and remedies - dimensional parameters such as stitch length, WPI, CPI, stitch density, GSM, Tightness factor-spirality-Production calculations of weft knitting.

UNIT III **9 Hours**

FLAT KNITTING

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

UNIT IV **9 Hours**

WARP KNITTING

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

UNIT V **9 Hours**

WARP KNITTED STRUCTURES

Basics - Two bar structures - Full tricot - Locknit - Reverse Locknit - Satin - Raised loop - Queen's cord - Shark skin - Double atlas. Fabric geometry: Dimensional parameters. An energy model of plain knitted fabrics - Dynamics of yarn tension on knitting machines. Application of weft and warp knit fabric in Technical Textiles. Seamless knitting; working and advantages. Knitting speciality yarns

EXPERIMENT 1 **6 Hours**

Analyze the structure of Single Jersey and its derivatives in Men's T-Shirt.

EXPERIMENT 2 **4 Hours**

Analyze the structure of Rib and its derivatives in men's T-Shirt Collar.

EXPERIMENT 3 **4 Hours**

Analyze the structure of Rib and its derivatives in men's T-Shirt cuff.

EXPERIMENT 4 **4 Hours**

Analyze the structure of Interlock fabric in dress wear.

EXPERIMENT 5 **4 Hours**

Analyze the structure of Interlock fabric derivative in women's skirt outerwear fabric.

EXPERIMENT 6 **4 Hours**

Analyze the structure of Warp knit Tricot fabric in women's Lingerie.

EXPERIMENT 7 **4 Hours**

Analyze the structure of Warp knit Raschel fabric in men's Jacket.

Total: 75 Hours

Reference(s)

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

22TT503 TEXTILE CHEMICAL PROCESSING II 3 0 2 4

Course Objectives

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

Programme Outcomes (POs)

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

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

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

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

PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

BASICS OF PRINTING OF TEXTILE MATERIALS
Objectives, styles, methods, auxiliary and specialty chemicals-Ingredients of printing paste-their properties and needs. Synthetic binders, Catalyst, Cross-Linking agents. Selection criteria for binders Printing with Direct-Discharge- Resist. Printing-quality control, Printing with Direct- Reactive-Acid-Disperse-Vat dyes and Pigments. Methods, styles, fixation, and after-treatment processes. Transfer Printing- Principles and methods.

UNIT II **9 Hours**

PRINTING MACHINES AND TECHNIQUES
Roller printing machinery. Screen printing: Automatic flat bet screen-Rotary screen. Thermo transfer printing machinery. Garment printing machines. Steamers-Agers-Curing process. Extraction of water: Hydroextractors-Cylinder drying-Stenters-High frequency stenter. Float dryers-Hot flue dryers-Perforated drum dryers-Heating Systems-Steam- Thermic Fluids-Heat requirement Printing with Pigments, Classification of pigments. Pigment printing of PET and blends. Other advanced printing techniques.

UNIT III **9 Hours**

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

UNIT IV **9 Hours**

FUNCTIONAL FINISHES
Flame retardant finish: Mechanism-Assessment methods of FR finish. Water repellent and waterproof finishes-Wetting- Contact Angle-Assessment methods. Soil release finish: mechanism-Evaluation of soil release. Wash and wear finish: mechanism-cross-linking agents (formaldehyde and non-formaldehyde)-Assessment methods. Mechanism and chemistry: Antistatic finish-UV Protection Finish-Antimicrobial finish- Anti odour finish-Enzymatic treatment (biopolishing).

UNIT V **9 Hours**

EFFLUENT TREATMENT
Textile Effluent: Characteristics, BOD, COD, TDS, and pH. Textile Effluent Treatment: Primary, Secondary and Tertiary methods. Membrane technology, Zero Discharge Method.

EXPERIMENT 1 **6 Hours**

Preparation of cotton fabric by removing impurities and make it absorbent to pick up dyes and chemicals in dyeing, printing and finishing.

EXPERIMENT 2 **6 Hours**

Production of dyed cotton fabric and evaluation of colour fastness properties to ascertain desirable performance in actual use.

EXPERIMENT 3 **6 Hours**

Visual quality enhancement of cotton fabric by Tie and Dye technique.

EXPERIMENT 4 **6 Hours**

Value addition of cotton fabrics by different chemical finishes with improved performance in wearing.

EXPERIMENT 5 **6 Hours**

Bio-polishing of cotton fabrics by different chemical finishes with improved aesthetic appeal and comforts in wearing.

Total: 75 Hours

Reference(s)

1. W. D. Schindler and P. J. Hauser, Chemical Finishing of Textiles, Woodhead Publishing Limited, 2004.
2. V. A. Shenai, Technology of Printing, Vol. IV, Sevak Publication, Bombay, 2001.
3. P. Vankar, Textile Effluent, NCUTE Publication, New Delhi, 2002.
4. W. C. Leslie Miles, Textile Printing, Society of Dyers and Colourists, 2003.
5. R. S. Bhagwat, Hand book of Textile Processing Machinery, 2003.

22TT504 FABRIC STRUCTURE AND DESIGN 3 0 2 4

Course Objectives

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

Programme Outcomes (POs)

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

BASIC WEAVES

Introduction-methods of representing weave-Elements of fabric design: Design, draft, peg plan, repeat. Plain Weave and its Derivatives-Warp rib, Weft rib, and Matt Weave-Regular and Irregular. Twill weave and its derivatives. Satin and Sateen.

UNIT II **9 Hours**

SPECIAL WEAVES
Ordinary and Brighton honeycomb, Huck-a-back, Mock leno, perforated and distorted mock leno, Crepe weaves. Gauze and Leno weaves: Russian Cord-Net Leno, Madras Muslin structures. Bedford cords-Plain and twill faced, Welts and Piques-Wadded Welts and Pique.

UNIT III **9 Hours**

PILE AND EXTRA THREAD FIGURING
Pile fabrics: Warp pile, Loose wire pile, Fast wire pile, Terry weaves, Terry stripes, and checks, Weft Pile, Plain back and Twill back velveteen, Lashed Pile, Corduroy, Weft plush. Extra warp and Extra weft figuring.

UNIT IV **9 Hours**

DOUBLE CLOTH
Classification, types of stitches, self-stitched double cloth, wadded double cloth, centre warp, and weft double cloth. Backed fabrics: Warp and weft backed, Reversible and Non-reversible backed fabrics.

UNIT V **9 Hours**

COLOUR THEORY AND DROP DESIGNS
Colour theory: Light and Pigment theory, Modification of colour, Applications of colour, Colour and weave effects, Spot figuring, Arrangement of figures, Drop design, Half drop bases, Rectangular design, Diamond design, Sateen system of distribution.

EXPERIMENT 1 **5 Hours**
Design and Development of Plain weave, and twill weave structures for shirting, drill fabrics, and children's dress material.

EXPERIMENT 2 **5 Hours**
Design and Development of Honeycomb and Huck-a-Back weave structures for hand towel application.

EXPERIMENT 3 **4 Hours**
Design and Development of Extra Warp and weft fabric structures for home furnishing and saree materials.

EXPERIMENT 4 **4 Hours**
Design and Development of pile structures for terry towels and loop pile carpets.

EXPERIMENT 5 **4 Hours**
Design and Development of backed fabric structure for lab overcoat materials and screen cloth.

EXPERIMENT 6 **4 Hours**
Design and Development of Bedford cord effect fancy fabrics for bed sheets.

EXPERIMENT 7 **4 Hours**
Design and Development of double cloth for sofa cover and Decorative curtain fabrics.

Total: 75 Hours

Reference(s)

1. Z. J. Grosicki, Watson, Textile Design and Colour: Elementary Weaves and Figured Fabrics, Butterworths, London, 2004.
2. Z. J. Grosicki, Watson, Advanced Textile Design: Compound Woven Structures, Butterworths London, 2004.
3. J. Hayavadana, Woven fabric Structure design and Product Planning, Woodhead Publishing India private limited, 2015.
4. B K Behera, P K Hari, Woven Textile Structure: Theory and Applications, Woodhead Publishing India private limited, 2011.

22TT507 MINI PROJECT I 0 0 2 1

Course Objectives

- Identify the problem statement and apply the engineering concepts to find the solution.
- Improve the analysing capability of the students.
- Increase the exuberance in finding the solution to various problems.

Programme Outcomes (POs)

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

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

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

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

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

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

PO11. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies
3. Utilize the new tools, algorithms, and techniques that contribute to obtaining the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis of the cost-effectiveness.
5. Prepare the report and present oral demonstrations.

Articulation Matrix

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

22TT601 TEXTILE TESTING 3 0 2 4

Course Objectives

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

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

SAMPLING AND FIBRE TESTING

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

UNIT II **9 Hours**

YARN TESTING

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

UNIT III **9 Hours**

FABRIC TESTING

Fabric thickness, Areal density, Crimp, Cover factor, and fabric sett. Fabric Tensile Strength, Principles: CRE, CRL, CRT. Breaking load, breaking extension, Influencing Factors, Tear and Bursting Strength: Dynamic tensile testing. Measurement, Applications. Constant tension transport testing. General Calibration of instruments and equipment. Hand: Stiffness, Flexural rigidity, Drape, Crease recovery and resistance, Abrasion, Pilling, Flex, Permeability: Air, Water vapour, Breathability, Thermal Insulation.

UNIT IV **9 Hours**

GARMENT TESTING

Button Strength, Seam puckering, Seam strength, Seam Slippage, size fit, spirality, Appearance, dimensional stability, zip fasters, Garment Inspection-Accepted Quality Level-4-point, 10-point, 2.5-point system. Organic standards and certification-GOTS, Organic clothing Certification, Oeko Tex, Global Recycle standard. Sustainability-EKO standard.

UNIT V **9 Hours**

ADVANCED TESTING AND STANDARDS

Primary and total hand value. KES and FAST modules. Fabric scanning systems. Friction: Measurement methods for fibre, yarn, and fabrics. Example Standard testing procedures (from AATCC, ASTM, BIS, BS, DIN, ISO). Labelling standards and methods.

EXPERIMENT 1 **4 Hours**

Determination of fibre length using baer sorter method.

EXPERIMENT 2 **4 Hours**

Determination of count of yarn.

EXPERIMENT 3 **4 Hours**

Fibre fineness by Cut-Weight Method.

EXPERIMENT 4 **3 Hours**

Determination of twist in double and single yarn.

EXPERIMENT 5 **3 Hours**
To measure Yarn Appearance, Hairiness/yarn imperfections.

EXPERIMENT 6 **3 Hours**
To measure Yarn twist/Count.

EXPERIMENT 7 **3 Hours**
To measure Fabric weight (GSM).

EXPERIMENT 8 **3 Hours**
To measure Fabric Count (Ends/pick, Wales/course).

EXPERIMENT 9 **3 Hours**
Determination of the single yarn strength and elongation at break of the yarns.

Total: 75 Hours

Reference(s)

1. J. E. Booth, Principles of Textile Testing, CBS Publishers & Distributors, New Delhi, 2001.
2. B. P. Saville, Physical Testing of Textiles, Woodhead Publishing Ltd., England, 2002.
3. Ahmad, S., Rasheed, A., Afzal, A., & Ahmad, F. (Eds.). Advanced textile testing techniques. CRC Press, 2017.
4. V. K. Kothari, Testing and Quality Management, Vol.1, IAFL Publications, New Delhi, 2000.
5. P. J. Morris, J. H. Merkin and R. W. Renal, Modelling of Yarn Properties from Fibre Properties, Journal of Textile Institute, 2001.

22TT602 TEXTILE MECHANICS **3 1 0 4**

Course Objectives

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

Programme Outcomes (POs)

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

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

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

POWER TRANSMISSION

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

UNIT II **9 Hours**

DIFFERENTIAL GEARING

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

UNIT III **9 Hours**

DESIGN OF CONE DRUMS AND CAMS

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

UNIT IV **9 Hours**

MOMENTS, KINETIC / POTENTIAL ENERGY, POWER CONSUMPTION

Calendar roller loading, top arm loading, Heald shaft lifting-shuttle movement, Bale handling and lifting, power consumption by ring frame traveller, and picking process.

UNIT V **9 Hours**

STRESSES IN TRANSMISSION SHAFTS AND DRAFTING ROLLERS

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

Tutorial: 15 Hours

Total: 60 Hours

Reference(s)

1. Rengasamy R S, Mechanics of Spinning Machines, NCUTE, New Delhi, 2002.
2. N. Gokarneshan, B. Varadarajan, C. B. Senthil Kumar, Mechanics and Calculations of Textile Machinery, Woodhead Publishing, India, 2013.
3. J. Hayavadana, Textile Mechanics and Calculations, Woodhead Publishing, India, 2018.
4. Taggart Scott, Textile Mechanics - Primary Source Edition, Creative Media Partners, LLC, England, 2014.
5. Ganapathy Nagarajan, Textile Mechanisms in Spinning and Weaving Machines, Woodhead Publishing, India, 2014.

22TT603 GARMENT TECHNOLOGY 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

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

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

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

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

PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO APPAREL MANUFACTURING

Functional divisions of the apparel industry, Material Evaluation of Fabric, Trims, and Accessories: Receiving and inspecting materials. Fabric inspection-4 points, 10 points. AQL, Types of defects. Common fabric problems for apparel manufacturers.

UNIT II **9 Hours**

CUTTING

Basics of Pattern making and grading, Introduction to cutting -Marker planning: requirements - Efficiency Marker making- Cut order planning. Spreading: Requirements-Methods-Nature of fabric package-Machines. Cutting: requirements-Hand shears- Straight knife- Round knife-Band Knife-Computer Control-Die - Laser-Plasma Torch-Water jet-Quality control in cutting- defects and trouble shooting.

UNIT III **9 Hours**

SEWING

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

UNIT IV **9 Hours**

APPAREL PRODUCTION SYSTEMS

Plant layout Planning, Apparel production systems-Progressing bundle System (PBS)-Unit Production System (UPS)-Modular Production System (MPS)-Flexible Manufacturing-work flow-Line Balancing Techniques.

UNIT V **9 Hours**

PRESSING AND PACKING

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

Total: 45 Hours

Reference(s)

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

22TT607 MINI PROJECT II 0 0 2 1

Course Objectives

- Identify the problem statement and apply the engineering concepts to find the solution.
- Improve the analysing capability of the students.
- Increase the exuberance in finding the solution to various problems.

Programme Outcomes (POs)

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

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

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

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

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

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

PO11. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies
3. Utilize the new tools, algorithms, and techniques that contribute to obtaining the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis of the cost-effectiveness.
5. Prepare the report and present oral demonstrations.

Articulation Matrix

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

22TT701 TEXTILE COSTING 3 1 0 4

Course Objectives

- To offer the students a broad overview of costing of textile products.
- To teach method of costing in textile industries.

Programme Outcomes (POs)

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

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

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

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

Course Outcomes (COs)

1. Analyse the concept of preparation of cost sheet, budget and breakeven analysis.
2. Create cost sheet and cost control in yarn production.
3. Create cost sheet and cost control in fabric production.
4. Analyse cost control in wet processing and calculate the cost of capital in dyeing industry.
5. Calculate the garment cost and shipment cost for the exports of goods.

Articulation Matrix

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

UNIT I **9 Hours**

PRINCIPLES OF COSTING

Costing- objectives- elements- different costs. Methods: Job- process -absorption- marginal- standard. Cost control and reduction- cost sheet- calculation of cost. Budget- budgetary control- Break even analysis. Profit and Loss account and Balance sheet analysis.

UNIT II **9 Hours**

YARN COST

Material- labour - direct expenses. Over heads: factory- office- selling and distribution. Budget- budgetary controls. Variances: material- labour- Over heads. Cost control in yarn production. Preparation of cost sheet in yarn production.

UNIT III **9 Hours**

FABRIC COST

Material- labour- direct expenses. Over heads: factory-office-selling and distribution. Variances: material- labour- over heads. Preparation of cost sheet in fabric production. Cost control measures in fabric production.

UNIT IV **9 Hours**

DYEING COST

Material- labour- direct expenses. Overheads: factory- office- selling and distribution. Variance: material-labour -over heads. Cost control in wet processing- preparation of cost sheet. Cost of capital, IRR, DRC, DSCR, ERR, payback period.

UNIT V **9 Hours**

GARMENT COST

Material- labour - direct expenses (trimmings) over heads factory: office- selling and distribution. Variance: material- labour - overheads. Effects of width, designs and lot size on cost - shipment cost - preparation of cost sheet in garment production, Duty drawback.

Tutorial: 15 Hours

Total: 60 Hours

Reference(s)

1. Richard D. Irwin Principles of Cost Accounting: Managerial Applications 2002.
2. P. V. Bhave and V. Srinivasan, Cost Accounting in Textile Mills- ATIRA Publication, 2005.
3. G. Shanmugam and T. Sivasankaran, Costing in Textile and Garment Industry-NCUTE Publication, 2002.

22TT702 TECHNICAL TEXTILES 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

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

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

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

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

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

PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

TECHNICAL FIBRES AND COMPOSITES
Classification and major applications of technical textiles, Introduction to high performance fibres (organic/inorganic) used for high modulus, thermal and chemical resistance. Market potential of Indian technical textiles in different sectors. Brief idea about technical fibres, role of yarn and fabric construction, composite material, Reinforcement fibres, matrix materials, Classification of textile reinforcement structure.

UNIT II **9 Hours**

MEDICAL AND HEALTHCARE TEXTILES
Classification of medical textiles, Fibres used and Basic requirements for medical textiles. Detailed study and application of textiles in: implantable, non-implantable and extracorporeal devices. Healthcare and hygienic products: face masks, PPE kits, incontinence products etc.

UNIT III **9 Hours**

PROTECTIVE TEXTILES
Brief idea about different types of protective clothing: Waterproof fabrics, breathable fabrics, Chemical protection, Fire protection, Heat and cold protection, Ballistic protective clothing and parachute cloth, Shear Thickening Fluids, Camouflage textiles, NBC protection, Nuclear protective fabrics. Sports and recreation textiles: Functional requirement of different types of products and their construction.

UNIT IV **9 Hours**

FILTRATION AND GEOTEXTILES
Filtration textiles: Definition of filtration parameters, theory of dust collection and solid liquid separation, filtration requirements, concept of pore size and particle size, role of fibre, fabric construction and finishing treatments. Geotextiles: Brief idea about geosynthetics and their uses, essential properties of geotextiles, geotextile testing and evaluation, application examples of geotextiles.

UNIT V **9 Hours**

INDUSTRIAL TEXTILES
Automotive Textiles: Application of textiles in automobiles, requirement and design for different tyres, airbags and belts, Seat belts and liner fabrics. Textiles for aircrafts methods of production and properties of textiles used in these applications. Functional requirements and types of textiles used for paper making, agricultural, electronics, power transmission belting, hoses, canvas covers and tarpaulins. Sewing threads, cords and ropes: Types, method of production and applications, functional requirements, structure and properties.

Total: 45 Hours

Reference(s)

1. Sabit Adanur and Wellington Sears, Handbook of Industrial Textiles, Technomic Publishing company Inc., USA, 2005.
2. R. Horrocks and S. C. Anand, Handbook of Technical Textiles, Woodhead Publishing Limited and The Textile Institute, 2000.
3. Alagirusamy and A. Das, Technical Textile Yarns, CRC press, 2010.
4. P. W. Harrison, The Design of Textiles for Industrial Applications, Textile Institute, Manchester, 2002.
5. Pushpa Bajaj and A. K. Sengupta, Industrial Applications of Textiles for Filtration and Coated Fabrics, Textile Progress Vol.14, 2000.
6. Jarmila Svedova, Industrial Textiles, Elsevier Science Publishing Co Inc. New York, 2001.

22TT707 PROJECT WORK I 0 0 4 2

Course Objectives

- Work in teams to propose, formulate, and solve a challenging open-ended design problem of significant scope, depth, and breadth.
- Understand and incorporate engineering standards and multiple realistic constraints, within realistic design time, budget, and performance objectives.
- Develop a prototype of the proposed design and demonstrate the prototype in accordance with the specifications.
- Effectively communicate information relating to all aspects of the design process in written, oral, and graphical form.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare a report and present the oral demonstrations.

Articulation Matrix

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

22TT801 PROJECT WORK II **0 0 20 10**

Course Objectives

- Work in teams to propose, formulate, and solve a challenging open-ended design problem of significant scope, depth, and breadth.
- Understand and incorporate engineering standards and multiple realistic constraints, within realistic design time, budget, and performance objectives.
- Develop a prototype of the proposed design and demonstrate the prototype in accordance with the specifications.
- Effectively communicate information relating to all aspects of the design process in written, oral, and graphical form.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare a report and present the oral demonstrations.

Articulation Matrix

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

22HS201 COMMUNICATIVE ENGLISH II 1 0 2 2

Course Objectives

- Command over the English language for day-to-day transactions.
- Improve listening and reading skills.
- Increase ability to comprehend complex content.
- Enhance confidence in expressing with clarity and elegance.
- Enthusiastic and reflective use of the language through sufficient and focused practice.
- Articulate fluently and confidently in challenging situations.

Programme Outcomes (POs)

PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Engage with the English language in functional contexts.
2. Express in both descriptive and narrative formats.
3. Interpolate and make effective use of the English Language in Business contexts.
4. Actively read and comprehend authentic text.
5. Express opinions and communicate experiences.

Articulation Matrix

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

UNIT I **15 Hours**

SELF-EXPRESSION

Personal Goals and Values - Being a Team Player-Expressing strengths and weaknesses-Abstract nouns - Adjectives-Active Listening Skills-Note making -Pronunciation and Accent. Personal goals and values - Reading for Gist and Details-Professional Ethics-Reported Speech-Conjunctions. Reading skills - phonemics, word/phrase recognition, sight words. Personal Goals and Values-Conditional clauses-Hypothetical questions and answers-Sentence Structure-Simple Present Tense-Perfect tense.

UNIT II **15 Hours**

CREATIVE EXPRESSION

Instructive and Expository Expression - Creating brochures, catalogues, and manuals for products/ services, Giving directions, Process writing, Sequencing experiments, Concept Explanation-Reported speech-Voice Sentence Equivalence-Proof reading.

UNIT III **15 Hours**

FORMAL EXPRESSION

Notices and Announcements-Writing: Creating notices and circulars for events, announcing college tours and lost and found-Varied Vocabulary - Gender Sensitive Vocabulary, Non-discriminatory Vocabulary, Concise Vocabulary-Paragraph writing - Effective titles, topics and supporting sentences, calling in registrations and queries. Effective communication- Understanding purpose, reach and target audience, achieving complete communication. Punctuation - Capitalization, Numeration, Use of proper nouns and articles-Spelling-Reading: Analysing and interpreting notices and circulars-Understanding the gist of short real-world notices, and messages. Culling out keywords. Information words vs Supporting Words-Interpreting Abbreviations, Acronyms and Short-forms-Listening: Analysing and interpreting announcements. Decoding - Screening for salient points-Note Making-Raising queries for clarification-Speaking: Announcements-Giving complete information-Pronunciation and Enunciation. Pace, Intonation, and Pitch-Conducting Events-Speaking: Master of ceremonies, short speeches - welcome speech, the vote of thanks/ valedictory speech, award-acceptance speech. Writing: Invitations, Preparation of script/draft after interviewing someone. Adjectives-Pronunciation/ Punctuation, Precision and Concision-Politeness markers.

Total: 45 Hours

Reference(s)

1. Sasikumar, V, et.al. A Course in Listening & Speaking Foundation Books, 2005.
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
3. Prasad, Hari Mohan. A Handbook of Spotting Errors. McGraw Hill Education, 2010.
4. Reynolds, John. Cambridge First Language English. 2018th ed., Hodder Education, 2018.
5. Wiggins, Grant P., and Jay McTighe. Understanding by Design. Association for Supervision and Curriculum Development, 2008.

22HSH01 HINDI **1 0 2 2**

Course Objectives

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

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Construct simple sentences and use vocabulary required for day- to -day conversation.
2. Distinguish and understand the basic sounds of Hindi language.
3. Apply appropriate grammar to write and speak in Hindi language.
4. Comprehend the conversation and give correct meaning.
5. Take up Hindi examinations conducted by Dakshin Bharat Hindi Prachar Sabha.

Articulation Matrix

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

UNIT I **9 Hours**

VOWELS AND CONSONANTS

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

UNIT II **9 Hours**

NOUNS

Nouns: Genders -Masculine & Feminine -Reading Exercises.

UNIT III **9 Hours**

PRONOUNS AND TENSES

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

UNIT IV **9 Hours**

CLASSIFIED VOCABULARY

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

UNIT V **9 Hours**

CONVERSATIONS

Speaking -Telling the times -Saying the Numbers from 1 to 50. Speaking practice for various occasions.

Total: 45 Hours

Reference(s)

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

22HSG01 GERMAN

1 0 2 2

Course Objectives

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

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Introduction to the German Language-Alphabets-Numbers Greetings -Days and Seasons-Working with Dictionary.

UNIT II **9 Hours**

LANGUAGE AND ITS COMMON USE

Nouns -articles-Speaking about oneself-Listening to CD supplied with books-paying special attention to pronunciation.

UNIT III **9 Hours**

TECHNICAL DEUTSCHE

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

UNIT IV **9 Hours**

INTERROGATION

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

UNIT V **9 Hours**

IMPLEMENTATION

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

Total: 45 Hours

Reference(s)

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

22HSJ01 JAPANESE

1 0 2 2

Course Objectives

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

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

SELF INTRODUCTION / DEMONSTRATIVES / NOUN MODIFIERS

Introduction to Japanese- Japanese script - Pronunciation of Japanese (Hiragana (Katakana) Long vowels - Pronunciation of in, tsu, ga -Letters combined with ya, yu, yo - Daily Greetings and Expressions -Numerals. Speaking: Self-Introduction - Listening: Listening to Greetings, Listening to specific information: Numbers, Time.

UNIT II **9 Hours**

TIME EXPRESSION / VERBS - PAST

Introduction to time -Introduction of verbs -Listening to specific information.

UNIT III **9 Hours**

ADJECTIVES

Word Sentence -Introduction to Adjectives -Technical Japanese Vocabulary -Pair Activity Day to day situational conversation.

Listening to Japanese Alphabet Pronunciation -Simple Conversation.

UNIT IV **9 Hours**

CONJUGATION OF II ADJECTIVE

Past tense of Noun sentences and Na adjective sentences -Past tense of ii adjective sentences -houga adjective desu -Technical Japanese Vocabulary -Individual Activity - Listening to conversation with related particles.

UNIT V **9 Hours**

CONJUGATION OF VERBS - TE FORM / TA FORM / NAI FORM / PLAIN FORM

N gahoshidesu - V masu form tai desu - Verb te form - Technical Japanese Vocabulary -Listening to different Counters, simple conversations with verbs and adjectives.

Total: 45 Hours

Reference(s)

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

22HSF01 FRENCH

1 0 2 2

Course Objectives

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

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

ENTRER EN CONTACT

La langue franaise, alphabets, les numerous, les jours, les mois. Grammaire Les verbes appeler, etre, avoir, les articles definis, indefinis Communication Saluer, s informer sur quelqu un, demander de se presenter Lexique L alphabet, les nationalites, l age, les pays, les couleurs, les jours de la semaine, les mois de l annee, les professions.

UNIT II **9 Hours**

PARTAGER SON LIEU DE VIE

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

UNIT III **9 Hours**

VIVRE AU QUOTIDIEN LES LOISIRS DES FRANCAIS, LES GOUTS DES AUTRES, LES ACTIVITES QUOTIDIENNES

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

UNIT IV **9 Hours**

COMPRENDRE SON ENVIRONNEMENT SOUVRIR A LA CULTURE

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

UNIT V **9 Hours**

GOUTER A LA CAMPAGNE

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

Total: 45 Hours

Reference(s)

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

22TT001 COLOUR SCIENCE **3 0 0 3**

Course Objectives

- To understand the fundamental knowledge of colour science and colour measurement.
- To understand the basics of kinetics and thermodynamics related to dyeing.

Programme Outcomes (POs)

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Use the principles of colour and colour vision for textile applications.
2. Apply colour order systems in textile finishing operations.
3. Use colour measurement systems.
4. Apply principles of kinetics and thermodynamics in the dyeing of textiles.
5. Select software tools for quality control in colouration.

Articulation Matrix

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

UNIT I **9 Hours**

COLOUR AND COLOUR VISION

Fundamentals of colour science: Eye and colour perception - Colour blindness - colour theory - Tests for defective colour vision. Metamerism, Dichroism, warm and cool colours

UNIT II **9 Hours**

COLOUR ORDER SYSTEM

Munsell system - Ostwald system - CIE matching functions - Determination of Tri-stimulus value - Linear and non-linear transformation - industrial colour tolerance limit and calculations - Concept of K-M theory for colour matching - Derivation of KM equation and its application.

UNIT III **9 Hours**

COMPUTER COLOUR MATCHING

Sample preparation for colour matching: Determination of optical data of dyes - Recipe formulation and correction - Detailed study about colour measuring instruments - Spectro photometer - limitations of CCM technique - Sequence of colour matching in industry - invariant and conditional matching. 555 Shade sorting technique.

UNIT IV **9 Hours**

KINETICS AND THERMODYNAMICS OF DYEING

Dyeing properties related to the inherent physical structure of the fibre - Interaction between dyes and fibre forming polymers - Study about types of adsorption isotherms - Absorption and desorption technique to determine the dyeing equilibrium - Derivation of affinity equation - determination of dyeing rate - theory of dyeing for different fibres.

UNIT V **9 Hours**

QUALITY CONTROL OF COLOUR

Colour difference equation - factors responsible for colour difference - yellowness and whiteness measurement with AATCC and ASTM standards - online colour measurement for textiles - database preparation for colour matching - colour control system and development of colour software.

Total: 45 Hours

Reference(s)

1. H.S. Shah and R.S. Gandhi, Instrumental Colour Measurements and Computer aided Colour Matching for Textiles, Mahajan Book Distributors, Ahmedabad, 1990.
2. A.T. Peters and H.S. Freeman, Physico-chemical Principles of Colour Chemistry, Blackie,1995.
3. Ashim Kumar Chaudry, Colour Science, Mahajan Book Distributors, Ahmedabad, 1990.
4. D. Sule, Computer Colour Analysis, New Age Internationals (P) Ltd, New Delhi, 2002.
5. Narendra S. Gangakhedkar, Science and Technology of Colour, Rutu Prakashan, 2003.
6. Westland, S., Ripamonti, C., & Cheung, V. Computational colour science using MATLAB. John Wiley & Sons, 2012.

22TT002 TEXTURIZING TECHNOLOGY 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

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

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

CONCEPTS OF TEXTURING

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

UNIT II **9 Hours**

FALSE TWIST TEXTURING

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

UNIT III **9 Hours**

AIR JET TEXTURING

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

UNIT IV **9 Hours**

BCF PROCESS

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

UNIT V **9 Hours**

OTHER METHODS OF TEXTURING

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

Total: 45 Hours

Reference(s)

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

22TT003 THEORY OF SPINNING 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

BLENDING

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

UNIT II **9 Hours**

OPENING, CLEANING AND CARDING

Intensity of opening. Opening and cleaning principles: tearing, picking, plucking, beating, combing, tossing. Processing of cotton, manmade fibres and blends. Degree of cleaning, carding and doffing disposition, Centrifugal forces. Action between feed roller and Licker-in, three licker-in theory, main cylinder and flats wide-width theory, autoleveller, periodic mass variation Fibre transfer, mechanism of elimination of neps. Effect of stationary flats on the opening and cleaning.

UNIT III **9 Hours**

DOUBLING AND DRAFTING

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

UNIT IV **9 Hours**

YARN FORMATION

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

UNIT V **9 Hours**

EVENNESS

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

Total: 45 Hours

Reference(s)

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

22TT004 HIGH PERFORMANCE FIBRES **3 0 0 3**

Course Objectives

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

Programme Outcomes (POs)

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

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

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

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

PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

STRUCTURE AND PROPERTIES

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

UNIT II **9 Hours**

NON-POLYMERIC FIBRES

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

UNIT III **9 Hours**

INORGANIC FIBRES

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

UNIT IV **9 Hours**

POLYMERIC HIGH-PERFORMANCE FIBRES

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

UNIT V **9 Hours**

CHEMICAL AND THERMAL RESISTANT FIBRES

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

Total: 45 Hours

Reference(s)

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

22TT005 THEORY OF WEAVING 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PSO1: Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

THEORY OF SHEDDING

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

UNIT II **9 Hours**

THEORY OF PICKING

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

UNIT III **9 Hours**

MECHANICS OF BEAT UP

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

UNIT IV **9 Hours**

WEFT INSERTION IN PROJECTILE AND RAPIER

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

UNIT V **9 Hours**

WEFT INSERTION - AIR JET, WATER JET, MULTI PHASE

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

Total: 45 Hours

Reference(s)

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

22TT006 CLOTHING SCIENCE 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

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

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

HUMAN PHYSIOLOGY ON CLOTHING

Need and selection of clothing. Definition of comfort. Human physiological aspect of comfort. Various aspects of clothing comfort. Comfort variables. Comfort properties of fibres, yarns and fabric structures. Psychological comfort of fabrics and garments.

UNIT II **9 Hours**

FIBRE AND FABRIC PROPERTIES ON CLOTHING

Effect of fibre properties, yarn structure, fabric design, fabric construction and treatments on the fabric properties such as air permeability, breathability, moisture transport -wetting and wicking. Study of factors that affect Hygral expansion, relaxation shrinkage, swelling shrinkage, felting shrinkage.

UNIT III **9 Hours**

FABRIC HANDLE AND COMFORT

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

UNIT IV **9 Hours**

TACTILE COMFORT AND FIT COMFORT

Tactile Comfort-Tactile comfort sensations, Fabric characteristics and tactile attributes, Fabric parameters influencing tactile sensation. Clothing Fit and Comfort. Body dimensions and pattern. Garment fit and comfort relationship. Factors related to clothing fit.

UNIT V **9 Hours**

DEVELOPMENTS AND IMPROVEMENTS IN CLOTHING

Fit analysis for various end uses: Winter - summer wear - innerwear - Sports - Casual - Swim wear. Functional and quality requirements. Different approaches for improving thermal comfort in apparel and Improving moisture management in apparel- Sensing and responding textiles, Fabric with pore size gradient, Fibres with nano-structured surface, Mixture of hydrophilic and hydrophobic fibres.

Total: 45 Hours

Reference(s)

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

22TT007 COSTING AND FINANCIAL MANAGEMENT **3 0 0 3**

Course Objectives

- To offer the students a broad overview of costing of textile products and teach principles of financial management.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PSO1: Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

1. Implement the cost accounting, and financial management.
2. Execute the concept of process costing, marginal costing and cost accounting.
3. Apply the principles and evaluation of capital budgeting techniques.
4. Analyse the cost of capital, capital structure and financial leverage in capital budgeting.
5. Apply the principles and determinants involved in working capital management.

Articulation Matrix

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

UNIT I **8 Hours**

BASICS OF COSTING AND FINANCIAL MANAGEMENT

Introduction to cost accounting-Cost ledgers: Reconciliation between cost and financial accounting -Costing methods -Product Costing, Job, order, Batch and Contract costing- Cost Sheet. Introduction Financial Management: Functions, Goals, Organization of Finance Function, Time Value of Money, Future Value and Present Value of Money. Real and Nominal Interest Rate.

UNIT II **8 Hours**

PROCESS COSTING AND ACCOUNTING

Process costing-operation costing -unit costing, multiple costing -Marginal costing -Throughput accounting -ABC -integration of standard costing with marginal cost -Transfer Pricing-Treatment of special expenses -Accounting and control of waste, scrap, spoilage, defective etc.

UNIT III **10 Hours**

PRINCIPLES OF CAPITAL BUDGETING

Principles and Nature of Capital Budgeting, Evaluation Techniques: Payback Period, Accounting Rate of Return, Net Present Value, Internal Rate of Return, Profitability Index. Project selection under Capital Rationing.

UNIT IV **10 Hours**

CAPITAL BUDGETING

Cost of Capital and Capital Structure Concept of Cost of Capital, Measurement of Specific Costs and Overall Cost of Capital, Factors Determining Capital Structure, Operating and Financial Leverage.

UNIT V **9 Hours**

WORKING CAPITAL MANAGEMENT

Principles of Working Capital, Principles and Determinants of Working Capital, Operating Cycle, Estimation of Working Capital, Policies for Financing Current Assets, GWC vs. NWC.

Total: 45 Hours

Reference(s)

1. M.N. Arora, Cost Accounting: Principles and practice, New Delhi: Vikas publishing Pvt. Ltd., 2011.
2. Horngreen, Foster & Datar, Cost Accounting-A Managerial Emphasis, New Delhi: Prentice Hall India, 2010.
3. Dr. Ashish K. Bhattacharyya, Principles and Practice of Cost Accounting, New Delhi: Prentice Hall (PHI), 2012.
4. I.M. Pandey, Financial Management, New Delhi: Vikas Publishing House Pvt. Ltd., 2012.
5. Brigham and Houston, Fundamentals of Financial Management, New Delhi: Thomson Learning, 2011.
6. Prasanna Chandra, Financial Management-Theory and Practice, New Delhi: Tata McGraw-Hill Publishing Company Ltd, 2012.

22TT008 MAINTENANCE MANAGEMENT 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

CONCEPTS

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

UNIT II **9 Hours**

SPINNING PREPARATION

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

UNIT III **9 Hours**

SPINNING AND POST SPINNING

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

UNIT IV **9 Hours**

WEAVING

Maintenance schedules for cone winding - pirn winding -warping -sizing- auto and non-auto weaving machines. Weaving machinery layout - material handling and equipment. Weaving machinery audit. Dobby, jacquard maintenance, allocations of machines.

UNIT V **9 Hours**

WEAVING ACCESSORIES MAINTENANCE

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

Total: 45 Hours

Reference(s)

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

22TT009 MANAGERIAL PRACTICES IN TEXTILE INDUSTRIES 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PSO1: Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

TEXTILE INDUSTRY

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

UNIT II **9 Hours**

CENTRAL AND STATE GOVERNMENT SCHEMES

Production Linked Incentive (PLI), PM Mega Integrated Textile Region & Apparel (PM MITRA), Comprehensive Handicrafts Cluster Development Scheme (CHCDS), Technology Up- gradation Fund Scheme (TUFS), Textile Workers Rehabilitation Fund Scheme, Group Work Shed Scheme, Comprehensive Power loom Cluster Development Scheme, Group Insurance scheme, Scheme for Integrated Textile Parks, Hank Yarn Obligation (HYO); Yarn Bank Scheme. Technology Missions for Technical textiles. Centre of Excellence.

UNIT III **9 Hours**

MILL ORGANIZATION AND PLANNING

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

UNIT IV **9 Hours**

UTILITIES

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

UNIT V **9 Hours**

PERSONNEL AND MARKETING MANAGEMENT

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

Total: 45 Hours

Reference(s)

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

22TT010 UTILITIES ENGINEERING 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

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

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

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

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

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

PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

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

PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

AIR ENGINEERING

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

UNIT II **9 Hours**

ELECTRICAL INSTALLATIONS

Design of electrical distribution system for textile plants, powerhouse, transformer capacity, distribution network, cable size calculations, capacitor calculations, power factor maintenance, power quality, sourcing electrical power, issues in power billing, lighting installations, economic aspects of power management.

UNIT III **9 Hours**

CAPTIVE POWER GENERATION

Generator set selection, load calculations, fuel efficiency, power factor effects, Generator set location, exhaust system, and Maintenance practices. Unconventional energy sources like wind power, solar power.

UNIT IV **9 Hours**

STEAM MANAGEMENT

Boilers, Types, stream distribution systems, fuel and air preheating, boiler blow down, pressure drop and pipe design, pipe fittings and lagging, Thermic fluid heating devices.

UNIT V **9 Hours**

COMPRESSORS AND PNEUMATIC SYSTEMS, SAFETY

Compressors, types, calculation of capacities, operational features, maintenance, safety, pneumatic lines, hoses, pneumatic pistons. Fire Fighting and Safety -Firefighting equipment, safety devices, accident prevention.

Total: 45 Hours

Reference(s)

1. G. Shanmugham, T. Sivasankaran and D. Saravanan, Engineering Aspects of Textile Mills, Module No 5, BIT, NCUTE Publications, 2002.
2. Steam Consumption Norms for Textile Processes Houses, BTRA, Mumbai, 2007.

22TT011 INDUSTRIAL ENGINEERING 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

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

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

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

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

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

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

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

PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

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

PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

PRODUCTIVITY

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

UNIT II **9 Hours**

WORK AND METHOD STUDY

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

UNIT III **9 Hours**

MOTION AND TIME STUDY

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

UNIT IV **9 Hours**

FACTORY LAYOUTS

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

UNIT V **9 Hours**

MATERIAL HANDLING AND WORK ENVIRONMENT

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

Total: 45 Hours

Reference(s)

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

22TT012 PROCESS CONTROL IN SPINNING AND WEAVING **3 0 0 3**

Course Objectives

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

Programme Outcomes (POs)

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

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

RAW MATERIALS AND SPINNING PREPARATORY PROCESSES

Cotton Mixing quality- Fibre Quality Index (FQI) and its applications -prediction of spinnability and yarn quality- Selection of manufactured fibres (polyester, viscose rayon, acrylic and nylon): Fibre parameters according to end use requirements including blended yarn production. Bale Management Techniques- blending irregularity. Causes of nep generation - nep removal in carding and combing machines. Cleaning efficiency of blowroom and cards, Trash % in card sliver, waste extraction in blowroom and cards. Deviation rate in yarns. On line nep monitoring, hooks & hooks removal. Contamination & its control-Online monitoring of contamination-Stickiness: causes, effect & control strategies. Process control strategies for organic cotton processing.

UNIT II **9 Hours**

YARN QUALITY CONTROL

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

UNIT III **9 Hours**

PROCESS CONTROL IN WEAVING PREPARATION

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

UNIT IV **9 Hours**

PROCESS CONTROL IN WEAVING

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

UNIT V **9 Hours**

PRODUCTIVITY IN SPINNING AND WEAVING

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

Total: 45 Hours

Reference(s)

1. T. V. Ratnam and K. P. Chellamani, Quality Control in Spinning, SITRA, Coimbatore, 1999.
2. A. R. Garde and T. A. Subramaniam, Process Control in Spinning, ATIRA, Ahmedabad, 1989.
3. A System of Process Control in Weaving, ATIRA, Ahmedabad, 1983.
4. A. J. Chuter, Quality Management in the Clothing and Textile Industry, Woodhead Publishing, UK, 2011.
5. M. C. Paliwal and P. D. Kimothi, Process Control in Weaving, ATIRA Publication, Ahmedabad, 1983.
6. W. Klein, Manmade Fiber and their Processing, The Textile Institute, Manchester, U.K.1994.

22TT013 ADVANCES IN CHEMICAL PROCESSING TECHNOLOGY

3 0 0 3

Course Objectives

- To understand the advancements in the chemical processing of textile materials.
- To evaluate the alternative processes using enzymes in preparation and finishing.
- To acquire knowledge on energy conservation and pollution control measures.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Analyse process parameters involved in fabric preparatory processes.
2. Resolve dye recipes for textile materials for different depths employing latest developments.
3. Evaluate the concepts involved in textile finishes.
4. Assess the issues involved in the operation and maintenance of effluent treatment plants.
5. Select suitable printing machines and techniques.

Articulation Matrix

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

UNIT I **9 Hours**

ADVANCES IN PREPARATORY PROCESSES

Combined preparatory processes - Single bath desizing, scouring and bleaching - Bio-scouring and its limitations - Bio-bleaching and combined enzyme assisted processes - Solvent scouring Process - Preparatory process for blends, application of enzymes in textile processing.

UNIT II **9 Hours**

DYEING

Developments in the application of direct, reactive, disperse dyes to textile materials using batch wise and continuous methods - Salt free dyeing of reactive dyes - Dyeing of wool blends - Concept of Right First- Time dyeing - Developments in E-control dyeing machines - Low liquor and Low wet pickup techniques, super critical carbon dioxide dyeing.

UNIT III **9 Hours**

FINISHING

Micro and Nano encapsulation and its application in finishing of textile materials - Finishing of technical textiles - Formaldehyde-free crease recovery finishing. Problems and remedies in the flame-retardant finishing of polyester and its blends. Bio-polishing - Influence of biopolishing on dyeability and physical properties of fibres and fabrics - developments of new fibres using Bio technology.

UNIT IV **9 Hours**

ENERGY CONSERVATION AND POLLUTION CONTROL

Energy conservation steps in chemical processing - causes and remedies for water and air pollution - Detailed study about characteristic of textile effluent and its norms - Developments in membrane techniques in the effluent treatment. Bio-technology in textile effluent treatment.

UNIT V **9 Hours**

PRINTING

Developments in rotary printing machine, Developments in pigment printing: foam, plastic, foil, rubber, glitter and transparent print. Synthetic thickeners for latest printing techniques - Digital printing - 3D printing- Transfer printing.

Total: 45 Hours

Reference(s)

1. V. A. Shenai, Technology of Printing, Vol. IV, Sevak Publication, Bombay, 1996.
2. John Shore, Cellulosic Dyeing, Society of Dyers and Colourists, 1995.
3. P. W. Harrison, Low-Liquor Dyeing and Finishing, Textile Progress, UK, 1986.
4. R B Chavan, Environmental Issues: Technology Options for Textile Industry, Special Issue, Indian Journal of Fibre and Textile Research, New Delhi, 2001.
5. A C Paulo, Enzymes in Textile Processing, Woodhead Publication, UK, 2002.

22TT014 PROCESS AND QUALITY CONTROL IN TEXTILE CHEMICAL PROCESSING

3 0 0 3

Course Objectives

- To acquire knowledge on quality and process control in chemical processing.
- To apply and use norms and standards applied to chemical processing.

Programme Outcomes (POs)

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

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Organize process control measures in preparatory process.
2. Assess process control measures in dyeing.
3. Evaluate process control measures in printing.
4. Analyse process control measures in mechanical finishing process.
5. Evaluate process control measures in chemical finishing process.

Articulation Matrix

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

UNIT I **9 Hours**

PROCESS CONTROL IN PREPARATORY

Overview of process and quality control in textile chemical processing. Machine and process parameters influencing the process performance and quality of preparatory processes. Desizing - Scouring – Bleaching -Souring - Mercerization. Quality evaluation of preparatory processed material.

UNIT II **9 Hours**

PROCESS AND QUALITY CONTROL IN DYEING

Machine and process parameters influencing dyeing of fibre, yarn and fabrics made from various fibres with different dyeing techniques. Quality evaluation of dyed material.

UNIT III **9 Hours**

PROCESS AND QUALITY CONTROL IN PRINTING

Machine and process parameters influencing the printing of fabrics made from various fibres with different printing techniques. Quality evaluation of printed material.

UNIT IV **9 Hours**

PROCESS AND QUALITY CONTROL IN FINISHING

Machine and process parameters influencing the Mechanical finishing of fabrics made from various fibres with different finishing techniques. Quality evaluation of mechanically finished textile material.

UNIT V **9 Hours**

PROCESS AND QUALITY CONTROL IN FINISHING

Machine and process parameters influencing the chemical finishing of fabrics made from various fibres with different finishing techniques. Quality evaluation of chemically finished textile material.

Total: 45 Hours

Reference(s)

1. B.P. Saville, Physical Testing of Textiles, The Textile Institute, Woodhead Publishing Limited, Cambridge, 1999.
2. R. Ed Postle, S. Kawabata and M. Niwa, Objective Evaluation of Fabrics, Textile Machinery Society, Japan, Osaka, 1993.
3. S. R. Karmakar, Chemical Technology in the Pretreatment Process of Textiles, Elsevier Publications, 1999.
4. P.C. Mehta, Process and Quality Control, BTRA, 1995.
5. Prof Y M India, Process control and safety in chemical processing of Textile, 2012.

22TT015 ENVIRONMENTAL ASPECTS OF DYEING 3 0 0 3

Course Objectives

- To acquire knowledge on environmental aspects in textile chemical processing.
- To apply different dyeing techniques to reduce chemicals for ecofriendly chemical processing.

Programme Outcomes (POs)

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Resolve the mechanism and applications in textile processing industry.
2. Implement environmental standards to control the usage of dyes in chemical processing.
3. Analyse various techniques in the area of dyeing and printing.
4. Analyse pollution control and decolouration of textile dye effluent in textile dyeing.
5. Apply suitable physical, chemical and biological treatment for waste minimization and dye effluent process in textile processing industry.

Articulation Matrix

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

UNIT I **9 Hours**

DYEING AND TEXTILE INDUSTRY

Dyes- properties - Mechanism and Applications in textile industry: fibre, yarn and fabric dyeing, Process parameters, quality evaluation.

UNIT II **9 Hours**

ENVIRONMENTAL CONCERN

European legislation relating to textile dyeing; Environmental legislation USA, Dangerous substances in textiles, Eco labelling, waste water, Air, water framework directive, globally harmonized system, Future trends.

UNIT III **9 Hours**

ENVIRONMENTAL DYEING TECHNIQUES

Toxicology of textile dyes, pigments; Genotoxicity, mutagens and carcinogens, Sustainable dye application, exhaustion dyeing, continuous, semi-continuous dyeing, Air-dye technology, Plasma technology, foam dyeing, spraying, microwave, ultrasonic wave dyeing technology, Ozone, electro chemical, bio-based technology and digital screen printing.

UNIT IV **9 Hours**

TEXTILE DYEING AND DECOLOURISATION OF TEXTILE DYE EFFLUENT

Supercritical fluid textile dyeing technology; High performance fibre dyeing, Market scenario, Future trends, Pollution abatement and waste minimization in textile dyeing; Decolourisation of textile dye effluent and re-use of spent dye bath; Resource management practices.

UNIT V **9 Hours**

PHYSICAL, CHEMICAL AND BIOLOGICAL TREATMENT OF DYE EFFLUENT PROCESS

Waste minimization, ozonisation, activated carbon, biomass, UV gamma, electron beam, filtration, Reverse osmosis, electrochemical, Chemical treatment of textile dye effluent; Biotechnological treatment of textile dye effluent.

Total: 45 Hours

Reference(s)

1. Christie R. Environmental aspects of textile dyeing. Elsevier; 2007.
2. Aspland J R, Textile Dyeing and Coloration, Research Triangle Park NC, AATCC, 1997.
3. Knittel D, Saus W and Schollmeyer E, Application of supercritical carbon dioxide in finishing processes, J Text Inst, 84, 2019.
4. Senthil Kumar, P., & Yaashika, P. R. Sustainable dyeing techniques. In Sustainable innovations in textile chemical processes, Springer, Singapore, 2018.

22TT016 TEXTILE EFFLUENT TREATMENT **3 0 0 3**

Course Objectives

- To understand the need to control the effluents arising from wet processing.
- To suggest different methods of treating the textile effluents.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Attribute textile effluents.
2. Attribute colour and turbidity of textile effluents.
3. Assess the water quality using standard procedures.
4. Resolve inputs for the design of an effluent treatment plant.
5. Analyse suitable methods to reduce the effluent load in textile processing.

Articulation Matrix

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

UNIT I **9 Hours**

SOURCES AND CHARACTERISTICS OF POLLUTION
Characteristics and treatment of effluents: Preparatory process - Colouration - Finishing - Combined effluents. Problem of colours. Synthetic and woollen textile processing effluents: Spin bath components - Wool scouring wastes: Solids - Liquids.

UNIT II **9 Hours**

COLOUR AND TURBIDITY
Primary treatment: Screening - sedimentation - Equalization - Neutralization - Coagulation - Floatation. Secondary biological treatments: Activated sludge - Trickling filtration - Aerated lagoons - Secondary sedimentation - Oxidation ponds - Anaerobic digestion - Sludge disposal. Tertiary treatment: Multimedia filtration - chemical coagulation - chemical precipitation - hyper filtration: Ultra filtration - Nano filtration - Reverse osmosis. Dialysis- Chlorination.

UNIT III **9 Hours**

WATER AND EFFLUENT ANALYSIS
Water analysis - Colour - Acidity - Alkalinity - Dissolved solids - Suspended solids - Total hardness (Calcium & Magnesium). Methods: EDTA Titrimetric - Total iron-thiocyanate - Determination of Alkalinity - Chlorides - Dissolved oxygen - Surfactants - Methylene blue - Corrosivity - BOD-COD - TDS Toxicity.

UNIT IV **9 Hours**

EFFLUENT TREATMENT PLANTS
Design of effluent treatment plant: Individual Unit- Common effluent treatment- Collection of samples - Quality assurance programmes in ETP: Audit- Assessment- Recording - Monitor - Re-evaluation. Sludge Management: Source reduction- Bio-elimination - Solid separation - Government Regulations- Norms for treated water.

UNIT V **9 Hours**

REDUCTION OF POLLUTION AND WATER REQUIREMENT
Waste segregation - recovery - reuse - substitution of low polluting chemicals - process modification - economy in water use. Quality requirement of water for processing: Cotton - Synthetics - Wool - Silk - Boiler - Humidification.

Total: 45 Hours

Reference(s)

1. C. S. Rao, Environment Pollution Control Engineering, New Age International Ltd., 1994.
2. P. Cooper, Colour in Dyehouse Effluent, Society of Dyers and Colourists, UK, 1995.
3. N. Manivasakam, Treatment of Textile Processing Effluents, Sakhi Publications, 1995.
4. P. Vankar, Textile Effluent, NCUTE Publication, New Delhi, 2002.

22TT017 ADVANCED KNITTING TECHNOLOGY 3 0 0 3

Course Objectives

- To acquire the knowledge of advanced technologies in knitting.
- To understand the mechanisms involved in advanced knitting machines.
- To analyse the latest developments in knitted fabric structures.

Programme Outcomes (POs)

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

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

Course Outcomes (COs)

1. Compare the contrast warp and weft knitted structures.
2. Select tricot and raschel knitting machines for production of knitted fabrics.
3. Analyse features of flat knitting machine to produce flat knit structures.
4. Outline the loop geometry and loop formation in a knitted fabric.
5. Select yarn preparation machines and methods for warp knitting.

Articulation Matrix

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

UNIT I **9 Hours**

WEFT KNITTING

Needle Selection Techniques in weft knitting - Storage and positive feeding devices - Patterning for multitrack machines.

UNIT II **9 Hours**

KNITTING DYNAMICS

Yarn tension and knitting forces - Effect of cam shape, increase in number of feeders and increase in linear speed - needle breakages.

UNIT III **9 Hours**

FABRIC GEOMETRY AND DEVELOPMENTS IN CIRCULAR KNITTING

Tightness factor- Dimensional properties -Spirality-Relaxation- Shrinkage. Ring and rotor yarn quality requirements for weft knitting- High Pile and Socks Knitting Machines.

UNIT IV **9 Hours**

WARP KNITTING AND FABRIC GEOMETRY

Tricot & Rachel Two, Three & Multibar Machines -Pattern Control Mechanisms - Pattern Wheels and Chain Links. Dimensional characteristics of warp knits, Warp knitted fabric geometry - relation between loop length and construction - fabric relaxation and shrinkage.

UNIT V **9 Hours**

SPECIALITY WARP KNITS

Weft insertion- co-we-nit - cut presser - Laying-in - fall plate - double needle bar warp knitting machines-Jacquard knitting. Warp knitted technical textiles. Testing and Quality Control of Weft and Warp knitted fabrics. Various defects in knitting.

Total: 45 Hours

Reference(s)

1. Spencer D J, Knitting Technology, Woodhead Publishing Limited, 2005.
2. Samuel Raz, Flat Knitting Technology, C.F. Rees GMBH, Druck-Repro-Verlag, Heidenheim, Germany, 1993.
3. Chris Wilkens, Warp Knit Machine Elements, U. Wilkens Verlag, 1997.
4. Henry Johnson, Introduction to Knitting Technology, Abhishek Publications, Chandigarh, 2006.
5. Chandrasekhar Iyer, Bernd Mammal and Wolfgang Schach, Circular Knitting, Meisenbach GmbH, Bamberg, 1995.
6. D. B. Ajgaonkar, Knitting Technology, Universal Publication Corporation, Mumbai, 1998.

22TT018 QUANTITATIVE METHODS IN TEXTILE INDUSTRY

3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

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

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

SPINNING

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

UNIT II **9 Hours**

SPINNING

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

UNIT III **9 Hours**

FABRIC FORMATION

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

UNIT IV **9 Hours**

FABRIC FORMATION

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

UNIT V **9 Hours**

TEXTILE CHEMICAL PROCESSING

Expression of volumes of liquids: w/w, w/v and v/v. Density of salt / chemical solution, 0°Be to °Tw to g/cc, Normality, Molarity - Molality. Lab-to-shop floor calculations for preparation, colouration and finishing. Estimation of degradation in Preparatory Processes: Calculation of Copper Number, carboxyl group content. Dye exhaustion to the fabric in padding process. Colour difference, shade sorting, CIE Whiteness Index, ASTM Yellowness Index. Utilities consumption.

Total: 45 Hours

Reference(s)

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

22TT019 APPAREL PRODUCTION PLANNING AND CONTROL

3 0 0 3

Course Objectives

- To understand the concepts in production planning and control.
- To understand the material management and their movement in the production.
- To apply the various techniques in production planning and control.
- To understand the material management and their movement in the production.

Programme Outcomes (POs)

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

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

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

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

PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

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

PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Evaluate the benefits of planning and controlling of different production systems adopted in apparel industry.
2. Assess product and process planning with respect to different levels of apparel industry.
3. Create schedules for material loading, production flow in order to control various processes.
4. Analyze the stocks in different inventory with integrated planning systems.
5. Evaluate aggregate planning and related issues and strategies for an apparel industry.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Objectives and benefits of planning and control-Functions of production control-Types of production systems -job- batch and continuous-Product development and design-Marketing aspect - Functional Aspects-Operational Aspect-Durability and dependability aspect- aesthetic aspect. Profit consideration-Standardization, Simplification & Specialization- Break even analysis-Economics of a new design.

UNIT II **9 Hours**

PRODUCT PLANNING AND PROCESS PLANNING

Product planning - Extending the original product information-Value Analysis-Problems in lack of product planning- Process planning and routing-Pre requisite information needed for process planning-Steps in process planning-Quantity determination in batch production-Machine capacity, balancing-Analysis of process capabilities in a multi-product system.

UNIT III **9 Hours**

PRODUCTION SCHEDULING

Production Control Systems- Loading and scheduling-Master Scheduling-Scheduling rules-Gantt Charts- Perpetual Loading-Basic scheduling problems - Line of balance - Flow production scheduling-Batch production scheduling- Product sequencing - Production Control systems- Periodic batch control-Material requirement planning kanban - Dispatching-Progress reporting and expediting-Manufacturing lead time- Techniques for aligning completion times and due dates.

UNIT IV **9 Hours**

INVENTORY CONTROL AND RECENT TRENDS IN PPC

Inventory control - Purpose of holding stock - Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system - Determination of Economic order quantity and economic lot size - ABC analysis - Recorder Procedure-Introduction to computer integrated production planning systems - elements of JIT - Fundamentals of MRP II and ERP.

UNIT V **9 Hours**

AGGREGATE PLANNING

Aggregate Units of production, Issues of aggregation- smoothing, bottle neck problem, planning horizon, treatment of demand; Cost in aggregate planning; Aggregate in chase strategy, constant workforce, and mixed strategies and additional strategies; Disaggregating aggregate plans.

Total: 45 Hours

Reference(s)

1. Steven Nahmias, Production and Operations Analysis, 6th edition; Tata McGraw-Hill, 2009.
2. S. K. Mukhopadhyay, Production Planning & Control: Text and Cases, PHI Learning Pvt. Ltd., 2007.
3. Martand Telsang, "Industrial Engineering and Production Management", S. Chand and Company, First edition, 2000.
4. Stephen N. Chapman, "The fundamentals of Production Planning and Control.", Pearson Education, 2009.
5. K. C. Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management", Khanna Publishers, 1990.
6. Upendra Kachru, "Production and operations management Text and cases" Excel books 1st edition 2007.

22TT020 PATTERN ENGINEERING 3 0 0 3

Course Objectives

- To impart knowledge on human body measurements and creating pattern from the measurements.
- To develop commercial pattern with design aspect by manipulating the basic pattern.
- To fabricate patterns of different sizes by grading the basic pattern.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Design and develop patterns based on figure analysis and by choosing suitable measurement technique.
2. Design and develop patterns for the basic blocks of garment.
3. Execute and prepare patterns for the body components of sleeve, cuff and collars.
4. Implement and prepare patterns for the body components of yokes and pockets.
5. Create pattern grading for basic body components to various sizes.

Articulation Matrix

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

UNIT I **9 Hours**

HUMAN ANTHROPOMETRICS AND SIZING SYSTEMS

Garment manufacturing process flow chart, Measurements and its importance, land mark terms, sequence of taking body measurements-vertical measurements and horizontal measurements-Anthropometrics research. Sizing system: size categories in men's wear, women's wear and children's wear, international sizing, ASTM standard size chart. Proportion and disproportion of human figure.

UNIT II **9 Hours**

PATTERN MAKING

Pattern making tools, pattern making terms, basic blocks, pattern details, dart, notches, grain line, drill hole marks, ease allowance, seam allowance, style lines, types of patterns, techniques of pattern making - drafting, draping and flat pattern, blending and trueing, Interpretation of design and specification sheet, tolerance, different types of patterns produced during sampling and production.

UNIT III **9 Hours**

DRAFTING

Principles of pattern drafting, Drafting patterns for basic bodice, sleeve, skirt, types of sleeves, collars, yokes, cuffs. shirt and trouser. Skirts - length variation, skirt foundations, styles pleated, tiers, godets, gored, circular, cowl, pegged, skirts with yoke, uneven hem lines, peplums, wrap skirt, cascade wrap, Pants: foundations, culottes, jean, hip hugger, jump suits, Bermudas, pedal pushers, capri.

UNIT IV **9 Hours**

FLAT PATTERN TECHNIQUES AND FIT

Dart manipulation methods - pivot, slash & spread and measurement method. Single and double dart series, conversion of dart into style lines, yokes, gathers and multiple darts. Pattern alterations: Fit-importance, standards, influence of clothing fit, importance of altering patterns, principles of pattern alterations, common pattern alterations in various garments, alteration of patterns for irregular figures.

UNIT V **9 Hours**

PATTERN GRADING

3D body scanning, principles, operations and advantages of body scanning technologies. Principles of pattern grading, types of draft grading and track grading, two dimensional and three-dimensional grading, grading of bodice, sleeve, skirt, trouser, and collar, computerized pattern grading. Types of layouts, laying patterns on different types of fabric, marker planning for different types of garments.

Total: 45 Hours

Reference(s)

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

22TT021 GARMENT PRODUCTION MACHINERY AND EQUIPMENT

3 0 0 3

Course Objectives

- To acquire knowledge on the design, construction and operational features of garment production machinery and equipment.
- To understand the details of garment machinery and equipment with focus on the means of exploiting the features built in the garment machinery and equipment.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PSO1: Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Organize the operational parameters of spreading, cutting machines and evaluate the performance.
2. Assess sewing machine and its components for their use in apparel manufacture.
3. Evaluate single needle lock stitch machine for apparel manufacture.
4. Select appropriate overlock sewing machines for apparel manufacture.
5. Select appropriate work aids in apparel manufacture.

Articulation Matrix

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

UNIT I **9 Hours**

SPREADING AND CUTTING MACHINES

Spreading machines: Spreading table - stationary-portable -fixed machines - travelling spreaders - manual - semi-automatic - automatic. Cutting machines: Vertical blade reciprocating - rotary blade - band knife - die cutter - clickers and presses - shears - hand knives - short knives - table sword knives - notches - drills - computer-controlled cutting knives - machines using laser, water, plasma and ultrasonic waves.

UNIT II **9 Hours**

SEWING MACHINE

History of sewing machines - classification according to bed types - major parts of sewing machinery and functions. Adjustment of major parts of single needle lock stitch machine: non-UBT: stand height, pedal, presser foot, and height of needle bar, needle to hook relationship, height of feed dog, normal and reverse feed stitch length, feed timing, presser foot pressure, needle and bobbin thread tension, bobbin winding assembly, belt tension.

UNIT III **9 Hours**

SEWING MACHINE ADJUSTMENT (SNLS)

Sewing needle and sewing thread, thread consumption, thread routing. Adjustment on SNLS-UBT: Needle stop position, wiper, thread timing sequence, timing of thread trimmer cam, positioning the moving knife, installation, sharpening, replacing moving knives.

UNIT IV **9 Hours**

SEWING MACHINE ADJUSTMENT (OVERLOCK)

Parts, functions and adjustments of over lock: Needle height, feed dog height, differential feed ratio, tilt of the feed dog, position of the upper and lower knives, sharpening of knife and looper.

UNIT V **9 Hours**

WORK AIDS

Work-aids and attachments, functions of pullers, guides and folders compensating presser foots left, right, double; feller, hemmer, etc. Collar turning machines, folding machinery, fusing and pressing machinery.

Total: 45 Hours

Reference(s)

1. Jacob Solinger, Apparel Manufacturing Handbook, Van Nostrand Reinhold Company, 1988.
2. Peyton B. Hudson, Guide to Apparel Manufacturing, Medi Apparel Inc. 1989.
3. H. Carr and B. Latham, The Technology of Clothing Manufacture, Blackwell Scientific Publications, 1988.

22TT022 MANAGEMENT OF APPAREL UNITS 3 0 0 3

Course Objectives

- To understand the managing aspects the apparel industry.
- To understand the basics of managing a garment production factory.

Programme Outcomes (POs)

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

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

PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Construct organization charts for various sizes of woven, knitted or leather apparel industry.
2. Organize appropriate layout for optimum utilization of resources.
3. Evaluate apparel market structure and market operations.
4. Create project report for an apparel start-up.
5. Organize export documentation according to rules and regulations.

Articulation Matrix

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

UNIT I **9 Hours**

ENTREPRENEURSHIP

Entrepreneurship development skills -concept of small-scale industry - advantages of SSI units. Classification of Garment Units: Woven - knitted - lingerie - leather garment - sportswear - outer wear - under garments - hospital wear. Costing: Garment cost elements - cost calculations (numerical problems).

UNIT II **9 Hours**

SETTING UP A GARMENT UNIT AND LABOUR LAWS

Study of land - Norms of SA-8000 - capital - labour - market demand - preparing a project - large scale industry - advantages over SSI - Bank assistance. Government Schemes. Labour - Study of labour laws - factory act - labour laws - welfare measures - safety act.

UNIT III **9 Hours**

PRODUCTION MANAGEMENT

Production planning and control - production systems - material flow control - optimization of work place arrangement for higher productivity. Types of production layouts: Process oriented - Product oriented. Case study.

UNIT IV **9 Hours**

MARKETING

Market structure: Domestic - International-Wholesale - Retail. Buying seasons: Spring - Summer - Autumn -Winter - Holiday. Advertising - different media - trade fare - display - exhibition - buyer - seller meet.

UNIT V **9 Hours**

EXPORTS SCENARIO

Exports policy - trade documentation and quota policy - AEPC and its role in the garments industry. Export Documentation. Payment terms.

Total: 45 Hours

Reference(s)

1. R. K. Sharma, Development Banks and Entrepreneurship Promotion in India, Mittal Publications, New Delhi, 2001.
2. O. P. Khanna, Industrial Engineering and Management, Dhanpat Rai Publications (p) Ltd., New Delhi, 1999.
3. Ruth E Glock, Grace I Kunz, Apparel Manufacturing - Sewn Product Analysis - 3rd Edition, Prentice Hall Inc., 2000.
4. Jacob Solinger, Apparel Manufacturing Handbook - Analysis Principles and Practice, Bobbin Blenheim Media Corp; 2nd edition, 1988.

22TT023 APPAREL MARKETING AND MERCHANDISING **3 0 0 3**

Course Objectives

- To teach the activities of marketing and merchandising in the apparel industry
- To teach the commercial and sourcing aspects of the garment industry.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Construct organization charts for industrial units of varying sizes; plan for realizing export incentives.
2. Organize and implement marketing strategies and goals.
3. Organize production, visual merchandising, product development and line presentation.
4. Generate materials requirement plan for a given order and identify sourcing resources.
5. Outline export documentation and its procedures.

Articulation Matrix

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

UNIT I **9 Hours**

ORGANIZATION OF THE APPAREL BUSINESS

Introduction to apparel industry - Organization of the apparel industry - Types of exporters - Business concepts applied to the apparel industry - International trade. WTO: Functions and objective. GSP. Export incentives: Duty drawback - DEPB - Import - Export.

UNIT II **9 Hours**

MARKETING

Functional organization of an apparel firm. Responsibilities of a marketing division - Marketing objectives and strategies - Marketing research, Consumer research, Product research - Types of markets: Retails and wholesale strategies for merchandise distribution - Retailers- Sourcing flows and practices - Marketing plan.

UNIT III **9 Hours**

MERCHANDISING

Definition - functions. Role and responsibilities of merchandiser - Apparel Merchandising and Visual merchandizing, different types of buyers - communications with the buyers - Role of Buying office - awareness of current market trends - Product development, Line planning - Line presentation- Line development.

UNIT IV **9 Hours**

SOURCING

Need for sourcing- Role of merchandiser in sourcing-Sourcing Process-Sourcing materials-manufacturing resources planning- principles of MRP- methods of sourcing- sourcing strategies. Supply chain and demand chain analysis- Materials management for quick response - JIT Technology.

UNIT V **9 Hours**

DOCUMENTATION

Order confirmation, Export documents, BoM, FOB, FAB, C&F value (Cost &Freight), CIF (Cost, insurance & freight), letter of credit, Shipping Bill /Bill of Export, Customs Declaration Form, Dispatch Note, Commercial invoice, Consular Invoice, Customs Invoice, Legalized/ Visaed Invoice, Certified Invoice, Packing List, Certificate of Inspection, Black List Certificate, Manufacturer's Certificate, Shipping Order-Pre-shipment post-Shipment Documentation-Terms of sale- Payment-Shipment.

Total: 45 Hours

Reference(s)

1. Ruth E Glock, Grace I Kunz, Apparel Manufacturing - Sewn Product Analysis - 3rd Edition, Prentice Hall Inc., 2000.
2. V. R. Sampath, P. Perumalraj and M. Vijayan, Apparel Marketing and Merchandising, Kalaiselvam Pathippakam, Coimbatore, 2007.
3. R. Rathinamoorthy, R. Surjit, Apparel Merchandising., Woodhead Publishing India private limited, 2017.
4. Grace I. Kunz, Merchandising: Theory, Principles and Practice, Fairchild Books, 2005.
5. V. Ramesh Babu, A. Arunraj, Fashion Marketing Management, Woodhead Publishing, India private Limited, 2019.

22TT024 SUSTAINABILITY IN TEXTILES AND FASHION

3 0 0 3

Course Objectives

- To teach the overview of sustainability within the textiles and fashion industry.
- To teach the slow and fast fashion to the supply chain, new design processes and material selection.

Programme Outcomes (POs)

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

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

PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

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

PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Outline the key sustainability challenges and opportunities during garment production, apparel use and end-of-use.
2. Resolve the sustainability innovation in production and designing fabrics and garments.
3. Analyse how to contribute to improved sustainability performance with textile waste management strategies and design processes.
4. Evaluate innovative fashion ideas with an environmental and humanitarian focus in sustainable fashion and textile industries.
5. Compare and utilize sustainable design terminology, concepts and theories in fashion and textile industries.

Articulation Matrix

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

UNIT I **9 Hours**

NATURAL AND SYNTHETIS FIBRES AND ITS SUSTAINABILITY IMPACTS

Material Diversity-Market in Textiles-Background to sustainability impacts-Review of Natural and manufactured fibres - Fibre comparisons and assessments- Fibre Alternatives-Organic Cotton-Low-chemical cotton-Low water use cotton-Fair Trade Cotton-Organic wool-Hemp-Wild (Tussah or peace) silk-Poly (lactic acid)- Lyocell-Bamboo-Soya-Naturally Coloured Fibre-Recycled fibre.

UNIT II **9 Hours**

SUSTAINABILITY INNOVATION IN FIBRE AND FABRIC PRODUCTION AND DESIGNING FABRICS AND GARMENTS

Background to sustainability innovation in production-Best practice in fibre and fabric processing-Spinning, weaving and knitting-Fabric finishing-Specialist fabric finishing-Cut-make-trim-Modelling the industry as a whole system-Use Matters- relative impact of textile products throughout life-Innovating to reduce the impact of the use phase-Process focus-more efficient laundering practices-Product focus-designing fabrics and garments that cause less impact as they are laundered-Consumer focus-designing clean clothes.

UNIT III **9 Hours**

TEXTILE WASTE MANAGEMENT STRATEGIES

Introduction to textile waste- Reuse, Recycling and Zero Waste- Waste management strategies-Design for recycling and disassembly-Critique of waste management strategies-Industrial Ecology-Cradle-to-cradle.

UNIT IV **9 Hours**

SUSTAINABLE FASHION AND TEXTILE SYSTEMS

Sustainable Fashion and Textile Systems-Fashion, Needs and Consumption-Value-free fashion-Fashion and clothes-A new fashion ethic-A new aesthetic -Reversing the escalators of consumption-Local and Light-Bio-Mimicry-Locally made, globally relevant-Local and connected-Local Wisdom-Distinctiveness- Light-Lightweight materials and structures-Nega Demand-Sharing-Services.

UNIT V **9 Hours**

SUSTAINABLE PASSIVE FASHION AND DURABILITY OF NEW PROJECTS

Speed and rhythms in nature and culture-Durability-Appropriateness-Understanding patterns of use-Slow design- Slow fashion-The Lifetimes Project-User Maker-Passive fashion-New model of action -Open- source design-Matrushka-Updatable.

Total: 45 Hours

Reference(s)

1. Sustainable Fashion and Textiles-Kate Fletcher-First published by Earth scan in the UK and USA in 2008- Kate Fletcher, 2008.
2. Simpson, P. (2006), Global trends in fibre prices, production and consumption, Textiles Outlook International, 125, pp 82-106.
3. ENDS Report, 2007, Textile firm fined for pollution and IPPC failures, No. 385, p10.
4. ENDS Report, 2002, Rochdale dyeing firm fined for bleach pollution, No. 328, p58.
5. Uitdenbogerd, D. E., Brouwer, N. M. and Groot-Marcus, J. P. (1998), Domestic Energy Saving Potentials for Food and Textiles: An Empirical Study. Wageningen, NL: Wageningen Agricultural University.
6. Campbell, C. Consuming goods and the good of consuming, in T. Jackson (edition), The Earthscan Reader in Sustainable Consumption, 2006.

22TT025/22TTM25/22TTH25 HOME TEXTILES 3 0 0 3

Course Objectives

- To analyse textiles-based products used in homes and their selection.
- To acquire knowledge on manufacture of home textiles.

Programme Outcomes (POs)

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

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

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

PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Assess the characteristics of home furnishing textile materials.
2. Select floor coverings according to specific needs.
3. Assess suitability of curtains and draperies according to customer needs.
4. Analyse bed linen requirements in technical terms.
5. Select technical parameters for bath towel applications.

Articulation Matrix

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

UNIT I **9 Hours**

HOME FURNISHING

Textile Furnishing: Woven and Nonwoven. Factors affecting selection of Home Furnishings, Selection of: Fibers, Colours, Designs. Kitchen Textiles: Apron-Dish cloth, Bread Bag, Pot Holders. Table textiles: Table Mats - Table cloths, Types - Materials. Upholstery: Materials - Fixed upholstery, Non-stretch loose covers, Stretch covers - Cushion covers. Developments in Textile Furnishing.

UNIT II **9 Hours**

FLOOR COVERINGS

Hard floor covering: Resilient -Soft floor coverings -Soft Rugs -Cushions-Pads. Carpet manufacture: Wilton - Axminister - Knitted, Stitch bonding- Flocking. Types: Tufted - Needle felt - Woven- Hand tufted. Recent Developments in manufacturing of floor coverings.

UNIT III **9 Hours**

CURTAINS AND DRAPERIES

Choice of Fabrics used for curtains and draperies, Curtains-Developments in Finishing of Draperies. Draperies - Tucks and pleats-use of Drapery Rods, Hooks, Tape Rings, Pins. Textile wall hanging and its methods. Advances in Home decoration.

UNIT IV **9 Hours**

BED LINEN

Bed Linen: Types: Sheets, Blankets, Blanket Covers, Comforters, Comforter Covers, Bed Spreads, Mattress - Mattress Covers, Pads, Pillows. Made-ups in hospitals, Textiles care labelling. Testing of home textiles: Colour fastness, Shrinkage, Abrasion - Flammability. Developments in living room furnishing.

UNIT V **9 Hours**

TOWELS

Types: Bath robes, Bead towels, Napkins. Construction: Weave- Pile height - Pattern - Dyeing and Finishing, Absorption tests. Velour, Types of Velvet, Construction of velvet fabrics.

Total: 45 Hours

Reference(s)

1. Subrata Das., Performance of Home Textiles, Woodhead Publishing India PVT. LTD, 2010.
2. V. Ramesh Babu, S. Sundaresan, Home Furnishing, Wood head Publishing India Pvt. ltd, 2018.
3. T. Karthik, D. Gopalakrishnan, Home Textiles, Wood head Publishing India PVT. LTD, 2016.
4. Irsak.C, Nonwoven Textiles, Textile Institute, Manchester, 2000.

22TT026/22TTM26/22TTH26 MEDICAL TEXTILES 3 0 0 3

Course Objectives

- To understand the technological aspects of medical textiles.
- To acquire knowledge on the implantable, non-implantable and extracorporeal devices.
- To innovate biomaterials based on the healthcare and hygiene products.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Execute the textile fibres, yarns and fabric structures used in biomaterials applications.
2. Assess functional requirements, types and evaluation of wound dressings, bandages, vascular grafts, and sutures for medical textile applications.
3. Resolve the processes, functional requirements, characterization and evaluation of blood vessel, tendons, ligaments and scaffolds for tissue engineering applications.
4. Outline the textile material used for hygiene and health care applications.
5. Choose appropriate techniques and processes for the production of medical textiles and products.

Articulation Matrix

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

UNIT I **9 Hours**

MEDICAL TEXTILES- AN OVERVIEW

Medical Textiles -basics, fibres used, classification. Biomaterials in medical textiles. Textile fibres and yarn - introduction, classification, chemical and physical properties. Manufacturing process - fibre and yarn. International standards. Fabric structures: Woven, Knitted, Nonwoven fabrics.

UNIT II **9 Hours**

IMPLANTABLE AND NON-IMPLANTABLE MATERIALS

Bandaging, pressure garments and wound care materials Implantable biomedical devices: Vascular grafts, Sutures, Heart valves- basic manufacturing process and evaluation methods.

UNIT III **9 Hours**

EXTRACORPOREAL DEVICES

Scaffolds for Tissue engineering, Rapid prototyping, Cartilages, Liver, Blood Vessel, Kidney, Urinary bladder, Tendons, Ligaments, Cornea- materials, function, evaluation techniques.

UNIT IV **9 Hours**

HEALTHCARE AND HYGIENE PRODUCTS

Application of nonwovens in healthcare and hygiene sectors- Surgical Gowns, masks, wipes, Antibacterial Textiles, Super absorbent polymers. Medical textiles in infection control.

UNIT V **9 Hours**

ADVANCES IN MEDICAL TEXTILES

Electro spinning, Plasma technology, Micro/nano encapsulation, Thin film technology, Ultrasonic sealing, Laser technology, Molecular Imprinting technology. Modelling methods of physiological system for medical textiles -basics. Fundamental aspects of legal and ethical issues involved within the medical textiles supply chain, Future of medical textiles and products.

Total: 45 Hours

Reference(s)

1. Anand, S.C, Traftab, M.M, and Rajendran, S, Medical Textiles & Biomaterial for Healthcare, Woodhead publishing Ltd, UK, 2005.
2. Anand S.C., Kennedy J.F. Miraftab M. and Rajendran S., Medical Textiles and Biomaterials for Health care, Wood head publishing Ltd. 2006.
3. Joon B. Park. and Joseph D. Bronzino., Biomaterials -Principles and Applications, CRC Press Boca Raton London, New York, Washington, D.C. 2002.
4. Horrocks, A.R and Anand S.C, Handbook of Technical Textiles, Woodhead publishing Ltd, UK, 2000.
5. Rajendran S., Advanced Textiles for Wound Care, Woodhead Publishing Ltd., ISBN 184569 2713, 2009.

22TT027/22TTM27/22TTH27 TEXTILE COMPOSITES 3 0 0 3

Course Objectives

- To acquire the knowledge of various manufacturing and processing technologies for composite materials.
- To understand mechanical characterization and applications of textile composites.
- To acquire knowledge of ASTM, ISO, BSI standards used in composite materials.

Programme Outcomes (POs)

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

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

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

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

PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

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

PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Organize the composite materials and evaluate the role of reinforcement and matrix in a composite.
2. Analyse physical and chemical properties of high-performance reinforcements and matrix materials and the methods to improve inter facial bonding.
3. Outline methods of manufacturing advanced composite preforms for designing composite materials
4. Analyse composite manufacturing techniques for selective end-use applications.
5. Evaluate the mechanical properties of composite materials employing standard test methods.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO COMPOSITE MATERIALS

Classification: fibre - particulate -laminar composites. Constituents of composite materials- functions of fibre and matrix - Properties of fibres and matrix materials- Critical fibre length - Aligned and random fibre composites - property prediction - rule of mixtures- simple problems.

UNIT II **9 Hours**

COMPOSITE MATERIALS

Types of high-performance fibres and their properties-Types of matrix materials -Properties of Thermoset and Thermoplastics properties, fibre matrix interface coupling agents- Coupling of interfaces and interfacial reaction in fibre composites.

UNIT III **9 Hours**

TEXTILE STRUCTURAL COMPOSITE REINFORCEMENTS

Textile Structural Composite, Reinforcements used for textile structural composite. Introduction to manufacturing techniques - property requirements. Textile preforms - weaving, knitting braiding, filament winding, pultrusion.

UNIT IV **9 Hours**

COMPOSITES PROCESSING TECHNIQUES

Prepregs - Introduction, manufacturing techniques, property requirements, compaction and applications - Advantages and disadvantages of prepreg materials. Vacuum bagging - compression moulding - injection moulding - pultrusion - thermoforming - resin transfer moulding (RTM), VARTM, SMC, and BMC.

UNIT V **9 Hours**

MECHANICAL CHARACTERISATION OF COMPOSITES

Introduction to structural material characterization standards- ASTM, ISO, BSI. Testing of composites materials- Fibre volume fraction - tensile- shear - compression - Impact-Fatigue -- flexural properties - Damage Tolerance assessment- Non-Destructive testing of composites.

Total: 45 Hours

Reference(s)

1. L. Gupta Advanced Composite Materials, Himalayan Books, New Delhi, 1998.
2. An introduction to composite materials Cambridge University Press, Cambridge, 1998.
3. C. Long, Design and manufacture of Textile composites, Woodhead Publishing Limited, 2005.
4. A. C. Long, Mechanical testing of advanced fibre composites, Woodhead Publishing Limited, 2005.
5. F. L. Mathews and R. D. Rawlings, Composite Materials Engineering Science, Chapman & Hall, London, 1994.

22TT028/22TTM28/22TTH28 SPECIALITY TEXTILES 3 0 0 3

Course Objectives

- To understand the technological aspects of specialty textiles.
- To acquire knowledge on the applications of specialty textiles.
- To innovate specialty textiles based on the requirements.

Programme Outcomes (POs)

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

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

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

PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Select fancy yarns for a given application.
2. Outline the manufacturing processes and applications of narrow fabrics.
3. Resolve the processes, techniques and applications of industrial webbings.
4. Outline the production processes of braided materials, machines and their applications.
5. Choose appropriate machines and processes for the production of carpets with the given specifications.

Articulation Matrix

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

UNIT I **9 Hours**

FANCY YARNS

Slub Yarns - Crimp Yarn - Diamond Yarn - Boucle Yarn - Loop Yarn - Snarl Yarn - Mock Chenille Yarn - Knop Yarn - Stripe Yarn - Grandrelle yarn - Neppy yarn or Flaggy yarn - Button Yarn - Fascinated yarn - melange yarn. Methods for the production of fancy yarns in Ring spinning, Rotor spinning and Air Jet spinning. Applications of fancy yarns.

UNIT II **9 Hours**

NARROW FABRICS

Fibre and Yarn types, Fabrics. Preparation process for narrow fabric production-Winding, Warping, Sizing, Drawing-in, Tenting-in. Woven narrow fabrics and their construction- structure of narrow fabrics woven on shuttleless looms. Conventional shuttle loom, unconventional shuttle looms and shuttleless looms for narrow fabrics production. End use. Industrial tapes: Slide fastener tapes - Insulating tapes - Book binder tapes - Labelling Tapes - Border Tapes, Elastic Pleated lingerie ribbing. Features and application of narrow fabrics.

UNIT III **9 Hours**

INDUSTRIAL WEBBINGS

Manufacture of spindle drive webbing- Print webbings - Webbings for automobile safety belts. Industrial nets: Knotted netting and applications.

UNIT IV **9 Hours**

INDUSTRIAL BRAIDS

Classification of braids - Trimmed braids, Flat braids and Circular Braids, Hollow braids. Production techniques. Properties and Application.

UNIT V **9 Hours**

CARPETS

Non-pile carpet weaves and their looms, Pile surfaced carpet weaves and their looms. Embossing, singeing, drying. Needle felt floor coverings.

Total: 45 Hours

Reference(s)

1. R. H. Gong and R. M. Wright, Fancy yarns their manufactures and applications, Wood head Publishing Limited, 2002.
2. Turner J P, " The production and properties of narrow fabrics, Textile Progress, Vol.8 No.4, The Textile Institute, Manchester, 2002.
3. Sabit Adanur, "Wellington Sears Handbook of Industrial Textiles, Technomic publishing company Inc., USA, 1995.
4. Jarmila Svedova," Industrial Textiles"", Elsevier Science Publishing Co in, ISBN -0444-98754-1, New York, 1990.
5. Alexander N G. Designing Interior Environment, Mas court Brace Covanorich Inc, New York, 1996.
6. Crew AH and Arahamsen H Carpets: Back to Front"", Textile Progress, Vol.19, No.3, The Textile Institute, Manchester, 1987.

22TT029/22TTM29/22TTH29 COATED AND LAMINATED TEXTILES 3 0 0 3

Course Objectives

- To acquire knowledge on the science and technology of coating and lamination of textile materials.
- To understand the applications of coated and laminated textiles.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Select polymers and resins for coating applications.
2. Assess textile fibres and structures for coating applications.
3. Select construction parameters for manufacturing coated fabrics.
4. Select coated textile-structure-based materials for specific end-uses.
5. Attribute coated and laminated textile materials.

Articulation Matrix

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

UNIT I **9 Hours**

MATERIALS

Commercial and technical scope of coated and laminated textiles. Materials for coating: Plastic materials - natural and synthetic rubbers, Polyvinyl Chloride, Acrylic polymers. Materials for lamination: Films - polyurethane foam -polyolefin foam.

UNIT II **9 Hours**

MATERIALS AND RHEOLOGY

Adhesives: Solvent-based and water-based. Textile Substrate: Requirements of textile substrates for coating, Selection of textile fibres and fabric structure. Rheological behaviour of fluids, Rheology of Plastisols: Apparent viscosity of Plastisols, Polymer size and size distribution, Plasticizer and Additives, Viscosity change during fusion.

UNIT III **9 Hours**

COATING AND LAMINATION METHODS

Coating and Lamination Methods: Calendaring coating - Knife coating - Roller coating - Nip and Dip coating - Spray coating - Foam coating - Powder coating-Slot die extruder-Flame lamination - Hot melt lamination.

UNIT IV **9 Hours**

PRODUCTS

Protective Clothing - the spacesuit - garment interlinings - Tarpaulins - Conveyor belts - PTFE coated belts - Hot air balloons - Exhibition board coverings - Labels -Tyres and hoses -applications: Automotive - Marine - Buildings and Architecture -Household products.

UNIT V **9 Hours**

QUALITY EVALUATION

Adhesion test -Flexing Test -Abrasion resistance - Fabric handle, drape and stiffness - Fabric strength - Bursting strength - Dimensional stability - Thermal comfort -Flammability testing.

Total: 45 Hours

Reference(s)

1. W. Fung, Coated and Laminated Textiles, Woodhead Publishing, England, 2002.
2. A. K. Sen, Coated Textiles, Principles and Applications, Technomic Publication, Lancaster, 2001.
3. S. C. Anand and W. Horrocks, Technical Textiles, Woodhead limited, Cambridge England, 2000.
4. R. S. Lenk, Polymer Rheology, Applied Science Publishers, London, 2000.
5. W. C. Smith, Smart Textile Coatings and Laminates, Woodhead Publishing, Cambridge England, 2010.

22TT030/22TTM30/22TTH30 NANO TEXTILES 3 0 0 3

Course Objectives

- To understand the concept of nanotechnology and its application in textiles.
- To evaluate the production methods of nanofibers.
- To acquire knowledge on nanocomposites and their properties.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and understanding of the processes and systems related to textile manufacturing and solve the problems related to production and quality of fibres, yarns and fabrics.
PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Assess nanofibers produced by electrospinning technique.
2. Evaluate and characterize carbon nanotubes and nanocomposites.
3. Create polymer layered silicate nanocomposites.
4. Assess surface modification of textile materials for functional application.
5. Analyse hybrid polymer nanolayers for smart textiles.

Articulation Matrix

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

UNIT I **9 Hours**

NANO FIBRES

Fundamentals of nanotechnology, Basic properties of nanomaterial, Fabrication of nanomaterial, Top down and Bottom-up approaches. Outline of Various methods of synthesis of nanomaterial. Process: Electro spinning - properties -improvement - fibre morphology - fibre alignment.

UNIT II **9 Hours**

NANO TUBES AND NANO COMPOSITES

Carbon nano tubes: synthesis -characterization techniques- nano tubes-Polymer fibres- structures-production process- properties-fibre morphology. Nanocomposites, Polymers with CNTs: synthesis and their application, Polymer-Nanoclay composites fabrication and application, Principles of Polymer/Inorganic-inorganic nano composites in various Textile applications.

UNIT III **9 Hours**

NANOFILLER POLYPROPYLENE FIBRES

Polymer layered silicate nano composites: structure and properties -Nano composites Dyeing of Polypropylene- Modified propylene for improved dyeability. Properties of polymer relevant to electrospinning, Polymer Crystallinity, Polymer Molecular Weight, Glass Transition Temperature (Tg), Solution properties-Surface tension and Viscosity, polymer solubility, evaporation, basics of electrostatics and conductivity of solutions.

UNIT IV **9 Hours**

NANO COATING OF TEXTILES

Surface modification techniques - anti- adhesive nano coating of fibre and textiles - Water and oil repellent coating - Self-cleaning. Functional textiles: Protection - Various applications of Nanofibres and nanofibre coated textile fabrics such as in filtration, scaffolds, composites, dye sensitized solar cells, catalysis etc. Outline of the characterization methods.

UNIT V **9 Hours**

HYBRID POLYMER NANOLAYERS

Thin hybrid film - Smart textiles - Polymer to polymer hybrid layers - Polymer to particles hybrid layers. Nano fabrication of thin polymer fibre - "Grafting from" and "Grafting to" techniques for synthesis of polymer films, synthesis of smart switchable coatings. Nanofinishes such as antimicrobial finishes, soil release finishes, flame retardants, antistatic, flouro chemical, Nanotechnology based finishes for personal protection, such as bacteria, virus, toxic gas and chemicals, chemical warfare agents (CWA).

Total: 45 Hours

Reference(s)

1. P. J. Brown and K. Stevens, Nanofibers and Nanotechnology in Textiles, Woodhead Publishing Limited, England, 2007.
2. Bharath Bhushan, Springer Handbook of Nanotechnology, Springer, 2004.
3. Rajesh Mishra, Jiri Militky, Nanotechnology in Textiles: Theory and Application, Woodhead Publishing Limited, United states, 2019.
4. P. Brown, K Stevens, Nanofibers and Nanotechnology in Textiles, Woodhead Publishing Limited, India, 2007.
5. E. Hammel, X. Tang, M. Trampert, T. Schmitt, K. Mauthner, A. Eder and P. Potschke, Carbon Nanofibers for Composites Applications, Carbon, Vol. 42, pp.1153-1158, 2004.
6. Mangala Joshi, Nanotechnology in textiles-Advances and Developments in Polymer Nanocomposites, Jenny Stanford Publishing Private Limited, 2020.

22TT0XA ENERGY MANAGEMENT IN TEXTILE INDUSTRY

1 0 0 1

Course Objectives

- To teach the importance of energy management systems in the textile industry.
- To teach the energy conservation and industrial safety aspects in the textile industry.

Programme Outcomes (POs)

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Construct organization charts for industrial units of varying sizes; plan the energy level utilizations
2. Organize production and power utilization systems in an effective manner to meet market demand.

Articulation Matrix

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

ENERGY MANAGEMENT IN TEXTILE INDUSTRY **15 Hours**

Power requirements and consumptions for spinning, weaving, Knitting, and Garment machinery, Amenities required, Ventilation, Humidification systems, RH, and temperature of various departments. Lighting types, Intensity requirements. Energy efficiency, Energy management in various textile sectors, Importance of energy efficiency, recent trends in energy efficient transformers, motors, compressors, and lighting systems. Energy generation and pollution effects in various textile sectors, CO_2 emission, and Carbon footprints.

References:

1. Energy conservation in Textile Industry, SITRA, 2005.
2. Energy conservation in the textile industry, S.C. Bhakia & Puneet Mangla Sarvesh, 2012, Wood head Publishing Pvt. Ltd.
3. Energy conservation in the textile industry, Sandeep Goyal, Lap lamlearnt academic publishing.

22TT0XB RECYCLING OF TEXTILE MATERIALS 1 0 0 1

Course Objectives

- To teach the importance of recycling in the textile and apparel industry
- To teach the commercial and sourcing aspects of the recycling industry

Programme Outcomes (POs)

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

PSO2: Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

1. Construct organization charts for industrial units of varying sizes; plan for realizing export incentives.
2. Organize production, visual merchandising, product development, and line presentation.

Articulation Matrix

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

RECYCLING OF TEXTILE MATERIALS **15 Hours**

Importance of textile and apparel recycling process. Sorting process. The pyramid models. Textile recycling constituents. Life cycle of textile products. Recycling Issues and Technology- Designing of easily recyclable textile products. Systems planning for carpet recycling. Reuse of Polymer and Fibre Waste - Introduction. Utilization of PET/ Nylon waste. Manufacturing nonwovens and other products using recycled fibres containing spandex. Recycling of industrial fibres. Recycled products available in the market and their manufacturing methods.

References:

1. Youjiang Wang, “Recycling in Textiles”, Woodhead Publishing Limited, Cambridge, 2006.
2. Marion I. Tobler-Rohr, "Handbook of Sustainable Textile Production", The Textile Institute, Woodhead Publications, UK, 2011.
3. R.S. Blackburn, "Sustainable Textiles – Life Cycle and Environmental Impact", Woodhead Publications, UK, CRC Press, 2009.
4. Miraftab M and Horrocks R, “Eco-Textiles”, Woodhead Publishing Limited, Cambridge, 2007.
5. Gupta V B and Kothari V K, “Manufactured Fibre Technology”, Chapman & Hall, London, 1997.
6. “Eco -Textiles, Special Report”, The Bombay Textile Research Association, Mumbai, 1996.

22TT0XC ECO-FRIENDLY DYEING TECHNIQUES 1 0 0 1

Course Objectives

- To learn the eco-friendly dyeing techniques used in the textile industry.
- To learn the eco-friendly safety standards in dyeing techniques used in the textile processing industry.

Programme Outcomes (POs)

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

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

PSO2.Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

The students will be able to,

1. Execute the mechanism and applications in the textile processing industry.
2. Implement environmental standards to control the usage of dye treatments in chemical processing.
3. Apply suitable physical, chemical, and biological treatment for waste minimization, and dye effluent processes in the textile processing industry.

Articulation Matrix

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

ECO-FRIENDLY DYEING TECHNIQUES **15 Hours**

Introduction about Eco-Labels- Dyes- Properties - Mechanisms and Applications in the Textile Industry- Environmental Awareness- Requirement for Environmentally Friendly Dyeing - Yarn, and Fabric Preparation for Dyeing - Yarn and Fabric Dyeing with Eco-Friendly Dyes and Chemicals- Yarn and Fabric Dyeing with Eco-Friendly Chemicals- Theory of Dyeing- Air-Dye Technology, Plasma Technology, Foam Dyeing, Spraying, Microwave, Ultrasonic Wave Dyeing Technology, Ozone, Electro-Chemical, Bio-Based Technology and Digital Screen Printing- Shade Matching and Analysis-Recycling of Wastewater.

References:

1. Muthu Swami, “Eco-friendly Dye Recovery”, MB Publishers Limited, Chennai, 2023.
2. Melih Gunay, " Eco-friendly Textile Dyeing and Finishing ", InTech Design Team, India, 2013.
3. Christie R, " Environmental Aspects of Textile Dyeing ", Elsevier Publications, India, 2007.

22TT0XD SUSTAINABLE DENIM PROCESSING AND FINISHING **1 0 0 1**

Course Objectives

- To learn the sustainable denim processing and finishing techniques used in the textile industry.
- To teach the overview of sustainability in denim processing, preparation of stock solution for dyeing, and denim finishing treatments used in the textile industry.

Programme Outcomes (POs)

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

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

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

PSO2.Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

The students will be able to,

1. Assess the key sustainability challenges and opportunities during denim processing and finishing treatments used in the textile industry.
2. Apply sustainable process parameters, concepts, and theories of denim dyeing and finishing treatments in the textile industry.
3. Analyse the sustainability innovation in denim dyeing and finishing techniques.

Articulation Matrix

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

SUSTAINABLE DENIM PROCESSING AND FINISHING **15 Hours**

Introduction about Sustainable Denim Dyeing and Finishing- Requirement for Denim Fabric Manufacture - Yarn Preparation-Warping, and Warp Beam Process in the Textile Industry- Indigo Dye - Definition, Properties, and Application- Indigo Dye Stock Solution Preparation and Recipe- Dyeing Parameters, Vatting, and Oxidation Process- Denim Fabric Sizing-Size Recipe Preparation, Process Parameters- Dyeing, Washing and Drying Process- No Stone Washing- Ozone and Enzyme Bleach-Whisker Effect and Sanding using Laser Technology- Shade Matching and Analysis- Denim Finishing-Definition, Types, and Applications- Chemical Finishing- Mechanical Finishing-Sustainable Solutions for Denim Processing..

References:

1. Subramanian Senthil Kannan Muthu, "Sustainability in Denim", Elsevier and Woodhead Publisher, India, 2017.
2. Md Khalilur Rahman Khan, " Denim Washing. Terminologies, Technologies, and Sustainability Issues ", Bod Third Party Titles, India, 2022.
3. Roshan Paul, "Denim Manufacture, Finishing, and Applications", Elsevier and Woodhead Publisher, India, 2015.

22TT0XE ECO-FRIENDLY HOME TEXTILE PRODUCTS 1 0 0 1

Course Objectives

- To teach the method of producing eco-friendly home textile products in the textile industry.
- To teach the eco-standard importance of home textile products.

Programme Outcomes (POs)

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

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

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

PSO2.Develop new designs (Woven / Printed / Dyed) and products (Knitted / Woven / Nonwoven) for apparel and technical applications.

Course Outcomes (COs)

The students will be able to,

1. Attribute the eco-friendly processes and develop home textile samples with eco-friendly certified products.
2. Organize production and product development processes for an eco-friendly environment.

Articulation Matrix

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

ECO-FRIENDLY HOME TEXTILE PRODUCTS **15 Hours**

Home textile definition and requirements. Kitchen linen types & Specifications, Bedlinen types & Specifications, Furnishing Fabrics, Floor coverings and Wall coverings, Decoration fabrics. Non-pile carpet weaves and their looms. Needle felt floor coverings. Global eco standards and eco-labels. Eco-mark scheme of India. Concept of eco-management, Eco-audit, certification, and labeling of eco-friendly textiles. Concept of Sustainable Textiles**,** Approach and Alternative methods/chemicals in Pretreatments, Eco-friendly dyes and dyeing, Eco-Friendly Finishing – formaldehyde free finishing, Comfort and Hygiene Finishing using natural agents like Neem **-** Aloe vera – Chitosan for antimicrobial finishing.

References:

1. Turner J P, “The production and properties of narrow fabrics”, Textile Institute, Manchester, 2002.
2. Sabit Adanur, "Wellington Sears Handbook of Industrial Textiles", Technomic Publishing Company Inc., USA, 1995.
3. Asokan R, "Eco-Friendly Textile Wet Processing", NCUTE Publications, New Delhi, India, 2001.
4. Miraftab M and Horrocks A R, “Eco Textiles”, Woodhead Publishing Ltd., Cambridge, 2007.

22OCE01 ENERGY CONSERVATION AND MANAGEMENT

3 0 0 3

Course Objectives

- To develop an understanding and analyze the energy data of industries.
- To carryout energy accounting and balancing.
- To conduct energy audit and suggest methodologies for energy savings.
- To utilize the available resources in optimal ways.

Programme Outcomes (POs)

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

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

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

PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

Course Outcomes (COs)

1. Assess and characterize the various energy utilization techniques.
2. Implement suitable technique to provide an energy efficient system.
3. Assess the need for thermal systems with latest technologies.
4. Choose suitable techniques doe conserving energy with respect to emerging trends.
5. Analyse the impact of economics on the conservation of energy.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Energy - Power – Past & Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

UNIT II **9 Hours**

ELECTRICAL SYSTEMS

Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT III **9 Hours**

THERMAL SYSTEMS

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and Encon measures. Steam: Distribution & Usage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories.

UNIT IV **9 Hours**

ENERGY CONSERVATION IN MAJOR UTILITIES

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets

UNIT V **9 Hours**

ECONIMICS

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept .

Total: 45 Hours

Reference(s)

1. Energy Manager Training Manual (4 Volumes) available at www.energymanager training.com, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.
2. Witte. L.C., P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilization" Hemisphere Publication, Washington, 1988.
3. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.
4. Dryden. I.G.C., "The Efficient Use of Energy" Butterworths, London, 1982.
5. Turner. W.C., "Energy Management Hand book", Wiley, New York, 1982.
6. Murphy. W.R. and G. Mc KAY, "Energy Management", Butterworths, London 1987.

22OCS01 OBJECT ORIENTED PROGRAMMING 3 0 0 3

Course Objectives

- To understand the concepts of Object-Oriented Programming.
- To study the concepts of objects and classes.
- To familiarize in the types of constructors.

Programme Outcomes (POs)

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Assess the characteristics and data types of C++ language.
2. Create programs using objects and classes for real world applications.
3. Construct programs to implement operator overloading and inheritance techniques.
4. Apply Polymorphism and File streams concepts to develop C++ program.
5. Design applications using templates and apply exception handling mechanisms.

Articulation Matrix

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

UNIT I **8 Hours**

INTRODUCTION

Need for object-oriented programming - Procedural Languages vs. Object oriented approach - Characteristics Object oriented programming - C++ Programming Basics: Basic Program Construction - Output Using cout - Input with cin - Data types- Variables and Constants - Operators - Control Statements-Manipulators - Type conversion. Function Prototyping- call by reference, return by reference- Inline function- Default arguments - Function overloading.(sona).

UNIT II **8 Hours**

OBJECTS AND CLASSES

Objects and Classes Simple Class - C++ Objects as Physical Objects - C++ Object as Data types-CONSTRUCTORS: Parameterized Constructors - Multiple Constructors in a Class - Constructors with Default Arguments - Dynamic Initialization of Objects - Copy and Dynamic Constructors - Destructors(PSG) - Structures and Classes - Arrays and Strings.

UNIT III **9 Hours**

OPERATOR OVERLOADING AND INHERITANCE

Operator Overloading and Inheritance Need of operator overloading- Overloading Unary Operators-Overloading binary Operators - Overloading Special Operators - Data Conversion Inheritance: Derived Class and Base Class - Derived Class Constructors-Overriding Member Functions-Class Hierarchies- Public and Private Inheritance-Levels of Inheritance-Multiple Inheritance.

UNIT IV

POLYMORPHISM AND FILE STREAMS **10 Hours**

Polymorphism and File Streams Virtual Function - Friend Function - Static Function-Assignment and Copy Initialization- Memory Management: new and delete Pointers to Objects, this Pointer-Streams - String I/O - Character I/O - Object I/O - I/O with Multiple Objects - File Pointers - Disk I/O with Member Functions- Error Handling in File I/O.

UNIT V **10 Hours**

TEMPLATES AND EXCEPTION HANDLING

Templates: Introduction - Function Templates - Overloading Function Templates-, user defined template arguments(sona) - Class Templates - Exception Handling - Syntax, multiple exceptions, exceptions with arguments.

Total: 45 Hours

Reference(s)

1. Deitel & Deitel, C++ How to program, Prentice Hall, 2005.
2. Robert Lafore, Object Oriented Programming in-C++, Galgotia Publication.
3. D.S.Malik, C++ Programming, Thomson, 2007.
4. K.R. Venugopal, Rajkumar and T.Ravishankar, Mastering C++, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2006.
5. E.Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill Publishing.

22OCS02 JAVA FUNDAMENTALS 3 0 0 3

Course Objectives

- Implement applications based on core Java Concepts with examples.
- Construct application using inheritance, packages and exception handling for real time problems.
- Integrate the Java I/O concepts to handle input and output operations.
- Develop programs to perform string manipulation in java.
- Design GUI with Java for event handling and database applications.

Programme Outcomes (POs)

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Execute applications based on core Java Concepts with examples.
2. Construct application using inheritance, packages and exception handling for real time problem.
3. Implement the Java I/O concepts to handle input and output operations.
4. Create programs to perform string manipulation in Java.
5. Apply GUI with Java for event handling and database applications.

Articulation Matrix

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

UNIT I **9 Hours**

BASICS OF JAVA

The Genesis of Java - Overview of Java - Data Types, Variables, and Arrays - Operators – Control Statements - Introducing Classes - Methods and Classes.

UNIT II **9 Hours**

INHERITANCE, PACKAGES AND EXCEPTIONS

Inheritance: Basics - Using Super - Creating a Multilevel Hierarchy - Method overriding - Using Abstract Classes - Packages and Interfaces: Packages - Access Protection - Importing Packages-Interfaces Definitions and Implementations - Exception Handling: Types - Try and Catch - Throw.

UNIT III **9 Hours**

EXPLORING JAVA I/O

I/O Basics - Reading Console Input -Writing Console output - Native Methods - I/ O Classes and Interfaces - File - The Byte Streams - The Character Streams - Using Stream I/ O - Serialization.

UNIT IV **9 Hours**

JAVA STRINGS

String Handling: Special String operations and Methods - String Buffer - Exploring java. Lang: Simple type Wrappers - System - Math - Collections Framework: Collections Interfaces and Classes – Utility Classes: String Tokenizer - Date and Time.

UNIT V **9 Hours**

GUI WITH JAVA

Applet Basics - Applet Architecture - Applet Display Methods - Parameter Passing - Event Handling Mechanisms - Event Classes - Event Listener - Working with Windows, Graphics, Colors and Fonts - AWT Controls - Layout Managers and Menus – JDBC.

Total: 45 Hours

Reference(s)

1. Herbert Schildt, Java 2-Complete Reference, Tata Mc Graw Hill, 2015.
2. Deitel & Deitel, Java How to Program, Prentice Hall of India, 2010.
3. Gary Cornell and Cay S. Horstmann, Core Java Vol.1 and Vol.2, Sun Microsystems Press, 2008.

22OCS03 KNOWLEDGE DISCOVERY IN DATABASES

3 0 0 3

Course Objectives

- Introduce the basic concepts of data warehousing.
- Impart knowledge about the data mining functionalities.
- Assess the strengths and weaknesses of association mining and cluster analysis.

Programme Outcomes (POs)

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

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

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

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

Course Outcomes (COs)

1. Implement the concepts of Data Warehousing architecture and business analysis process.
2. Execute the process of Data Mining and preprocessing techniques for data cleansing.
3. Apply the association rules for mining the various kinds of data.
4. Analyze Classification and Clustering algorithms for various problems with high dimensional data.
5. Analyse various data mining techniques on complex data objects.

Articulation Matrix

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

UNIT I **9 Hours**

DATA WAREHOUSING AND BUSINESS ANALYSIS

Data warehousing Components -Building a Data warehouse -Data Warehouse and DBMS-Metadata-Multidimensional data model - Data Extraction, Cleanup and Transformation Tools - Reporting, Query tools and Applications - OLAP vs OLTP - OLAP operations - Data Warehouse Schemas: Stars, Snowflakes and Fact constellations.

UNIT II **8 Hours**

INTRODUCTION TO DATA MINING

Introduction - Steps in knowledge discovery from databases process - Architecture of a Typical Data Mining Systems - Data Mining Functionalities - Classification of Data Mining Systems - Data mining on different kinds of data - Different kinds of pattern - Task Primitives - Integration of a Data Mining System with a Data Warehouse - Major issues in Data mining.

UNIT III **9 Hours**

ASSOCIATION RULE MINING

Market Basket Analysis- Frequent Item Set Mining methods: Apriori algorithm - Generating Association Rules - A Pattern Growth Approach- Pattern mining in multilevel and multidimensional space - Mining Various Kinds Of Association Rules - Association Analysis to Correlation Analysis - Constraint Based Association Mining.

UNIT IV **9 Hours**

CLASSIFICATION AND CLUSTERING

Decision Tree Induction - Bayesian Classification - Rule Based Classification - Classification by Back propagation - Support Vector Machines - Clustering: Types of data - Partitioning methods: k-means, k- medoid - Hierarchical Methods: distance based agglomerative and divisible clustering, BIRCH – Density Based Method: DBSCAN - Grid Based Method: STING.

UNIT V **10 Hours**

DATA MINING APPLICATIONS

Mining complex data objects - Text Mining - Graph mining - Web mining - Spatial Data mining -Application and trends in data mining - Social impacts of Data mining.

Total: 45 Hours

Reference(s)

1 Jiawei Han, Micheline Kamber and Jian Pai , Data Mining: Concepts and Techniques, Morgan Kauffman, 3rd Edition, 2013.

2 Alex Berson and Stephen J Smith, Data Warehousing, Data Mining, and OLAP, Tata Mcgraw- Hill, 1997.

3 David Hand, Heikki Manila, Padhraic Symth, Principles of Data Mining, MIT Press, 2001.

4 Margaret H.Dunham, Data Mining: Introductory and Advanced Topics, Pearson Education 2003.

22OCS04 E-LEARNING TECHNIQUES 3 0 0 3

Course Objectives

- Understand the technologies involved in e-learning.
- Gain the fundamentals of e-learning techniques.
- Determine the characteristics of Teaching-Learning Process.

Programme Outcomes (POs)

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

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

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

Course Outcomes (COs)

1. Assess knowledge about the basic concepts of e-learning.
2. Implement the technology mediated communication in e-learning
3. Outline the concept of e-learning and content the process management.
4. Analyze the teaching and learning processes in e-learning environment.
5. Assess the various applications of e-learning.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Evolution of Education - Generations of Distance Educational Technology - Role of E-Learning - Components of e-learning: CBT, WBT, Virtual Classroom - Barriers to e-Learning Roles and Responsibilities: Subject Matter Expert - Instructional Designer - Graphic Designer - Multimedia Author - Programmer - System Administrator - Web Master.

UNIT II **9 Hours**

TECHNOLOGIES

Satellite Broadcasting - Interactive Television - Call Centers - Whiteboard Environment - Teleconferencing: Audio Conferencing - Video Conferencing -Computer Conferencing. Internet: E-mail, Instant Messaging, Chat, Discussion Forums, Bulletin Boards, Voice Mail, File Sharing, Streaming Audio and Video.

UNIT III **9 Hours**

MANAGEMENT

Content: E-Content, Dynamic Content, Trends - Technology: Authoring, Delivery, Collaboration - Services: Expert Service, Information Search Service, Knowledge Creation Service - Learning Objects and E-Learning Standards. Process of E-Learning: Knowledge acquisition and creation, Sharing of knowledge, Utilization of knowledge - Knowledge Management in E-Learning.

UNIT IV **9 Hours**

TEACHING-LEARNING PROCESS

Interactions: Teacher-Student - Student-Student - Student-Content - Teacher- Content - Teacher-Teacher - Content-Content Role of Teachers in E-Learning - Blended Learning -Cooperative Learning - Collaborative Learning - Multi Channel learning -Virtual University - Virtual Library.

UNIT V **9 Hours**

APPLICATIONS

Customer service training - Sales training - Customer training - Safety training - IT training – Product training - Healthcare training.

Total: 45 Hours

Reference(s)

1. E-Learning: An Expression of the Knowledge Economy, Gaurav Chadha, S.M. Nafay Kumail, Tata McGraw-Hill Publication, 2002.
2. E-Learning: New Trends and Innovations, P.P. Singh, Sandhir Sharma, Deep & Deep Publications, 2005. 4. 4. Michael Allen's Guide to E-Learning, Michael W. Allen, Michael Allen, Wiley Publication, 2002.
3. E-Learning: Concepts, Trends and Applications, Epignosis LLC, LLC publications, 2014.
4. Michael Allen's Guide to E-Learning, Michael W. Allen, Michael Allen, Wiley Publication, 2002.

22OCS05 SOCIAL TEXT AND MEDIA ANALYTICS 3 0 0 3

Course Objectives

- Understand the basic ideas of Text mining.
- Analyze the methods and approaches used in analytics.
- Gain knowledge on various types of analytics like web, social network, and social media.

Programme Outcomes (POs)

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

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Create the concepts and applications of text mining.
2. Execute the content analysis and sentiment analysis.
3. Implement web analytics with a suitable model.
4. Analyse social network analytics with suitable example.
5. Analyse social media analytics with suitable example.

Articulation Matrix

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

UNIT I **7 Hours**
TEXT MINING

Introduction, Core text mining operations, Preprocessing techniques, Categorization, Clustering, Information extraction, Probabilistic models for information extraction, Text mining applications.

UNIT II **9 Hours**
METHODS

Content Analysis-Natural Language Processing-Clustering & Topic Detection-Simple Predictive Modeling-Sentiment Analysis; Sentiment Prediction.

UNIT III **9 Hours**

WEB ANALYTICS

Web analytics tools-Clickstream analysis-A/B testing, online surveys-Web search and retrieval-Search engine optimization-Web crawling and Indexing-Ranking algorithms-Web traffic models.

UNIT IV **10 Hours**

SOCIAL NETWORK ANALYTICS

Social contexts: Affiliation and identity - Social network analysis - Social network and web data and methods. Graphs and Matrices - Basic measures for individuals and networks.

UNIT V **10 Hours**

SOCIAL MEDIA ANALYTICS

Information visualization - Making connections: Link analysis - Random graphs and network evolution.

Total: 45 Hours

Reference(s)

1. Ronen Feldman and James Sanger, The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data, Cambridge University Press, 2006.
2. Hansen, Derek, Ben Sheiderman, Marc Smith. Analyzing Social Media Networks with NodeXL: Insights from a Connected World, Morgan Kaufmann, 2011.
3. Avinash Kaushik. Web Analytics 2.0: The Art of Online Accountability, 2009.
4. Hanneman, Robert and Mark Riddle. Introduction to Social Network Method, 2005.
5. Wasserman, S. & Faust, K. Social network analysis: Methods and applications. New York: Cambridge University Press, 1994.
6. Monge, P. R. & Contractor, N. S. Theories of communication networks. New York: Oxford University, 2003.

21OME01 DIGITAL MANUFACTURING 3 0 0 3

Course Objectives

- To understand the process of generating 3D Computer Aided Design (CAD) model by different method.
- To explain the constructional features and develop simple program for CNC lathe and Milling machines.
- To provide an exhaustive knowledge on various generic process and benefits of Additive Manufacturing.
- To familiarize about materials and process parameters of liquid and solid based AM techniques.
- To educate powder-based methodology and emerging trends with case studies, applications of AM techniques.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PSO1. Design, analyse and evaluate the performance of mechanical systems.
PSO2. Choose the appropriate methodology, materials, tools and machinery to manufacture quality products at economical cost.

Course Outcomes (COs)

1. Design a 3D model from the 2D data.
2. Create a CNC program for simple components.
3. Generate still file and manipulate parameters of AM machine.
4. Implement appropriate liquid or solid materials-based AM process to the respective application.
5. Select appropriate process to fabricate a functional/prototype for aerospace, automotive, electronics, manufacturing and medical applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	-	2	-	-	-	-	-	-	-	1	2	-
2	2	2	2	-	2	-	-	-	-	-	-	-	1	2	-
3	2	2	2	-	2	-	-	-	-	-	-	-	1	2	-
4	2	2	2	-	2	-	-	-	-	-	-	-	1	3	-
5	2	2	2	-	2	-	-	-	-	-	-	-	1	2	-

UNIT I **9 Hours**

CAD MODELING

Introduction - Design process - Stages. CAD - Input and Output devices, Modelling methods - Wire frame modelling, Surface modelling, Solid modelling - Constructive Solid Geometry and Boundary Representation Techniques. CAD/CAM data exchange - IGES, STEP. Product Life cycle management (PLM).

UNIT II **10 Hours**

AUTOMATION AND CNC MACHINES

Introduction to Automation - Definition, types, reasons for automating. CNC Machines - Principles, types, features, advantages, applications. CNC Machine structure - Linear motion bearings, Recirculating ball bearings, drive system, and control system. CNC Lathe and Milling programming - Linear and circular interpolation, threading and drilling programs.

UNIT III **7 Hours**

ADDITIVE MANUFACTURING

Introduction - Impact of Additive Manufacturing (AM) and Tooling on Product Development - Distinction between AM and CNC Machining - The Generalized AM Process chain - CAD Model - Input file formats - Generation and Conversion of STL file - File Verification and Repair - Build File Creation - Part Construction - Part Cleaning and finishing - AM Benefits - Classification of AM process

UNIT IV **8 Hours**

LIQUID AND SOLID MATERIAL BASED SYSTEMS

Stereo lithography Apparatus (SLA), Digital Light Processing (DLP), Fused Deposition Modelling (FDM) and Laminated Object Manufacturing (LOM) - Working Principle, Construction, Process, Materials and Applications

UNIT V **11 Hours**

POWDER BASED PROCESSES AND APPLICATIONS OF ADDITIVE MANUFACTURING

Selective Laser Sintering (SLS), Color Jet Printing (CJP), Electron Beam Melting (EBM) and Laser Engineered Net Shaping (LENS) - Working Principle, Construction, Process Variables, Materials and Applications. Reverse Engineering using 3D scanner. Application of Additive Manufacturing in Medical field, Manufacturing, Automotive industries, Aerospace and Electronics and Retail industries.

Total: 45 Hours

Reference(s)

1. Ibrahim Zeid, R.Sivasubramania, CAD/CAM Theory and Practice, Tata McGraw Hill, 2010.
2. M. Aditan, B.S. Pabala, CNC Machines, New age International, 2012.
3. C. K. Chua, K. F. Leong and C. S. Lim, Rapid prototyping: Principles and applications, Cambridge University Press, 2010.
4. D. T.Pham, S. S.Dimov, Rapid manufacturing, Springer-Verlag, London, 2001.
5. I. Gibson, D. W. Rosen, and B. Stucker, Additive Manufacturing Technologies 3D Printing, Rapid Prototyping and Direct Digital Manufacturing, Springer, 2015 http://www.springer.com/978-1-4939-2112-6.
6. www.grabcad.com, www.all3dp.com.

22OME02 INDUSTRIAL PROCESS ENGINEERING 3 0 0 3

Course Objectives

- To impart the knowledge on production planning methodologies and layout design.
- To learn about production planning and its control methods.
- To provide the knowledge of work study, process charts and ergonomic condition.
- To impart the knowledge on inventory control and material handling.
- To learn about system analysis and different types of maintenance processes.

Programme Outcomes (POs)

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PSO2. Choose the appropriate methodology, materials, tools and machinery to manufacture quality products at economical cost.

Course Outcomes (COs)

1. Select proper plant layout for the required production system.
2. Plan the resources required for the production and to perform the control methods.
3. Apply work study method, prepare charts to outline the process and develop ergonomic condition suitable for the processes.
4. Analyze the inventory required based on production needs and material handling.
5. Execute system analysis and use different types of maintenance process for smooth operations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	1	-	1	-	-	-	-	-	-	-	-	2	-
2	3	3	1	-	2	-	-	-	-	-	2	-	-	2	-
3	1	3	3	-	2	-	-	-	-	-	-	-	-	2	-
4	2	3	1	-	2	-	-	-	-	-	-	-	-	2	-
5	2	3	1	-	2	-	-	-	-	-	-	-	-	2	-

UNIT I **9 Hours**

INDUSTRIAL ENGINEERING AND PRODUCTION SYSTEM

Industrial engineering - Concept, History and development, Applications, Roles of Industrial engineer- Production management, Industrial engineering versus production management, operations management. Plant layout, Criteria for good layout, Types of layouts - Process layout, Product layout, Combination layout and fixed position layout, Flow (material movement) pattern, Workstation Selection and design.

UNIT II **10 Hours**

PROCESS PLANNING AND PRODUCTION CONTROL

Introduction to Process Planning-Definition, Procedure, Process selection, Machine capacity, Process sheet. Process analysis - Group technology, classification and coding system, formation of component family - Production planning, loading, scheduling. Production control -dispatching, routing - Progress control bar, curve, Gantt chart, route and schedule chart.

UNIT III **8 Hours**

WORK STUDY AND ERGONOMICS

Work study - Definition, Need, Advantages, objectives of method study and work measurement, method study procedure, Process chart - symbols, outline process chart, flow process chart, principles of motion economy, ergonomics- applications of ergonomic principles in the shop floor- work benches-seating arrangement, Industrial physiology.

UNIT IV **10 Hours**

INVENTORY MANAGEMENT

Inventory control, classification, management, objectives, functions. Economic order quantity, Economic batch quantity, inventory models, ABC analysis, Material Requirement Planning(MRPI), Manufacturing Resource Planning (MRPII), Operating cycle, lean manufacturing, Supply chain management - Material handling.

UNIT V **8 Hours**

SYSTEM ANALYSIS AND MAINTENANCE

System concept - system analysis, systems engineering, value engineering, value control, types of values. Plant maintenance - objectives, importance. Maintenance engineer - duties, functions and responsibilities. Types - breakdown, scheduled, preventive and predictive - Plant maintenance schedule, Condition monitoring.

Total: 45 Hours

Reference(s)

1. Khanna O.P., Industrial Engineering and management, Dhanpat Rai Publications., 2010.
2. Martand T. Telsang, Industrial Engineering and Production Management, S Chand Publishers, 2006.
3. Panneerselvam R., Production and operations management, Heritage Publishers, 2006.
4. Ravi Shankar, Industrial Engineering and Management, Golgotia Publications Pvt. Ltd., New Delhi, 2009.

22OME03 MAINTENANCE ENGINEERING 3 0 0 3

Course Objectives

- To understand the principles, objectives and importance of maintenance adopted in industry for successful progress.
- To introduce different maintenance categories, its merits and types of lubrication.
- To expose the idea of condition monitoring, methods and instruments used for allied measurements.
- To learn about failure analysis and repair methods for few mechanical elements.
- To promote computerization in maintenance and inventory management.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PSO2. Choose the appropriate methodology, materials, tools and machinery to manufacture quality products at economical cost.

Course Outcomes (COs)

1. Implement the principles, objectives and importance of maintenance adopted in industry.
2. Select the suitable maintenance category and lubrication type.
3. Apply the appropriate methods and instruments for condition monitoring.
4. Analyze the failures of mechanical systems and select suitable repair methods.
5. Apply computers in maintenance and inventory management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	-	-	-	-	-	-	-	-	-	-	-	2	-
2	2	2	-	-	-	-	-	-	-	-	-	-	-	2	-
3	-	-	-	-	2	2	1	-	-	-	-	-	-	2	-
4	1	2	1	-	2	2	2	-	-	-	-	-	-	2	-
5	2	2	2	-	1	1	1	-	-	-	-	-	-	2	-

UNIT I **9 Hours**

PRINCIPLES OF MAINTENANCE PLANNING

Basic principles of maintenance planning - Objectives and principles of planned maintenance activity - Importance and benefits of sound maintenance systems - Maintenance organization - Maintenance economics.

UNIT II **9 Hours**

MAINTENANCE CATEGORIES AND LUBRICATION

Maintenance categories - Comparative merits of each category - Preventive maintenance, Maintenance schedules, Repair cycle - Total Productive Maintenance - Principles and methods of lubrication.

UNIT III **9 Hours**

CONDITION MONITORING

Condition based maintenance - Cost comparison with and without Condition Monitoring - Methods and instruments for condition monitoring - Noise, vibration, wear and temperature measurement.

UNIT IV **9 Hours**

FAILURE ANALYSIS AND REPAIR METHODS

Failure analysis - Failures and their development - Role of Non-Destructive Testing in failure analysis - Repair methods for bearings, cylinder block, fuel pump, shaft.

UNIT V **9 Hours**

COMPUTER AIDED MAINTENANCE MANAGEMENT

Approach towards Computerization in maintenance - computer-aided maintenance management system (CAMMS) - Advantages of CAMMS - spare parts and inventory centre performance reporting.

Total: 45 Hours

Reference(s)

1. Srivastava S.K, Maintenance Engineering, S Chand and Company, 2010.
2. Mishra R.C, Pathak K, Maintenance Engineering and Management, second edition, Prentice Hall India Learning Pvt. Ltd., 2012.
3. Keith Mobley R, Lindley R. Higgins and Darrin J. Wikoff, Maintenance Engineering Handbook, Seventh edition, McGraw-Hill Professional, 2008.
4. Davies A, Handbook of Condition Monitoring: Techniques and Methodology, Springer, 2012.
5. Otegui Jose Luis, Failure Analysis, Fundamentals and Applications in Mechanical Components, Nineteenth edition, Springer, 2014.

22OME04 SAFETY ENGINEERING 3 0 0 3

Course Objectives

- To study the principles of safety management system.
- To introduce the provisions contained in the industrial laws.
- To provide knowledge on safety requirements for engineering industry.
- To learn safety requirement for chemical industry.
- To study the various safety measures adopted in construction industries.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9.Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1. Design, analyse and evaluate the performance of mechanical systems.
PSO2. Choose the appropriate methodology, materials, tools and machinery to manufacture quality products at economical cost.
PSO3. Address all the fluid flow and heat transfer related problems of mechanical systems.

Course Outcomes (COs)

1. Assess safety management system of an industry.
2. Implement the provisions of acts and rules in industries.
3. Implement and review the safety performance followed in various industries.
4. Evaluate safety appraisal in chemical industries.
5. Generate safety reports on construction industries.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	2	1	-	1	-	-	-	-	-	2	2
2	-	-	-	-	1	-	-	3	-	-	-	-	2	1	-
3	2	-	-	-	-	-	-	-	-	-	-	3	1	-	2
4	2	3	-	-	-	-	-	-	2	-	-	-	2	-	1
5	-	-	-	-	2	-	-	-	-	3	-	-	-	3	-

UNIT I **8 Hours**

SAFETY MANAGEMENT

Concepts - Evolution, International Labour Organization (ILO), National Safety Council, Techniques - Job Safety Analysis (JSA), Safety survey, Safety inspection, Safety Sampling, Accident Reporting and Investigation - Concept of an accident, Accident causation models, cost of accident, investigation, Safety Performance Monitoring - Safety indices.

UNIT II **10 Hours**

SAFETY AND LAW

Factory Act 1948-Safety and Health chapters, Tamil Nadu Factories Rules- Safety and Health chapters, Environment and Pollution Laws, Building and other construction works act 1996, Electricity Rules.

UNIT III **10 Hours**

SAFETY IN ENGINEERING INDUSTRIES

Safety in machine shop - Principles of machine guarding - Personal protective equipment- Safety in handling industrial gases - Safety in cold forming and hot working of metals- Safety in finishing, inspection and testing, heat treatment, electro plating, leak test, radiography.

UNIT IV **9 Hours**

SAFETY IN CHEMICAL INDUSTRIES

Safety in process design, unit operations, pressure vessel, heat exchanger, safety valves -Plant commissioning and inspection, pressure vessel, Plant maintenance and emergency planning, management of maintenance HAZOP study.

UNIT V **8 Hours**

SAFETY IN CONSTRUCTION INDUSTRY

Construction regulations, contractual clauses, permit to work, - Education and training-Hazards of construction and prevention- excavation, scaffolding, dismantling, road works, construction of high-rise buildings - Working at heights, -Working on fragile roofs, work permit systems-Construction machinery, cranes, chain pulley blocks, earth moving equipment, conveyors- Manual handling, Safety in demolition work, - Safety in confined spaces

Total: 45 Hours

Reference(s)

1. Blake R.B., Industrial Safety, Prentice Hall, Incorporated, New Jersey, 1973.
2. National Safety Council, Accident Prevention Manual for Industrial Operations, Chicago,1988. Subramanian V., The Factories Act, 1948, with Tamil Nadu Factories Rules, 1950, Madras.
3. Environmental Pollution Control Act, 1986.
4. BOCW Act,1996, Madras Book agency, Chennai-1.
5. Explosive Act, 1884, Eastern Book Company, Lucknow -266 001.

22OBT01 BIOFUELS 3 0 0 3

Course Objectives

- To understand and explore the scope of biofuels the most efficient renewable source of energy.
- To develop the expertise in the technology pertaining to their generation and employment in order to surrogate the existing conventional fuels and hence strives towards sustainable development
- To give way to the bolster green technology and incline towards more eco-friendly options.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PSO3. Conceive Plan and Deploy bio-resources for the benefit of society and environment.

Course Outcomes (COs)

1. Apply the bioresources that can be used for the production of biofuels.
2. Analyze the physical and chemical properties of the biodiesel.
3. Analyze the mechanisms of improvising the quality and performance of engines using biofuels
4. Analyze the bio-fuel conversion technologies and their environmental attributes
5. Evaluate the designing aspects of major unit processes/operations of an integrated bio-refinery

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	2	-	-	-	3	-	-	-	-	-	-	-	1
2	2	-	-	-	-	-	1	-	-	-	-	-	-	-	3
3	1	-	-	-	-	-	3	-	-	-	-	-	-	-	2
4	2	-	-	-	-	-	3	-	-	-	-	-	-	-	3
5	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-

UNIT I **9 Hours**

CLASSIFICATION AND RESOURCES

Introduction, biofuel as a renewable energy, classification of biofuels - First, second, third and fourth generation biofuels, different plant sources as biofuel feedstocks, Biogases, physical and chemical characteristics of vegetable oils - iodine number, hydroxyl, acid values, rancidity, hydrogenolysis and hydrolysis, Food vs energy.

UNIT II **9 Hours**
BIODIESEL

Definition, basics and chemistry of biodiesel, vegetable oils in biodiesel production, Trans esterification: Chemical methods, enzymatic methods and types of catalysts, separation and purification, physical properties and characterization of biodiesel - Cloud point, pour point, cold filter plugging point, flash point, viscosity and cetane number.

UNIT III **9 Hours**
QUALITY BIODIESEL AND ENVIRONMENT

Producing Quality Biodiesel, quality control, test methods, ASTM specifications. Oxidative and thermal stability, estimation of mono, di, triglycerides and free glycerol, engine performance test, blending of ethanol with biodiesel, blending of biodiesel with high-speed diesel (HSD) and their combustion properties.

UNIT IV **9 Hours**
BIOETHANOL AND BIOGASES

Ethanol as a fuel, microbial and enzymatic production of ethanol from biomass - lignocellulose, sugarcane, sugar beet, corn, wheat starch, purification - wet and dry milling processes, saccharification-chemical and enzymatic. Production of bio methane and bio hydrogen.

UNIT V **9 Hours**
BIOREFINERIES

Definition and types of biorefineries, co-products of biorefineries-oil cake and glycerol, purification of glycerol obtained in biodiesel plant; anaerobic and thermal gasification of biomass, economics of biorefineries.

Total: 45 Hours

Reference(s)

1. Caye Drapcho, John Nghiem and Terry Walker, Biofuels Engineering process technology, McGraw Hill Professional, 2008.
2. Mousdale, Biofuels, CRC Press, 2008.
3. Ahindra Nag, Biofuels Refining and Performance, McGraw-Hill Professional, 2007.
4. Lisbeth Olsson, Biofuels (Advances in Biochemical Engineering/ Biotechnology), Springer, 2007.

22OFD01 TRADITIONAL FOODS **3 0 0 3**

Course Objectives

- Understand the importance of traditional foods and food habits.
- Know the traditional processing of snack, sweet and dairy food products.
- Infer the wide diversity and common features of traditional Indian foods and meal patterns.

Programme Outcomes (POs)

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

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

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

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

Course Outcomes (COs)

1. Justify the processing methods of traditional foods in terms of its health benefits.
2. Assess the production methods of traditional sweets, snacks and dairy products.
3. Differentiate Traditional fermented foods products based on its raw material.
4. Implement a large-scale production of tradition foods for its increased consumption.
5. Compare the health aspects of traditional foods with modern foods.

Articulation Matrix

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

UNIT I **9 Hours**

TRADITIONAL METHODS OF FOOD PROCESSING

Introduction - food culture -geographical features and food. Traditional methods of milling grains - rice, wheat and corn - equipment and processes as compared to modern methods. Equipment and processes for edible oil extraction- comparison of traditional and modern methods. Energy costs, efficiency, yield, shelf life and nutrient content comparisons. Traditional methods of food preservation - sun-drying, osmotic drying, brining, pickling and smoking.

UNIT II **9 Hours**

TRADITIONAL SWEETS, SNACKS AND DAIRY PRODUCTS

Production, formulation, preparation and processing of Indian traditional sweet and snack food products: -Rasgolla, Gulab jamun; formulation and preparation of namkeen, potato chips, banana chips. Acid coagulated and fermented dairy products- paneer, dahi, shrikhand, lassi - processing conditions, defects etc. Fat rich products- Butter, ghee and its processing.

UNIT III **9 Hours**

TRADITIONAL FERMENTED FOOD PRODUCTS

Idli, Soya sauce, fish pickle, dry fish, meat and vegetable fermented products. Various alcohol-based products. Ways to increase nutritional quality of food such as enrichment, fortification, fermentation and mutual supplementation. Best cooking and processing methods to retain nutrients.

UNIT IV **10 Hours**

COMMERCIAL PRODUCTION OF TRADITIONAL FOODS

Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods -types marketed, turnover; role of SHGs, SMES industries, national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi. Commercial production of intermediate foods - ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idly and dosa batters

UNIT V **8 Hours**

HEALTH ASPECTS OF TRADIONAL FOODS

Comparison of traditional foods with typical fast foods / junk foods - cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments /illnesses.

Total: 45 Hours

Reference(s)

1. Sen and Colleen Taylor, Food Culture in India, Greenwood Press, 2005.
2. Davidar, Ruth N. "Indian Food Science: A Health and Nutrition Guide to Traditional Recipes:" East West Books, 2001.
3. Steinkrus.K.H. Handbook of Indigenous Fermented Foods, CRC press, 1995.
4. Aneja. R.P, Mathur.BN, R.C. Chandan,and Banerjee.A.K. Technology of Indian Milk Products. Dairy India Year Book, 2009.

22OFD02 FOOD LAWS AND REGULATIONS **3 0 0 3**

Course Objectives

- Introduce the concept of food hygiene, importance of safe food and laws governing it.
- Learn common causes of food borne illness - viz. physical, chemical and biological and identification through food analysis.
- Understand food inspection procedures employed in maintaining food quality.

Programme Outcomes (POs)

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

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

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

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

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

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

Course Outcomes (COs)

1. Analyse the food safety strategies and nutritional quality of the food.
2. Assess the food regulatory mechanism and mandatory laws for food products.
3. Resolve the national and international regulatory agencies.
4. Execute and apply the voluntary regulatory standards.
5. Assess the implementation of food safety for a food processing industry.

Articulation Matrix

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

UNIT I **10 Hours**

INTRODUCTION

Introduction, concept of food safety and standards, food safety strategies. Food hazards and contaminations - biological (bacteria, viruses and parasites), chemical (toxic constituents / hazardous materials) pesticides residues / environmental pollution / chemicals) and physical hazards. Preventive food safety systems - monitoring of safety, wholesomeness and nutritional quality of food. Prevention and control of physical, chemical and microbiological hazards. Principles of food safety - Establishment: design and facilities - emergency preparedness - Maintenance cleaning and sanitation - personal hygiene - packaging and labelling - transportation - traceability - recall procedure - visitor policy. Adulteration: Intentional and unintentional - Preservatives - antioxidants, sweeteners, flavours, colours, vitamins, stabilizers - indirect additives - organic resides - inorganic residues and contaminants.

UNIT II **10 Hours**

FOOD LAWS

Indian and Food Regulatory Regime (Existing and new), PFA Act and Rules, Food Safety and Quality Requirements, Additives, Contaminants and Pesticide Residue. Food Safety and Standards Act, 2006, FSSAI roles and responsibilities, Essential Commodities Act, 1955, Global Scenario, Codex Alimentarius, WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR) WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR). Food safety inspection services (FSIS) and their utilization.

UNIT III **10 Hours**

REGULATIONS

Introduction to OIE & IPPC, Other International Food Standards (e.g. European Commission, USFDA etc). WTO: Introduction to WTO Agreements: SPS and TBT Agreement, Export & Import Laws and Regulations, Export (Quality Control and Inspection) Act, 1963. Role of Agricultural and Processed Food Products Export Development Authority (APEDA), Customs Act and Import Control Regulations, Other Voluntary and mandatory product specific regulations, Other Voluntary National Food Standards: BIS Other product specific standards; AGMARK. Nutritional Labelling, Health claims.

UNIT IV **10 Hours**

STANDARDS

Voluntary Quality Standards and Certification GMP, GHP, HACCP, GAP, Good Animal Husbandry Practices, Good Aquaculture Practices ISO 9000, ISO 22000, ISO 14000, ISO 17025, PAS 22000, FSSC 22000, BRC, BRCIOP, IFS, SQF 1000, SQF 2000. Role of NABL, CFLS.

UNIT V **5 Hours**

IMPLEMENTATION AND RISK ASSESSMENT

Implementation of food safety for a desired food processing industry. Risk assessment studies: Risk management, risk characterization and communication.

Total: 45 Hours

Reference(s)

1. Singal RS (1997). Handbook of indices of food quality and authenticity. Woodhead Publishing Cambridge, UK.
2. Shapton DA (1994). Principles and practices of safe processing of foods. Butterworth Publication, London. Winton AL (1999) Techniques of food analysis, Allied Science Publications New Delhi.
3. Pomeranze Y (2004). Food analysis - Theory and Practice CBS Publications, New Delhi.
4. Jacob MB (1999). The chemical analysis of foods and food products. CBS Publ. New Delhi.

22OFD03 POST HARVEST TECHNOLOGY OF FRUITS AND VEGETABLES

3 0 0 3

Course Objectives

- To understand the importance and different methods of post-harvest handling and storage of fruits and vegetables.
- To gain knowledge on different preservation methods of fruits and vegetables
- To familiarize with the value-added products from fruits and vegetables

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Implement the different post-harvest handling practices for the storage of fruits and vegetables.
2. Analyze the suitable preservation method (sugar, salt or dehydration) to produce value added products from fruits and vegetables.
3. Evaluate the requirement of low temperature and irradiation methods to preserve specific fruits and vegetables.
4. Apply the concentration and fermentation methods to preserve fruits and vegetables.
5. Implement the canning method to preserve fruits and vegetables.

Articulation Matrix

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

UNIT I **9 Hours**

POST-HARVEST PRACTICES AND PROCESSING

Maturity indices for harvesting; pathological spoilage's during storage, ripening and control measures, post-harvest handling, sorting & grading, packaging, storage, transportation, Methods of pre-cooling, post-harvest treatments to hasten and delay ripening; Methods of storage at farm level - cold storage, controlled/modified atmosphere storage, Quality management, export requirements, Nutritive value, nutraceutical properties

UNIT II **9 Hours**

PRESERVATION AND VALUE ADDITION

General principles and methods of fruit and vegetable preservation. Preservation using sugar: Principle and Preparation of jam, jelly, marmalade, squash, RTS, carbonated beverages, crush, nectar, cordial, fruit bar, preserves, candies and carbonated fruit beverages. Processing using salt: Principle - Brining - Preparation of pickles, chutney and sauces, ketchup.

UNIT III **9 Hours**

PRESERVATION BY LOW TEMPERATURE AND IRRADIATION

Preservation by low temperature: definition, principle, methods - Refrigeration, freezing. Methods of freezing- changes during freezing. Preparation of frozen foods. Minimal Processing of Fruits and Vegetables - techniques involved - Preservation by irradiation: definition- principle, application, irradiation unit.

UNIT IV **9 Hours**

PRESERVATION BY DRYING

Machineries involved in processing of fruits and vegetables products. Drying and dehydration: definition, principle, Types of driers: Solar, cabinet, spray drier, drum drier, fluidized bed drier. Preparation of product for dehydration. Dehydration principles and equipment. Preparation of fruits - powder production. Problems related to storage of dehydrated products.

UNIT V **9 Hours**

PRESERVATION BY CANNING

Canning: principles, Types of cans, packing of canned products-preparation of canned products - general considerations in establishing a commercial fruit and vegetable cannery, machineries involved in canning and bottling unit- spoilage of canned foods. Bottling of fruit and vegetable. Precautions in canning operations.

Total: 45 Hours

Reference(s)

1. S. Ranganna, HandBook of Analysis and Quality Control for Fruit and Vegetable Products, McGraw Hill Education (India) Private Limited, Chennai, 2017.
2. N.W. Desrosier, the Technology of Food Preservation, CBS Publisher & Distributions, New Delhi, 1987.
3. R.P. Srivastava and S. Kumar, Fruit and Vegetable Preservation: Principles and Practices, Second Edition, International Book Distribution Co., Lucknow, 1998.
4. G. Lal, G. Siddappa and G.L. Tondon, Preservation of Fruits and Vegetables, Indian Council of Agricultural Research, New Delhi, 1986.
5. Chakraverty, A.S. Mujumdar, G.S.V. Raghavan and H.S. Ramaswamy, Handbook of Post-harvest Technology, Marcel Dekker Press, USA, 2001.
6. D.K. Salunkhe, and S.S. Kadam, Handbook of Fruit Science and Technology: Production, Composition and Processing, Marcel Dekker, New York, 1995.

22OFD04 CEREAL, PULSES AND OIL SEED TECHNOLOGY

3 0 0 3

Course Objectives

- Understand the application of scientific principles in the processing technologies specific to the materials
- Understand the storage methods and handling techniques followed for cereals, pulses and oil seeds
- Develop the knowledge in the area of Cereals, pulses and oil seed processing and technology

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO4.Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO6.The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PSO2. Practical and research training imparted to the students will pave the way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Assess the specific processing technologies employed for cereals.
2. Analyse the composition of millets and their nutritional importance.
3. Apply the compositional changes and processing methods of pulses and legumes.
4. Create the competence in processing of oilseeds technology.
5. Execute the storage processing of food grains with quality aspects.

Articulation Matrix

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

UNIT I **9 Hours**

CEREALS

Cereal Grains- Basic agricultural aspects, structure and composition; Storage, Insect control; Processing: Wheat- milling, (Atta and Maida), quality aspects of flour, wheat proteins and their function, rheology of flour; wheat based baked products - Bread, Biscuit, Cakes, Extruded products, Pizza, Chapatis, malting and malt products; Rice-Milling, Parboiling, Quick cooking rice, Traditional Indian Products- Puffed Rice, flaked rice, Idli/Dosa/vada mixes and other savouries; Corn- Wet and dry milling, Corn Products - Corn flakes, Corn starch, canned corn products, puffed product; Oats-Milling, Oat Products - Steel cut, rolled oats, quick cooking; Traditional and Fermented cereal products.

UNIT II **9 Hours**

OTHER CEREALS AND MILLETS

Sorghum, Pearl Millet, Finger millet, Foxtail Kodo Millet - Basic agricultural millet, aspects, structure and composition; storage, insect control; processing - pearling, Milling, Malting, Malt based foods, flaked and fermented products; Traditional and Nutritional products based on finger millet.

UNIT III **9 Hours**

PULSES AND LEGUMES

Basic agricultural aspects, structure, composition, storage, insect control, processing Milling/splitting, dhal milling, products - puffed, flakes, flour, legume-based traditional products, flour based Indian sweets and savouries, soya milk, soy protein Isolate, soya paneer

UNIT IV **9 Hours**

OIL SEEDS AND NUTS

Basic agricultural aspects structure, composition, Storage, Insect control; processing: traditional and modern methods of oil extraction, refining, bleaching, deodorizing, hydrogenation; oil blends; applications of different oils and fats in food processing & products.

UNIT V **9 Hours**

STORAGE AND HANDLING

Bag Storage - Advantages and Disadvantages, Cover Plinth Storage Structures, CAP storage (Cover and Plinth Storage). Protection against Rodents, Fungi, Pests and Mites. Fumigation Processes for bag storage piles. Bulk Storage in silos and large Bins. Conveyors and Elevators for feeding and discharging.

Total: 45 Hours

Reference(s)

1. Chakraverty, A.: Post Harvest Technology of Cereals, Pulses and Oilseeds. Oxford and IBH Publishing Co, Calcutta, 1995.
2. Delcour, Jan A. and R. Carl Hoseney., Principles of Cereal Science and Technology, 3rd Edition, American Association of Cereal Chemists, 2010.
3. Karl Kulp, Handbook of Cereal Science and Technology, 2nd Rev. Edition, CRC Press, 2000.
4. N.L.Kent and A.D.Evans, Technology of Cereals (4th Edition) Elsevier Science (Pergaman),Oxford, UK, 1994.
5. Matz, Samuel A., The Chemistry and Technology of Cereals as Food and Feed, 2nd Edition, CBS, 1996.
6. Morris, Peter C. and J.H. Bryce., Cereal Biotechnology, CRC/Wood head publishing, 2004.

22OFT01 FASHION CRAFTSMANSHIP 3 0 0 3

Course Objectives

- To impart theoretical and practical knowledge about various handi-craft techniques
- To enhance innovative skills on hand crafts.
- To build confidence on doing handicrafts.

Programme Outcomes (POs)

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

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

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

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

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

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

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

PSO1.Interpret trends, decipher fashion movements, apply the knowledge of elements of design and Gestalt theory of visual perception; and incorporate sustainable decisions into their design artworks, fashion products and accessories.

Course Outcomes (COs)

1. Outline the classification, techniques and criteria for selecting raw materials for making various handicraft materials and produce textile-based handicrafts. Produce various decorative and appealing products.
2. Design and construct various wall hangings and fashion accessories.
3. Design and construct toys and accessories.
4. Design and construct head accessories, home furnishings and paintings.
5. Design and construct various decorative and appealing products for interiors.

Articulation Matrix

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

UNIT I **9 Hours**

TECHNIQUES OF HANDICRAFT MATERIALS

Definition of Handicraft, Classification: Reusable, Non reusable, Raw materials used in various craft materials: printed, embroidered, stitched and handmade, Criteria for selection of raw materials: material types and end uses.

UNIT II **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - INTERIORS

Designing and Construction procedures for following various decorative and appealing products: Wall hangings - String Art on plywood, Pressed Flower Art frames.

UNIT III **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - ACCESSORIES

Designing and Construction procedures for following various decorative and appealing products: Handbags, Hats, footwear.

UNIT IV **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - ORNAMENTS

Designing and Construction procedures for following various decorative and appealing products: Stone necklace using Macrame Technique, Tribal Jewellery using woollen threads, Floral Jewellery using Resin Technique, Fabric Jewellery using Tie and Dye Technique.

UNIT V **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - FANCY ITEMS

Designing and Construction procedures for following various decorative and appealing products: Jewellery Box, Utility Holder, Gift items. Lampshade decors from cardboard, Driftwood Frames for pictures and Mirrors.

Total: 45 Hours

Reference(s)

1. Handmade in India: A Geographic Encyclopedia of India Handicrafts. Abbeville press; 1st edition (October 20, 2009)
2. Encyclopedia of Card making Techniques (Crafts), Search Press Ltd, illustrated edition, 2007.
3. All about Techniques in Illustration, Barron Educational Series, 2001.
4. Printing by Hand: A Modern Guide to printing with Handmade stamps, Stencils and Silk Screens, STC Craft/A Melanie Falick Book, 2008.
5. Materials & Techniques in the Decorative Arts: An Illustrated Dictionary, University of Chicago Press, 2000.
6. https://www.marthastewart.com/274411/fashion-crafts.

22OFT02 INTERIOR DESIGN IN FASHION 3 0 0 3

Course Objectives

- To impart knowledge on interior design.
- To improve the design skills, sustainable with socially-conscious designs

Programme Outcomes (POs)

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

PSO1. Interpret trends, decipher fashion movements, apply the knowledge of elements of design and Gestalt theory of visual perception; and incorporate sustainable decisions into their design artworks, fashion products and accessories.

Course Outcomes (COs)

1. Assess the elements of interior design concepts and resolve the personality requirements.
2. Create graphical representations of interior design concepts.
3. Resolve the space planning requirements of residential home as per CPWD guidelines.
4. Analyse the aesthetic requirements of interior design components.
5. Evaluate the roles and responsibilities of interior designer.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Interior designing - definition, importance, requirements and types - Structural design, Decorative Design -Designing interiors, Good taste; Design themes, types and application. Personality of the Home - Art elements - Line: types, characteristics and importance; form: size and shape, characteristics; Colour - sources, qualities, emotional effects, colour wheel and schemes.

UNIT II **9 Hours**

GRAPHICAL PRESENTATIONS

3D composition; Isometric and Axonometric- Still life- Furniture Sketching- Object Drawing with colour rendering - Interior elements, Lighting, plants. Perspective, Axonometric Isometric drawing. Orthographic Projection - Lifts and escalators.

UNIT III **9 Hours**

SPACE PLANNING

Space planning concepts- interiors, circulation. Definition, application of ergonomic principals in interiors. Residential house space planning case study- CPWD guidelines. Lighting for different locations and activities, measurement, ventilation and indoor air quality, noise control methods.

UNIT IV **9 Hours**

INTERIOR COMPONENTS

Application of colour in interiors; Texture - types and significance; Pattern: types and effects; Light - importance. Importance of Furniture Design for Interiors- Ancient Age / Middle Age / Contemporary. Doors, Windows, Staircase designs, False Ceiling, Partitions, Wall Panelling, Comics, Mosaic, Cladding- Flooring and Wall Cladding

UNIT V **9 Hours**

ROLES AND RESPONSIBILITIES OF INTERIOR DESIGNER

Role of an Interior Designer- Responsibility towards society and need of an Interior Designer to better the environment- Ethics and Code of Conduct- Responsibility towards client, contractor and supplier, Estimation. Professional Fees- Work of an Interior Designer- Making of portfolio, JD Annual Design Awards.

Total: 45 Hours

Reference(s)

1. Joanna Gaines, Homebody: A guide to creating spaces you never want to leave, Harper design, 2018.
2. Erin gates, Elements of Style: Designing a Home and a life, Simon and Schuster, 2014.
3. Simon Dodsworth, The Fundamentals of Interior Design, AVA publishing, 2009.
4. V. Mary. Knackstedt, The Interior Design Business Handbook: A Complete Guide to Profitability, Wiley, New Jersey; 2006.
5. M. G. Shah, C. M. Kale, and S.Y. Patki, Building Drawing with an Integrated Approach to Build Environment, Tata McGraw Hill, 2002.
6. Https://eclectictrends.com

22OFT03 SURFACE ORNAMENTATION 3 0 0 3

Course Objectives

- To familiarize the students about the various techniques of surface embellishment with relevance to garment embellishments.
- To aware of various types of embroidery and methods of producing it.
- To make the students confident about doing surface embellishment work.

Programme Outcomes (POs)

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

PSO1. Interpret trends, decipher fashion movements, apply the knowledge of elements of design and Gestalt theory of visual perception; and incorporate sustainable decisions into their design artworks, fashion products and accessories.

PSO2. Articulate design aesthetics, communicate product values, collaborate across disciplines as member and leader; and envision solutions in fashion systems: design, technology, production and management.

Course Outcomes (COs)

1. Analyze the raw material requirements for surface ornamentation and its application.
2. Implement hand embroidery stitches on fabric and show the stitch development procedure in diagrammatic representations.
3. Apply the machine and computerized embroidery stitches.
4. Analyze the surface embellishment techniques and its application.
5. Assess the quality maintenance parameters of all embroidered products and analyze the six traditional embroidery techniques.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO SURFACE ORNAMENTATION

Introduction, Definition, Need, Types, Raw materials, Importance of surface ornamentation, Selection of needle, thread and fabric for hand embroidery and machine embroidery. various methods of surface embellishment- embroidery and surface ornamentation.

UNIT II **9 Hours**

HAND EMBROIDERY

General rules for hand embroidery. Types of hand embroidery stitches-Running, Couching, Button hole, Satin, Long & Short, Wheat, Chain, Stem, Herringbone, Cross stitch, Knotted stitches, Fish bone, Fly stitch, Braids, Back, Hem, Seed, Needle weaving, Whip stitches.

UNIT III **9 Hours**

MACHINE EMBROIDERY

General rules for machine embroidery. Types of frames and methods of transferring the designs. Attachments to sewing machines for embroidery, Types of machine embroidery stitches- Eyelet work, Cut work, patch work, Mirror work, Applique, Shaded embroidery, Shadow work, Bead and Sequins work, Vermicelli, Zigzag, Granite stitch. Computerized embroidery machine- Concept of design and development, software used in embroidery machines, process of designing, method and types of stitch application, punching and digitizing.

UNIT IV **9 Hours**

EMBELLISHMENT TECHNIQUES

Materials used and Applications. Types of embellishment techniques- fabric painting-hand, Stencil-dabbing and Spraying. Dyeing and printing-advanced tie and dye techniques, batik and block printing. Trimmings and decorations-Laces, Pompons, Fringes, Tassels, Tucks, Show buttons, Crocheting.

UNIT V **9 Hours**

TRADITIONAL EMBROIDERIES OF INDIA AND CARE

Care and maintenance of embroidered articles-care and maintenance methods for embroidered apparel, pressing. Traditional Embroideries of India-Phulkari, Kasuti, Kashmiri embroidery, Kutch work, Chikkankari, Kantha.

Total: 45 Hours

Reference(s)

1. Ruth Chandler, Modern Hand Stitching-Dozens of stitches with creative free-form variations, 2014.
2. Sophie Long, Mastering the Art of Embroidery: Traditional Techniques and Contemporary Applications for Hand and Machine Embroidery, Heritage Publishers, London, 2013.
3. Christen Brown, Embroidered & Embellished, C&T Publishing, 2013.
4. Sheila Paine, Embroidered Textiles, Thames and Hudson Publisher, UK, 1990.
5. Gail Lawther, Inspirational Ideas for Embroidery on Clothes & Accessories, Search Press Ltd, UK, 1993.
6. http://www.needlenthread.com/tag/hand-embroidery-stitches.

22OPH01 NANOMATERIALS SCIENCE **3 0 0 3**

Course Objectives

- Impart knowledge on Nanoscience.
- Explore different techniques of producing nanomaterials.
- Create expertise on the applications of nanomaterials in various fields.

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Analyse the origin and advance of nanomaterials and its classification.
2. Compare the different types of methods adopted for synthesizing nanomaterials.
3. Analyze the characterization techniques for analyzing nanomaterials.
4. Assess the physical properties exhibited by nanomaterials.
5. Organize the nanomaterials developed for advanced technological applications.

Articulation Matrix

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

UNIT I **9 Hours**

NANO SCALE MATERIALS

Introduction-Feynman's vision-national nanotechnology initiative (NNI) - past, present, future - classification of nanostructures, nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures- effect of nanoscale dimensions on various properties -differences between bulk and nanomaterials and their physical properties.

UNIT II **9 Hours**

NANOMATERIALS SYNTHESIS METHODS

Top-down processes - mechanical milling, nanolithography and types based on radiations - Bottom-up process physical method: physical vapour deposition, RF sputtering, CVD- chemical method: colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self-organization.

UNIT III **9 Hours**

CHARACTERIZATION TECHNIQUES

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

UNIT IV **9 Hours**

SEMICONDUCTOR NANOSTRUCTURES

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nano tubes-structure, synthesis and electrical properties -applications- quantum well laser- quantum efficiency of semiconductor nanomaterials

UNIT V **9 Hours**

NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits- single electron transistor - organic photovoltaic cells- spintronics

Total: 45 Hours

Reference(s)

1. Willam A. Goddard, Donald W.Brenner, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, 2012.
2. Charles P. Poole Jr and. Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2007.
3. Guozhong Cao, Y. Wang, "Nanostructures and Nanomaterials-Synthesis, Properties & Applications", Imperials College Press, 2011.
4. T. Pradeep, "NANO: The Essentials Understanding Nanoscience and Nanotechnology", McGraw - Hill Education (India) Ltd, 2012.
5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley and Sons Ltd, 2006.
6. Viswanathan B, AuliceScibioh M, "Fuel cells: Principles and Applications", University Press, 2009.

22OPH02 SEMICONDUCTOR PHYSICS AND DEVICES 3 0 0 3

Course Objectives

- Impart knowledge in physical properties of semiconducting materials.
- Analyze the factors affecting the operation of semiconductor devices.
- Apply the physics of semiconductors to develop semiconductor devices.

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Execute the band gap, drift and diffusion current densities due to carrier transport in semiconductors.
2. Analyze the energy band diagram in thermal equilibrium and space charge width of PN junction.
3. Create the operation of Bipolar Junction transistor at different modes and different configurations.
4. Analyse the operation of metal oxide field effect transistor and their memory devices.
5. Execute the working mechanism of opto-electronic devices.

Articulation Matrix

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

UNIT I **9 Hours**

ENERGY BANDS AND CARRIER TRANSPORT PROPERTIES

Energy Bands: Formation of energy bands - doping effects - energy levels - electron and hole concept in semiconductor. Carrier transport: Carrier drift-drift current density - conductivity- diffusion current density - total current density.

UNIT II **9 Hours**

P-N JUNCTION

Basic structure and fabrication process of p-n junction - current - voltage characteristics - energy band diagram - equilibrium Fermi levels - depletion region - junction breakdown phenomena - Zener - avalanche breakdown.

UNIT III **9 Hours**

BIPOLAR JUNCTION TRANSISTOR

The basic transistor action - operation in the active mode - current gain - static characteristics - carrier distribution in emitter, base and collector region - modes of operation - current - voltage characteristics of common base and emitter configuration - frequency response and switching of bipolar transistor.

UNIT IV **9 Hours**

MOSFET

The ideal MOS diode - basic fundamentals and characteristics - types - CMOS and BiCMOS - CMOS inverter - MOSFET on insulator - thin film transistor (TFT) - silicon on insulators (SOI) devices - MOS Memory structures - DRAM and SRAM

UNIT V **9 Hours**

PHOTONIC DEVICES

Radiative transitions and optical absorption-light emitting diodes-organic LED - infrared LED - semiconductor laser - temperature effect - photo detector - photo diode - silicon and compound semiconductor solar cells - efficiency

Total: 45 Hours

Reference(s)

1. Donald A Neamen, "Semiconductor Physics and Devices", Tata McGraw Hill, 2012.
2. S. M. Sze and M. K. Lee, "Semiconductor Devices, Physics and Technology", John-Wiley & Sons, 2015.
3. Ben. G. Streetman and S. K. Banerjee, "Solid State Electronic Devices", Pearson Education Ltd, 2015.
4. C. Kittel, "Introduction to Solid State Physics", John-Wiley & Sons, 2012.
5. J. Millman and C. Halkias, "Electronic Devices and Circuits", Tata McGraw Hill, 2010.
6. Hagen Klauk, "Organic Electronics: Materials, Manufacturing and Applications", Wiley-VCH, 2006.

22OPH03 APPLIED LASER SCIENCE **3 0 0 3**

Course Objectives

- Impart knowledge on laser science
- Explore different strategies for producing lasers
- Create expertise on the applications of lasers in various fields

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Analyse the transition mechanisms and the components of a laser system.
2. Compare the different types of lasers based on pumping method, active medium and energy levels.
3. Compute the rotation of earth, velocity and distance using lasers and apply the same for day today applications.
4. Analyze the role of lasers in surgical and endoscopy applications.
5. Apply the laser techniques in industrial applications.

Articulation Matrix

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

UNIT I **9 Hours**

LASER FUNDAMENTALS

Introduction - principle - absorption and emission of light - thermal equilibrium - Einstein's prediction - Einstein's relations - A and B coefficients - condition for large stimulated emission - spontaneous and stimulated emission in optical region - light amplification - condition for light amplification - population inversion- Components of lasers - pumping methods - pumping mechanisms - optical resonator.

UNIT II **9 Hours**

LASER BEAM CHARACTERISTICS AND TYPES

Characteristics of laser - Classification of lasers - principle, construction, working, energy level diagram and applications of molecular gas laser (CO2 laser) - liquid laser (dye laser) - excimer laser - Solid state laser (Nd: YAG laser) - semiconductor laser (homojunction laser).

UNIT III **9 Hours**

LASERS IN SCIENCE

Introduction - Harmonic generation (SHG) - Stimulated Raman emission - lasers in chemistry - laser in nuclear energy - lasers and gravitational waves - rotation of the earth - measurement of distance - Light detection And Ranging (LIDER) - velocity measurement – holography.

UNIT IV **9 Hours**

LASERS IN MEDICINE AND SURGERY

Light induced biological hazards: Eye and skin - Eye laser surgery - photocoagulations - homeostasis - dentistry - laser angioplasty - different laser therapies - advantages & disadvantages - laser endoscopy.

UNIT V **9 Hours**

LASERS IN INDUSTRY

Applications in material processing: laser welding - hole drilling - laser cutting - Lasers in electronics industry: information storage - bar code scanner- Lasers in defence: laser based military weapons - laser walls.

Total: 45 Hours

Reference(s)

1. K. Thiyagarajan and A. K. Ghatak, "LASERS: Fundamentals and Applications", Springer, USA, 2015.
2. M. N. Avadhanulu, "An Introduction to Lasers Theory and Applications", S. Chand Publisher, 2013.
3. W. Koechner, M. Bass, "Solid State Lasers: a graduate text", Springer Verlag, New York, 2006.
4. K. P. R. Nair, "Atoms, Molecules and Lasers", Narosa Publishing House, 2009.
5. K. R. Nambiar, "Lasers: Principles Types and Applications", New Age International Publications, 2006.
6. A. Sennaroglu, "Solid-State Lasers and Applications", CRC Press, 2006.

22OPH04 BIO-PHOTONICS 3 0 0 3

Course Objective:

- To understand the light-matter interaction in biological cells or tissues by using the principles of optics and lasers.
- To apply the properties of biological cells or tissues in biomedical applications by various optical imaging, sensing and activation techniques.
- To analyze the concepts of Modern optical measurement techniques and devices in early detection of disease and cure them.

Programme Outcomes (POs)

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

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Implement the laws of optics and lasers to interpret the biological cells and tissues.
2. Evaluate the properties of different optical instruments in biological systems to represent their behavior in structure and design of detection engineering instruments.
3. Use laser tweezers techniques to infer the activities of cells (tissues) and explain the single molecule detection processes in medical diagnosis.
4. Outline the properties of ultra short laser pulses and tissue engineering to rectify the affecting factors in biological cells.
5. Compare the various types of bio-imaging methods to detect the infected cells and molecules in biological science.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO BIOPHOTONICS

Light as Photon Particles – Coherence of light - lasers – classification of lasers – Mechanisms of Non-linear Optics (NLO) processes associated with Biophotonics - Light scattering mechanisms: Rayleigh scattering, Miescattering, Brillouin Scattering, Raman Scattering -Different light sources – Quantitative description of light: Radiometry.

UNIT II **9 Hours**

PHOTOBIOLOGY

Interaction of light with cells and tissues – Light – Tissue Interaction Variables – Light –Tissue Interaction Theory: Radiative Transport Theory – Photo process in biopolymers – In Vivo Photoexcitation – photo-induced physical, chemical, thermal and mechanical effects in biological systems – Optical biopsy – Single molecule detection

UNIT III **9 Hours**

BIO-NANO-PHOTONICS

Laser Microtools, Semiconductor quantum dots for bioimaging, Metallic nanoparticles and nanorods for biosensing – Optical biosensors: Fibre-Optic, evanescent wave, surface Plasmon resonance (SPR) based biosensors – biomaterials for photonics – Principle and design of laser tweezers – laser trapping and dissection for biological manipulation.

UNIT IV **9 Hours**

TISSUE ENGINEERING WITH LIGHT

Basics of tissue optics: Light absorption and scattering in tissues, Wavelength effects and spectra– the therapeutic window, Light penetration in tissues – Absorbing agents in tissues and blood –Skin optics, response to the UV radiation, Optical parameters of tissues – tissue welding – tissue contouring – tissue regeneration – Femto laser surgery – low level light therapy and photo dynamic therapy

UNIT V **9 Hours**

BIO-IMAGING TECHNIQUES AND ITS APPLICATIONS

An overview of optical imaging – Fluorescence Microscopy – Scanning Microscopy – In vivo Confocal Microscopy – Multi photon Microscopy – Optical Coherence Tomography (OCT) – Fluorescence Resonance Energy Transfer (FRET) imaging – fluorescence lifetime imaging Microscopy (FLIM) – Nonlinear optical imaging – Coherent Anti-stokes Raman Scattering –Bioimaging Applications.

Total: 45 Hours

Reference(s)

1. Paras N Prasad, Introduction to Biophotonics, Wiley Inter-science, A John Wiley & Sons, Inc., Publication, 2003.
2. Andrew GWebb, Introduction to Biomedical Imaging, IEEE Press, 2002.
3. Lihong V Wang and HSin-i Wu, Biomedical Optics: Principles and Imaging, Wiley, 2007.
4. R Splinter and B A Hooper, An Introduction to Biomedical Optics, Wiley Inter science , Taylor & Francis, 2007.
5. D E Chandler and R W Roberson, Bioimaging Current Concepts in Light and Electron Microscopy, Jones and Bartlett publishers, 2008.
6. Peter Torok and Fu-Jen Kao, Optical Imaging and Microscopy: Techniques and Advanced Systems, Springer, 2004.

22OPH05 PHYSICS OF SOFT MATTER **3 0 0 3**

Course Objectives

- To recognize the properties of soft matter and hard matter.
- To understand the fundamental interactions of colloids and gels.
- To explain the structure and phase behaviour of liquid crystals and supramolecules.
- To summarize the soft matter properties of structures and components of life.

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Analyse the salient features of soft matter and hard matter.
2. Implement the fundamental interactions and stability of colloids and gels.
3. Analyse the structure and properties of liquid crystals.
4. Outline the aggregation and phase behaviour of surfactants, polymers, copolymers and block copolymers.
5. Analyze the soft matter behaviour of nucleic acids, proteins, polysaccharides and membranes.

Articulation Matrix

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

UNIT I **9 Hours**

CONDENSED MATTER

Intermolecular forces-Condensation and freezing-mechanical response: Hookean solid-Newtonian liquid-viscoelasticity. Glasses: relaxation time-viscosity- glass forming liquids. Soft matter: length scales-fluctuations and Brownian motion.

UNIT II **9 Hours**

COLLOIDAL DISPERSIONS & GELS

Forces between colloidal particles: Vander Waals forces-electrostatic double layer forces-steric hindrance-depletion interactions. Stability and phase behaviour: Crystallization-strong colloids-weak colloids. Physical and chemical gels-classical theory of gelation-elasticity of gels.

UNIT III **9 Hours**

LIQUID CRYSTALS

Liquid crystal phases-distortions and topological defects-electrical and magnetic properties-polymer liquid crystals-Fredricks transition and liquid crystal displays

UNIT IV **9 Hours**

SUPRAMOLECULAR SELF ASSEMBLY

Aggregation and phase separation-types of micelles- bilayers and vesicles. Phase behaviour of concentrated surfactant solutions-phase separation in polymers, copolymers and block copolymers

UNIT V **9 Hours**

SOFT MATTER IN NATURE

Components and structures of life-Nucleic acids-proteins-interaction between proteins-polysaccharides-membranes

Total: 45 Hours

References

1. Richard A L Jones, Soft Condensed Matter, Oxford University Press, UK, 2002.
2. Masao Doi, Soft Matter Physics, Oxford University Press, UK, 2013.
3. Ian W. Hamley, Introduction to Soft Matter, John Wiley & Sons, 2007.
4. A. Fernandez-Nieves, A M Puertas, Fluids, Colloids and Soft materials: An Introduction to Soft Matter Physics, John Wiley & Sons, 2016.
5. Maurice Kleman, Oleg D. Lavrentovich, Soft Matter Physics: An Introduction, Springer-Verlag, New York, 2003.

22OCH01 CORROSION SCIENCE AND ENGINEERING

3 0 0 3

Course Objectives

- Analyse the loss incurred due to corrosion in different sectors and terminologies related to corrosion.
- Identify forms and types of corrosion with suitable mechanism.
- Apply various methods of corrosion control, corrosion testing and monitoring.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Analyse if corrosion can occur under specific operating conditions in a given equipment or construction and indicate regions of immunity, corrosion and passivity of a metal.
2. Compare different corrosion types on metals when exposed to air, water and at high temperatures (> 100^o C).
3. Implement the corrosion mechanism on steel, iron, zinc and copper metal surfaces.
4. Calculate the rate of corrosion on metals using electrochemical methods of testing.
5. Execute the correct materials, design and operation conditions to reduce the likelihood of corrosion in new equipment and constructions.

Articulation Matrix

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

UNIT I **9 Hours**

CORROSION

Importance of corrosion - spontaneity of corrosion - units of corrosion rate (MDD and MPY) - direct and indirect damage by corrosion - importance of corrosion prevention in industries - Pilling Bedworth ratio and its significance - passivation - area relationship in both active and passive states of metals - Pourbaix diagrams of Mg, Al and Fe and their advantages and disadvantages.

UNIT II **7 Hours**

TYPES OF CORROSION

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress corrosion-Catastrophic oxidation corrosion.

UNIT III **9 Hours**

MECHANISM OF CORROSION

Hydrogen embrittlement - corrosion fatigue - filiform corrosion - fretting damage and microbes induced corrosion. Corrosion mechanism on steel, iron, zinc and copper metal surfaces.

UNIT IV **10 Hours**

CORROSION RATE AND ITS ESTIMATION

Rate of corrosion: Factors affecting corrosion. Electrochemical methods of polarization: Tafel extrapolation polarization and linear polarization. Weight loss method - testing for intergranular susceptibility and stress corrosion. Non-destructive testing methods: Visual testing - liquid penetrant testing - magnetic particle testing - Ultrasonic monitoring, and eddy current testing.

UNIT V **10 Hours**

CORROSION CONTROL METHODS

Fundamentals of cathodic protection - types of cathodic protection (sacrificial anodic and impressed current cathodic protection). Stray current corrosion, problems and its prevention. Protective coatings: Metal coatings: Hot dipping (galvanizing, tinning and metal cladding) - natural inhibitors. Selection of suitable design for corrosion control.

Total: 45 Hours

Reference(s)

1. Mouafak A. Zaher, "Introduction to Corrosion Engineering", CreateSpace Independent Publishing Platform, 2016.
2. E. McCafferty, "Introduction to Corrosion Science", Springer; 2010 Edition, January 2010.
3. R. Winstone Revie and Herbert H. Uhlig, "Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering", 4th Edition, John Wiley & Science, 2008.
4. Mars G. Fontana, "Corrosion Engineering", Tata McGraw Hill, Singapore, 2008.
5. David E.J. Talbot (Author), James D.R. Talbot, "Corrosion Science and Technology", Second Edition (Materials Science & Technology), CRC Press; 2nd Edition, 2007.
6. http://corrosion-doctors.org/Corrosion-History/Eight.html.

22OCH02 POLYMER SCIENCE 3 0 0 3

Course Objectives

- Explain the properties of different polymers with its mechanism.
- Select the appropriate polymerization techniques to synthesize the polymers.
- Identify suitable polymers for various industrial applications.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Evaluate the types of mechanism of polymerization reactions and analyze the natural and synthetic polymers.
2. Implement the suitable polymerization techniques to synthesize the high-quality polymers.
3. Resolve the structure, thermal, and mechanical properties of polymers for different applications.
4. Apply the polymer processing methods to design polymer products.
5. Analyze the polymers used in electronic and biomedical applications.

Articulation Matrix

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

UNIT I **10 Hours**

POLYMERS AND ELASTOMERS

Classification of polymers - Mechanism: Addition polymerization - free radical, cationic, anionic and co-ordination (Ziegler-Natta) polymerization - copolymerization - condensation polymerization (nylon-6,6) -ring opening polymerization (nylon-6). Elastomers: Natural rubber and synthetic rubber: styrene -butadiene rubber (SBR), butyl, neoprene, thiocol rubbers. High performance polymers: polyethers, polyether ether ketone (PEEK), polysulphones and polyimides.

UNIT II **8 Hours**

POLYMERIZATION TECHNIQUES

Homogeneous and heterogeneous polymerization - bulk polymerization (PMMA, PVC) - solution polymerization - polyacrylic acid, suspension polymerization (ion-exchange resins) - emulsion polymerization (SBR) - advantages and disadvantages of bulk and emulsion polymerization. Melt solution and interfacial poly-condensation.

UNIT III **8 Hours**

CHARACTERIZATION AND TESTING

Characterization of polymers by Infrared Spectroscopy (IR) and Nuclear Magnetic Spectroscopy (NMR) - Thermal properties: TGA and DSC - Testing tensile strength - Izod impact - Compressive strength - Rockwell hardness - Vicot softening point - water absorption.

UNIT IV **9 Hours**

POLYMER PROCESSING

Moulding: Compression - injection - extrusion and blow mouldings. Film casting - calendaring. Thermoforming and vacuum formed polystyrene - foamed polyurethanes. Fibre spinning: melt, dry and wet spinning. Fibre reinforced plastics fabrication: hand-layup - filament winding and pultrusion

UNIT V **10 Hours**

SPECIALITY POLYMERS

Preparation and properties of heat resistant and flame-retardant polymers. Polymers for electronic applications: liquid crystalline, conducting and photosensitive polymers – E waste management. Polymer for biomedical applications: artificial organs, controlled drug delivery, Scaffolds in tissue Engineering –waste management.

Total: 45 Hours

Reference(s)

1. V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar, "Polymer Science", New Age International (P) Ltd., New Delhi, 2021.
2. Joel R. Fried, "Polymer Science and Technology", Prentice Hall of India (P). Ltd., 2014.
3. F. W. Billmeyer,"Text Book of Polymer Science", John Wiley & Sons, New York, 2008.
4. Barbara H. Stuart, "Polymer Analysis", John Wiley & Sons, New York, 2008.
5. George Odian , "Principles of Polymerization", John Wiley & Sons, New York, 2004.
6. R. J. Young and P. A. Lovell, "Introduction to Polymers", CRC Press, New York, 2011.
7. Common Biocompatible Polymeric Materials for Tissue Engineering and Regenerative Medicine (2019), Materials Chemistry and Physics https://doi.org/10.1016/j.

22OCH03 ENERGY STORING DEVICES 3 0 0 3

Course Objectives

- Compare the energy density of commercialized primary and secondary batteries.
- Classify the fuel cells and compare their efficiency in different environmental conditions.
- Demonstrate the various energy storage devices and fuel cells.

Programme Outcomes (POs)

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

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

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

Course Outcomes (COs)

1. Apply the parameters required for operation of a cell to evaluate the capacity of energy storage devices.
2. Analyse the electrodes, electrolyte and cell reactions of different types of primary, secondary batteries and infer the selection criteria for commercial battery systems with respect to commercial applications.
3. Differentiate fuel cells based on its construction, production of current and applications.
4. Compare different methods of storing hydrogen fuel and its environmental applications.
5. Organize the solar cell based on the materials used in it for various applications.

Articulation Matrix

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

UNIT I **6 Hours**

BASICS OF CELLS AND BATTERIES

Components - classification - operation of a cell - theoretical cell voltage - capacity - specific energy - energy density of lithium and lead acid battery - charge efficiency- charge rate - charge retention - closed circuit voltage - open circuit voltage current density - cycle life - discharge rate-over charge-over discharge.

UNIT II **10 Hours**

BATTERIES FOR PORTABLE DEVICES AND ELECTRIC VEHICLES

Primary batteries: zinc-carbon - magnesium, and mercuric oxide - recycling/safe disposal of used cells. Secondary batteries: lead acid - nickel-cadmium - lithium-ion batteries - rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide - lithium anode cell - photo galvanic cells. Battery specifications for cars and automobiles. Extraction of metals from battery materials.

UNIT III **10 Hours**

TYPES OF FUEL CELLS

Importance and classification of fuel cells: Description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells - phosphoric acid - solid oxide - molten carbonate and direct methanol fuel cells.

UNIT IV **10 Hours**

HYDROGEN AS A FUEL

Sources and production of hydrogen: Electrolysis and photocatalytic water splitting. Methods of hydrogen storage: High pressurized gas - liquid hydrogen type - metal hydride. Hydrogen as engine fuel - features, application of hydrogen technologies in the future – limitations.

UNIT V **9 Hours**

ENERGY AND ENVIRONMENT

Future prospects of renewable energy and efficiency of renewable fuels - economy of hydrogen energy. Solar Cells: First, second, third and fourth generation solar cell - photo biochemical conversion cell.

Total: 45 Hours

Reference(s)

1. N. Eliaz, E. Gileadi, Physical Electrochemistry, Fundamentals, Techniques and Applications, Wiley, 2019.
2. J. Garche, K. Brandt, Electrochemical Power sources: Fundamentals Systems and Applications, Elsevier, 2018.
3. S.P. Jiang, Q. Li, Introduction to Fuel Cells, Springer, 2021.
4. A. Iulianelli, A. Basile, Advances in Hydrogen Production, Storage and Distribution, Elsevier, 2016.
5. M.M. Eboch, The Future of Energy, From Solar Cells to Flying Wind Farms, Capstone, 2020.

22OMA01 GRAPH THEORY AND COMBINATORICS

3 0 0 3

Course Objectives

- This course comprehends the graphs as a modelling and analysis tool in computer science & Engineering.
- It introduces the structures such as graphs & trees and techniques of counting and combinations, which are needed in number theory-based computing and network security studies in Computer Science.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Differentiate the basic ideas of graph and its characteristics.
2. Assess the characteristics of trees and its properties.
3. Apply the colouring of graphs and its applications in the respective areas of engineering.
4. Execute the permutations and combinations in the engineering field.
5. Implement the types of generating functions and their applications in engineering.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
3	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
4	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
5	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I **9 Hours**

INTRODUCTION

Graphs - Introduction - Isomorphism - Sub graphs - Walks, Paths, Circuits - Connectedness - Components - Euler graphs - Hamiltonian paths and circuits - Trees - Properties of trees - Distance and centers in tree - Rooted and binary trees.

UNIT II **9 Hours**

TREES, CONNECTIVITY

Spanning trees - Fundamental circuits - Spanning trees in a weighted graph - cut sets - Properties of cut set - All cut sets - Fundamental circuits and cut sets - Connectivity and separability - Network flows - 1-Isomorphism - 2-Isomorphism - Combinational and geometric graphs - Planer graphs - Different representation of a planer graph.

UNIT III **9 Hours**

MATRICES, COLOURING AND DIRECTED GRAPH

Chromatic number - Chromatic partitioning - Chromatic polynomial - Matching - Covering - Four colour problem - Directed graphs - Types of directed graphs - Digraphs and binary relations - Directed paths and connectedness - Euler graphs.

UNIT IV **9 Hours**

PERMUTATIONS

Fundamental principles of counting - Permutations and combinations - Binomial theorem - combinations with repetition - Combinatorial numbers - Principle of inclusion and exclusion - Derangements - Arrangements with forbidden positions.

UNIT V **9 Hours**

GENERATING FUNCTIONS

Generating functions - Partitions of integers - Exponential generating function - Summation operator - Recurrence relations - First order and second order - non-homogeneous recurrence relations - Method of generating functions.

Total: 45 Hours

Reference(s)

1. Narsingh Deo, Graph Theory: With Application to Engineering and Computer Science, Prentice Hall of India, 2003.
2. Grimaldi R.P., Discrete and Combinatorial Mathematics: An Applied Introduction, Addison Wesley, 1994.
3. Rosen K.H., Discrete Mathematics and Its Applications, McGraw Hill, 2007.
4. Clark J. & Holton D.A., A First Look at Graph Theory, Allied Publishers, 1995.
5. Mott J.L., Kandel A. & Baker T.P., Discrete Mathematics for Computer Scientists and Mathematicians, Prentice Hall of India, 1996.
6. Liu C.L., Elements of Discrete Mathematics, McGraw Hill, 1985.

22OGE01 PRINCIPLES OF MANAGEMENT 3 0 0 3

Course Objectives

- To develop cognizance about importance of management principles.
- Extract the functions and responsibilities of managers.
- To study and understand the various HR related activities.
- Learn the application of the theories in an organization.
- Analyze the position of self and company goals towards business.

Programme Outcomes (POs)

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

PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Evaluate the basic concepts of Management.
2. Implement some basic knowledge on planning process and its Tools & Techniques.
3. Apply the management concept of organizing and staffing.
4. Execute the management concept of directing.
5. Apply the management concept of controlling.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	-	-	-	2	-	3	-	-	-	-
2	-	-	-	-	-	-	-	-	2	-	2	-	-	-	-
3	-	-	-	-	-	-	-	-	2	-	2	-	-	-	-
4	-	-	-	-	-	-	-	-	3	-	2	-	-	-	-
5	-	-	-	-	-	-	-	-	2	-	2	-	-	-	-

UNIT I **9 Hours**

INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

Definition of Management Science or Art Manager Vs Entrepreneur-types of managers - Managerial roles and skills Evolution of Management Scientific, Human Relations, System and Contingency approaches Types of Business organization - Sole proprietorship, partnership, Company - public and private sector enterprises - Organization culture and Environment Current Trends and issues in Management.

UNIT II **9 Hours**

PLANNING

Nature and purpose of planning - Planning process - Types of planning – Objectives - Setting objectives - Policies - Planning premises - Strategic Management - Planning Tools and Techniques - Decision making steps and process.

UNIT III **9 Hours**

ORGANISING

Nature and purpose – Formal and informal organization - Organization chart - Organization Structure Types - Line and staff authority - Departmentalization - Delegation of authority - Centralization and decentralization - Job Design - Human Resource - Management - HR Planning, Recruitment, Selection, Training and Development, Performance Management, Career planning and management.

UNIT IV **9 Hours**

DIRECTING

Foundations of individual and group behaviour - Motivation-Motivation theories - Motivational techniques - Job satisfaction - Job enrichment - Leadership-types and theories of leadership - Communication-Process of communication - Barrier in communication Effective Communication-Communication and IT.

UNIT V **9 Hours**

CONTROLLING

System and process of controlling - Budgetary and non-Budgetary control techniques - Use of Computers and IT in Management control - Productivity problems and management - Control and Performance-Direct and preventive control - Reporting.

Total: 45 Hours

Reference(s)

1. Robbins S, Management, (13th ed.), Pearson Education, New Delhi, 2017.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, Fundamentals of Management, Pearson Education, 7th Edition, 2011.
3. Robert Kreitner and Mamata Mohapatra, Management, Biztantra, 2008.
4. L. M. Prasad, Principles and Practice of Management. 7th Edition, Sultan Chand & Sons, 2007.
5. P. C. Tripathi and P. N. Reddy, Principles of Management, Fourth Edition, Tata McGraw Hill, 2008.

22OGE02 ENTREPRENEURSHIP DEVELOPMENT I 3 0 0 3

Course Objectives

- Learn the basics and scope of the Entrepreneurship.
- Understand the generation of ideas of the Entrepreneurship.
- Evolve the legal aspects of the business.
- Learn to analyze the various business finance.
- Learn the basics of the Operations Management.

Programme Outcomes (POs)

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

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

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

Course Outcomes (COs)

1. Analyze the role of entrepreneurship in economic development.
2. Execute the types of ideas that to be used for entrepreneurship development.
3. Evaluate the legal aspects of business and its association.
4. Evaluate the sources of business and its analysis.
5. Analyse the different modes of operation management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	1	2	-	2	-	-	-	-	-	-
2	-	-	-	-	-	1	2	-	2	-	-	-	-	-	-
3	-	-	-	-	-	1	2	-	2	-	-	-	-	-	-
4	-	-	-	-	-	1	2	-	2	-	-	-	-	-	-
5	-	-	-	-	-	1	2	-	2	-	-	-	-	-	-

UNIT I **9 Hours**

BASICS OF ENTREPRENEURSHIP

Nature, scope and types of Entrepreneurships, Entrepreneur Personality Characteristics, Entrepreneurship process. Role of entrepreneurship in economic development

UNIT II **9 Hours**

GENERATION OF IDEAS

Creativity and Innovation, Lateral Thinking, Generation of Alternatives, Fractional, Reversal Method, Brain Storming, Analogies

UNIT III **9 Hours**

LEGAL ASPECTS OF BUSINESS

Contract act-Indian contract act, Essential elements of valid contract, classification of contracts, sale of goods act- Formation of contract of sale, negotiable instruments- promissory note, bills and cheques, partnership, limited liability partnership (LLP), companies act-kinds, formation, memorandum of association, articles of association.

UNIT IV **9 Hours**

BUSINESS FINANCE

Project evaluation and investment criteria (cases), sources of finance, financial statements, break even analysis, cash flow analysis.

UNIT V **9 Hours**

OPERATIONS MANAGEMENT

Importance – functions - deciding on the production system - facility decisions: plant location, plant layout (cases), capacity requirement planning - inventory management (cases) - lean manufacturing, Six sigma.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005.
2. Prasanna Chandra, Projects Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill Publishing Company Limited, New Delhi: 2000.
3. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006.

22OGE03 ENTREPRENEURSHIP DEVELOPMENT II 3 0 0 3

Course Objectives

- Evolve the marketing mix for promotion the product / services.
- Handle the human resources and taxation.
- Learn to analyze the taxation.
- Understand the Government industrial policies and supports.
- Preparation of a business plan.

Programme Outcomes (POs)

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

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

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

Course Outcomes (COs)

1. Evaluate the strategies and plans in marketing management.
2. Analyse the cases involved in human resource management.
3. Organize the direct and indirect taxes in business.
4. Analyze the supports given by government for improving the business.
5. Evaluate the various steps involved in preparing the business plan.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	1	2	-	2	-	-	-	-	-	-
2	-	-	-	-	-	1	2	-	2	-	-	-	-	-	-
3	-	-	-	-	-	1	2	-	2	-	-	-	-	-	-
4	-	-	-	-	-	1	2	-	2	-	-	-	-	-	-
5	-	-	-	-	-	1	2	-	2	-	-	-	-	-	-

UNIT I **9 Hours**

MARKETING MANAGEMENT

Marketing environment, Segmentation, Targeting and positioning, Formulating marketing strategies, Marketing research, marketing plan, marketing mix (cases).

UNIT II **9 Hours**

HUMAN RESOURCE MANAGEMENT

Human Resource Planning (Cases), Recruitment, Selection, Training and Development, HRIS, Factories Act 1948 (an over view).

UNIT III **9 Hours**

BUSINESS TAXATION

Direct taxation, Income tax, Corporate tax, MAT, Tax holidays, Wealth tax, Professional tax (Cases). Indirect taxation, Excise duty, Customs, Sales and Service tax, VAT, Octroi, GST (Cases).

UNIT IV **9 Hours**

GOVERNMENT SUPPORT

Industrial policy of Central and State Government, National Institute - NIESBUD, IIE, EDI. State Level Institutions - TIIC, CED, MSME, Financial Institutions.

UNIT V **9 Hours**

BUSINESS PLAN PREPARATION

Purpose of writing a business plan, Capital outlay, Technical feasibility, Production plan, HR plan, Market survey and Marketing plan, Financial plan and Viability, Government approvals, SWOT analysis.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005.
2. Philip Kotler., Marketing Management, Prentice Hall of India, New Delhi: 2003.
3. Aswathappa K, Human Resource and Personnel Management - Text and Cases, Tata McGraw Hill: 2007.
4. Jain P C., Handbook for New Entrepreneurs, EDII, Oxford University Press, New Delhi: 2002.
5. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006.
6. http://niesbud.nic.in/agencies.html.

22OGE04 NATION BUILDING, LEADERSHIP AND SOCIAL RESPONSIBILITY

3 0 0 3

Course Objectives

- To understand the importance of National Integration, Patriotism and Communal Harmony.
- To outline the basic awareness about the significance of soft skills in professional and inter-personal communications and facilitate an all-round development of personality.
- To analyze the different types of responsibility role of play for the improvement of society.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO7.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO12.Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Execute religo-cultural diversity of the country and its impact on the lives of the people and their beliefs.
2. Implement a sense of responsibility, smartness in appearance and improve self-confidence.
3. Create the sense of self-less social service for better social & community life.
4. Apply the importance of Physical and Mental health and structure of communication organization and various mode of communication.
5. Execute awareness about the various types of weapon systems in the Armed Forces.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	-	1	-	-	-	1	-	-	-	-	3	-	-	-
2	2	-	2	-	-	-	2	-	-	-	-	2	-	-	-
3	2	-	1	-	-	-	1	-	-	-	-	2	-	-	-
4	2	-	3	-	-	-	3	-	-	-	-	3	-	-	-
5	2	-	1	-	-	-	1	-	-	-	-	2	-	-	-

UNIT I **9 Hours**

NATIONAL INTEGRATION

Importance & Necessity, Factors Affecting National Integration, Unity in Diversity. Threats to National Security. Water Conservation and Rain Harvesting, Waste Management and Energy Conservation. Leadership Capsule-Traits-Indicators-Motivation-Moral Values-Honor Code-Case Studies: Shivaji, Jhansiki Rani, Case Studies–APJ Abdul kalam, Deepa Malik, Maharana Pratap, N Narayan Murthy Ratan Tata Rabindra Nath Tagore, role of NCC cadets in 1965 war.

UNIT II **9 Hours**

PERSONALITY DEVELOPMENT AND LEADERSHIP

Intra & Interpersonal skills - Self-Awareness- &Analysis, Empathy, Critical & creative thinking, Decision making and problem solving, Communication skills, Group Discussion – copping with stress and emotions, changing mindset, Public Speaking, Time Management, Social skills, Career counselling, SSB procedure and Interview skills.

UNIT III **9 Hours**

SOCIAL SERVICE, COMMUNITY DEVELOPMENT AND ENVIRONMENTAL AWARENESS

Basics of social service and its need, Types of social service activities, Objectives of rural development programs and its importance, NGO's and their contribution in social welfare, contribution of youth and NCC in Social welfare. Protection of children & women safety, Road/ Rail Travel Safety, New initiatives, Cyber and mobile security awareness. Disaster management Capsule-Organization-Types of Disasters-Essential Services-Assistance-Civil Defence Organization

UNIT IV **9 Hours**

HEALTH, HYGIENE AND COMMUNICATION

Sanitation, First Aid in Common Medical Emergencies. Health, Treatment and Care of Wounds. Yoga-Introduction, Definition, Purpose, Benefits. Asanas-Padamsana, Siddhasana, Gyan Mudra, Surya Namaskar, Shavasana, Vajrasana, Dhanurasana, Chakrasana, Sarvaangasana, Halasana etc.

Obstacle Training Contact: Obstacle training - Intro, Safety measures, Benefits, Straight balance, Clear Jump, Gate Vault, Zig Zag Balance, High Wall etc.

Communication: Basic Radio Telephony (RT) Procedure-Introduction, Advantages, Disadvantages, Need for standard- Procedures-Types of Radio Telephony Communication-Radio telephony procedure, Documentation.

UNIT V **9 Hours**

ARMED FORCES AND NCC GENERAL

Introduction to Digital Signal Processors- Basic Classification-Features TMS320C6713 Architecture-Functional Unit-Pipelining- Addressing Modes -Instruction set Simple Assembly Language Program.

Total: 45 Hours

Reference(s)

1. Director General NCC Website: https://indiancc.nic.in/ncc-general-elective-subject-course-design/.
2. Grooming Tomorrow's Leaders, published by DG, NCC. https://indiancc.nic.in/.
3. Youth in Action, published by DG, NCC. https://indiancc.nic.in/.
4. The Cadet, Annual Journal of the NCC. https://indiancc.nic.in/.
5. Précis Issued by respective Service Headquarters on specialized subject available to PI Staff as reference material. https://indiancc.nic.in/.

22OAI01 FUNDAMENTALS OF DATA SCIENCE

3 0 0 3

Course Objectives

- To learn the basics of data science and statistical inference.
- To understand the concept of data pre-processing.
- To visualize the processed data using visualization techniques.

Programme Outcomes (POs)

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

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

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

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

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PSO1. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2. Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Apply the basics of data science and exploratory data analysis.
2. Execute the useful information using mathematical skills.
3. Implement the usage of statistical inference and regression models.
4. Assess various data operations for cleaning and grouping of data.
5. Implement the visualization of data using visualization tools.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	2	2	-	-	-	-	-	-	-	3	3	-
2	3	3	3	3	3	-	-	-	-	-	-	-	3	3	-
3	3	3	3	3	3	-	-	-	-	-	-	-	3	3	-
4	3	3	3	3	3	-	-	-	-	-	-	-	3	3	-
5	3	3	3	3	3	-	-	-	-	-	-	-	3	3	-

UNIT I **9 Hours**

INTRODUCTION

Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleaning, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications.

UNIT II **9 Hours**

DESCRIPTIVE STATISTICS I

Frequency distributions – Outliers – relative frequency distributions – cumulative frequency distributions – frequency distributions for nominal data – interpreting distributions – graphs – averages – mode – median – mean – averages for qualitative and ranked data – describing variability– range – variance – standard deviation – degrees of freedom – interquartile range.

UNIT III **9 Hours**

DESCRIPTIVE STATISTICS II

Normal distributions – z scores – normal curve problems – finding proportions – finding scores – more about z scores – correlation – correlation coefficient for quantitative data – computational formula for correlation coefficient – regression – regression line – least squares regression line – standard error of estimate – interpretation of r^2.

UNIT IV **9 Hours**

PYTHON FOR DATA HANDLING

Basics of Numpy arrays – aggregations – computations on arrays – comparisons, masks, boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – hierarchical indexing – combining datasets – aggregation and grouping.

UNIT V **9 Hours**

DATA VISUALIZATION

Types of data visualization: Exploratory, Explanatory, visualization with matplotlib – line plots – scatter plots – visualizing errors – density and contour plots – histograms, binnings, and density – three-dimensional plotting– geographic data – data analysis using statmodels and seaborn – graph plotting using Plotly - Visualization Tools: Tableau.

Total: 45 Hours

Reference(s)

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.
2. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017.
3. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016.
4. Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press, 2014.
5. https://www.coursera.org/specializations/data-science-fundamentals.
6. https://www.coursera.org/learn/foundations-of-data-science
7. https://onlinecourses.swayam2.ac.in/imb23_mg64/preview
8. https://www.udemy.com/course/the-data-science-course-complete-data-science-bootcamp/

22OAM01 COMPUTER VISION IN HEALTHCARE APPLICATION 3 0 0 3

Course Objectives

- Understand the algorithms and techniques used in image formation.
- Implement the motion computation and 3D vision to generate 3-Dimensional images of an object.
- Develop computer vision tools to assist surgeons during procedures, providing real- time feedback and guidance.

Program Outcomes (POs)

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

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

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

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

PO5.Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PSO1. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Apply the image processing techniques for computer vision.
2. Implement the image pre-processing techniques.
3. Create 3D vision and motion related techniques.
4. Evaluate computer vision for physical rehabilitation and training.
5. Analyse of Medical Image for Predictive Analytics and Therapy.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1	1	-	-	-	-	-	-	-	-	-	2	-	-
2	2	3	2	-	3	-	-	-	-	-	-	-	3	-	-
3	2	2	2	-	2	-	-	-	-	-	-	-	3	-	-
4	2	3	3	-	3	-	-	-	-	-	-	-	3	-	-
5	2	3	3	2	3	-	-	-	-	-	-	-	3	-	-

UNIT I **10 Hours**

COMPUTER VISION FOUNDATIONS

History of Computer Vision – Basics of Image Processing, Machine Learning – Information Retrieval – Neuroscience – Robotics – Speech – Cognitive Sciences –Algorithms, Systems and Theory .Image Processing - Colour - Linear Algebra Primer - Pixels and Filters – Edge Detection - Features and Fitting - Feature Descriptors - Image Resizing - Segmentation - Semantic Segmentation - Clustering - Object recognition - Dimensionality Reduction - Face Identification - Visual Bag of Words - Object Detection from Deformable Parts - Semantic Hierarchies and Fine Grained Recognition - Motion - Tracking - Deep Learning

UNIT II **10 Hours**

IMAGE FORMATION AND IMAGE PRE-PROCESSING

Geometric primitives and transformations – Photometric image formation – The digital camera – Point operators – Linear Filtering – More neighbourhood operators – Fourier transforms – Pyramids and wavelets – Geometric transformations – Global optimization. Feature detection and matching – Segmentation – Edge detection - 2D and 3D feature based alignment – Pose estimation – Geometric intrinsic calibration – Triangulation – Two-Frame Structure from motion – Factorization – Bundle adjustment – Constrained Structure and Motion – Dense motion estimation.

UNIT III **7 Hours**

3D VISION

Methods for 3D Vision - 3D reconstruction – Image based rendering, Image Recognition – Object Detection – Space, Instance and Category Recognition – Recognition Databases and test sets.

UNIT IV **9 Hours**

COMPUTER VISION FOR ASSISTING HEALTHCARE APPLICATIONS

Computer Vision to see - Computer Vision for Cognition - Computer Vision for physical rehabilitation and training - Computer Vision for CAD systems in surgery - Computer Vision for human-machine interaction - Computer Vision for Ambient Assisted Living - Egocentric (first person) vision.

UNIT V **9 Hours**

HEALTH CARE APPLICATIONS AND CONTEMPORARY ISSUES

Analysis of Medical Image - Computer Vision for Predictive Analytics and Therapy - Fundamental Algorithms for Medical Images - Machine Learning Algorithms for Medical Images – Deep learning approaches for healthcare applications - Contemporary issues.

Total: 45 Hours

Reference(s)

1. Ranjay Krishna, "Computer Vision: Foundations and Applications", Stand ford University, December 2017.
2. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer 2011.
3. Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University Press, 2012.
4. Forsyth D A and Ponce J, "Computer Vision: A Modern Approach", Prentice Hall, 2003.
5. Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", Third Edition, Academic Press, 2012.
6. Forsyth D A and Ponce J, "Computer Vision: A Modern Approach", Prentice Hall, 2003.

22OAM02 NEURAL NETWORKS **3 0 0 3**

Course Objectives

- To understand the major concepts in deep neural networks.
- To apply Convolutional Neural Network architectures for any real-life applications.
- To analyse the key computations underlying deep learning to build and train deep neural networks for various tasks.

Program Outcomes (POs)

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

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

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

PO5.Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PSO1. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Apply convolution neural network for any suitable applications.
2. Analyze the various classifiers of Single-layer perceptron.
3. Apply convolutional neural networks and its variants for any suitable applications.
4. Analyze the single-layer feedback networks with its mathematical foundation.
5. Analyze the various categories of associative memory with its case studies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	-	1	-	-	-	-	-	-	-	2	-	-
2	2	2	3	-	3	-	-	-	-	-	-	-	2	-	-
3	1	3	3	-	3	-	-	-	-	-	-	-	2	-	-
4	2	2	2	-	3	-	-	-	-	-	-	-	2	-	-
5	2	2	1	-	3	-	-	-	-	-	-	-	2	-	-

UNIT I **9 Hours**

INTRODUCTION

Fundamental concepts and Model: Models of artificial Neural Networks, Neural processing, Learning and Adaptation, Neural network Learning rules- Hebbian rule, Perceptron rule, Delta rule.

UNIT II **9 Hours**

SINGLE LAYER PERCEPTRON MODEL

Single-layer perceptron classifiers: Classification model, Features and decision regions, Discriminant functions, Linear machine and Minimum distance classification, Non- parametric training concept, Training and Classification using the Discrete perceptron: algorithm and example, Single layer continuous Perceptron networks for linearly separable classifications.

UNIT III **9 Hours**

MULTI LAYER FEED FORWARD NETWORKS

Multilayer feed forward Networks: Linearly separable Pattern classification, Delta learning rule for Multi-perceptron model, Generalized Delta learning rule, Feed forward recall and error back propagation training.

UNIT IV **9 Hours**

SINGLE LAYER FEEDBACK NETWORKS

Single-layer Feedback Networks: Basic concepts of dynamic systems, Mathematical foundations of Discrete-time Hopfield Networks, Mathematical foundations of Gradient type Hopfield networks, Associative memories: Basic concepts, Linear Associator.

UNIT V **9 Hours**

ASSOCIATIVE MEMORY

Bidirectional associative memory - associative memory for spatio-temporal patterns - Case study: Implementation of NN in any simulator. Self-Learning: Bidirectional Associative memory.

Total: 45 Hours

Reference(s)

1. E. A.E and S. J.E, "Introduction to Evolutionary Computing | The on-line accompaniment to the book Introduction to Evolutionary Computing", Evolutionary computation.org, 2015.
2. F. Lobo, "Evolutionary Computation 2018/2019", Fernandolobo.info, 2018.
3. "EC lab Tools", Cs.gmu.edu, 2008.
4. "Kanpur Genetic Algorithms Laboratory", Iitk.ac.in, 2008.
5. "Course webpage Evolutionary Algorithms", Liacs.leidenuniv.nl, 2017.

22OBM01 OCCUPATIONAL SAFETY AND HEALTH IN PUBLIC HEALTH EMERGENCIES

3 0 0 3

Course Objectives

- To know about Occupational safety and health (OSH).
- To discuss about risks faced by emergency responders during disease outbreaks and other emergencies.
- To create awareness on necessary strategies for managing OSH in emergency situations.

Programme Outcomes (POs)

PO2.Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO12. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO2. Critically analyze the current healthcare systems and develop innovative solutions effectively through problem specific design and development using modern hardware and software tools.

Course Outcomes (COs)

1. Execute the occupational safety measures by the scientific knowledge to overcome the risks faced by emergency responders.
2. Apply appropriate strategies and tools in Occupational safety and healthcare.
3. Analyze common risks for safety and health in emergencies.
4. Implement appropriate occupational safety practices in chemical accidents.
5. Create occupational safety measures in radiation incidents.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	3	2	1	-	-	-	1	-	-	-	2	-	2	-
2	-	2	2	2	-	-	-	1	-	-	-	2	-	2	-
3	-	3	2	2	-	-	-	1	-	-	-	2	-	2	-
4	-	2	2	2	-	-	-	1	-	-	-	2	-	2	-
5	-	3	2	2	-	-	-	1	-	-	-	2	-	2	-

UNIT I **9 Hours**

MANAGEMENT ASPECTS

Management system approach to occupational safety and health hazards and risks – rights, duties and responsibilities of employers and workers during outbreaks and emergencies – Emergency responders health monitoring and surveillance.

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UNIT II **9 Hours**

STRATEGIES AND TOOLS

International Health Regulations, 2005 – Incident command system for managing outbreaks and emergencies – Occupational safety and health controls – Strategies for infection prevention and control.

UNIT III **9 Hours**

COMMON RISKS FOR SAFETY AND HEALTH IN EMERGENCIES

Vector-borne diseases, water and food-borne diseases, Vaccine-preventable diseases – Heat stress - Slips, trips and falls - Road traffic injuries – Ergonomic hazards - Violence – Psychological stress during outbreaks and injuries.

UNIT IV **9 Hours**

OCCUPATIONAL SAFETY AND HEALTH IN CHEMICAL INCIDENTS

Emergencies caused by chemical incidents – occupational safety and health hazards and risks of chemicals – Personal Protective Equipment – Decontamination of emergency response personnel – medical surveillance of emergency responders

UNIT V **9 Hours**

OCCUPATIONAL SAFETY AND HEALTH IN RADIATION INCIDENTS

Sources and scenarios of radiation incidents – guidance for protection of emergency responders - Occupational health surveillance of persons occupationally exposed to radiation in emergencies

Total: 45 Hours

Reference(s)

1. Emergency responder health monitoring and surveillance. National Response Team technical assistance document. Atlanta (GA): National Institute for Occupational Safety and Health; 2012.
2. Emergency response framework (ERF). Geneva: World Health Organization; 2013.
3. Guidelines on occupational safety and health management systems, second edition. Geneva: International Labour Organization; 2009.
4. OSH management system: a tool for continual improvement. Geneva: International Labour Organization; 2011.
5. OECD Environmental Outlook to 2050: the consequences of inaction. Paris: Organization for Economic Co-operation and Development; 2012.

22OBM02 AMBULANCE AND EMERGENCY MEDICAL SERVICE MANAGEMENT

3 0 0 3

Course Objectives

- To understand the ambulance & transport management and allied services.
- To compare the ambulance design and equipment, transportation and corporate Profit.
- To carry-out various acts governing transport management.

Programme Outcomes (POs)

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

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

PSO1.Apply knowledge on foundation in Life Science, engineering, mathematics and current biomedical engineering practices with an ability to demonstrate advanced knowledge of a selected area within Biomedical Engineering.

PSO2. Critically analyze the current healthcare systems and develop innovative solutions effectively through problem specific design and development using modern hardware and software tools.

Course Outcomes (COs)

1. Implement ambulance services, types and allied services.
2. Create minimum ambulance rescue equipment and developing a transportation strategy.
3. Execute the emergency response team, transportation interfaces, transportation service characteristics and regulatory reforms involved.
4. Resolve ambulance services, types and allied services.
5. Create minimum ambulance rescue equipment and developing a transportation strategy.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	-	-	-	-	-	-	-	-	-	-	-	2	-
2	2	-	-	-	-	-	-	-	-	-	-	-	-	3	-
3	-	2	-	-	-	-	-	-	-	-	-	-	-	2	-
4	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
5	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-

UNIT I **9 Hours**

INTRODUCTION

Introduction-Transportation ambulance types-Advanced Life Support Ambulance-Basic Life Support Ambulance-Patient Transport Ambulance-Emergency Services-Ambulances-Allied services-telephone management

UNIT II **9 Hours**

AMBULANCE DESIGN AND EQUIPMENT

Design and Equipment of Ambulances -Minimum Ambulance Rescue Equipment-Emergency drugs medicines Recruitment validation Training to handle in house Ambulance emergency procedures Checklist measures Roles of paramedics, midwives, community nurses, hospice workers in emergency handling via ambulance.

UNIT III **9 Hours**

TRANSPORTATION REGULATION FOR EMERGENCY MEDICAL SERVICE

Crisis Management-Anxiety and Stress Management-the Emergency response team-police assistance- Information handling & processing-Establishing customer service levels - Developing and Reporting customer service standards - Impediments to an Effective customer Service strategy - Improving customer Service Performance Transportation.

UNIT IV **9 Hours**

AMBULANCE PREVENTIVE MAINTENANCE

Legal obligations Switch Console Front, Main Electrical, Patient Compartment Climate Oxygen System On Board Suction system 110/12 VOLT system, Modular Body, Medical Equipment - Cot & Stretcher, safety belts-driver(s), passenger, Patients-child restraint device-incubator.

UNIT V **9 Hours**

THE MOTOR VEHICLE ACT

The Motor Vehicle Act, 1988- Rules of the road Regulations 1989- Overall Dimensions of Motor Vehicles (Prescription of conditions for exemption) Rules 1991-Use of Red light on the top front of the vehicle.

Total: 45 Hours

Reference(s)

1. Fawcett, "Supply Chain Management", Pearson Education India, 01-Sep-2008 - 600 pages.
2. B. Feroz, A. Mehmood, H. Maryam, S. Zeadally, C. Maple and M. A. Shah, "Vehicle-Life Interaction in Fog-Enabled Smart Connected and Autonomous Vehicles," in IEEE Access, vol. 9, pp. 7402-7420, 2021, Doi: 10.1109/ACCESS.2020.3049110.
3. R. Jin, T. Xia, X. Liu, T. Murata and K. -S. Kim, "Predicting Emergency Medical Service Demand with Bipartite Graph Convolutional Networks," in IEEE Access, vol. 9, pp. 9903-9915, 2021, Doi: 10.1109/ACCESS.2021.3050607.
4. Les Pringle, "Call the Ambulance", Transworld Publishers, 2010.
5. Edward J. Bardi, John Joseph Coyle, Robert A. Novack "Management of Transportation", Thomson/South-Western, 2006.

22OBM03 HOSPITAL AUTOMATION 3 0 0 3

Course Objectives

- To introduce the concepts of hospital systems and need for central monitoring.
- To exemplify the power generation, utility and protection systems.
- To apply the distributed and central monitoring functions in hospital environment.

Programme Outcomes (POs)

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

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

PSO1.Apply knowledge on foundation in Life Science, engineering, mathematics and current biomedical engineering practices with an ability to demonstrate advanced knowledge of a selected area within Biomedical Engineering.

PSO2. Critically analyze the current healthcare systems and develop innovative solutions effectively through problem specific design and development using modern hardware and software tools.

Course Outcomes (COs)

1. Assess the factors in central power generating and monitoring systems.
2. Analyze the sensors and actuators for the automation systems.
3. Organize the equipment types and its applications.
4. Apply software tools and digital computer for monitoring of parameters and medical data handling.
5. Execute central monitoring station for hospitals for control and surveillance applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	-	-	-	-	-	-	-	-	-	-	-	-	2	-
2	-	2	-	-	-	-	-	-	-	-	-	-	-	2	-
3	-	2	-	-	-	-	-	-	-	-	-	-	3	-	-
4	-	2	-	-	-	-	-	-	-	-	-	-	-	2	-
5	3	-	-	-	-	-	-	-	-	-	-	-	-	2	-

UNIT I **9 Hours**

AUTOMATION IN HEALTHCARE

Introduction to automation Role of automation in healthcare Remote Patient Monitoring Maximizing resources on patient care Reducing variability, Automating clinician and patient interactions through products.

UNIT II **9 Hours**

POWER GENERATION AND MEDICAL GAS PRODUCTION

Power generator, Battery: Maintenance and troubleshooting, energy conservation and monitoring system - Automation in dryer, compressor, air conditioning, lighting, heating systems.

UNIT III **9 Hours**

AUTOMATION IN PIPING

Monitoring of flow and pressure of medical gas System components Vacuum control unit's Automatic changeover system - Types of Outlets - Leakage test- Prevention and safety automation.

UNIT IV **9 Hours**

INSTRUMENTATION SYSTEMS

Optical sensors, Pressure Sensors - Ultrasonic Sensors - Tactile Sensors - Thermal sensors -Biosensor - Linear Actuators, Central monitoring station - Alarm system - Regulation and standards.

UNIT V **9 Hours**

APPLICATIONS

Business intelligence & executive dashboards - Radio-Frequency Identification (RFID)- based patient and asset tracking solutions - Tablet-based applications for bed side access to doctors/nurses - Healthcare CRM for patient relationship management - Patient kiosk, tele-health - HIS integration.

Total: 45 Hours

Reference(s)

1. Khandpur RS, Handbook of Biomedical Instrumentation, Prentice Hall of India, New Delhi, 3rd edition, 2014.
2. Joseph J. Carr and John M. Brown, Introduction to Biomedical Equipment Technology, Pearson Education India, Delhi, 4th edition 2008.
3. Curtis Johnson D Process Control Instrumentation Technology, Prentice Hall of India, 8th edition 2006.
4. John V. Grimaldi and Rollin H. Simonds., Safety Management, All India Travelers Book seller, New Delhi, 1989.
5. N.V. Krishnan, Safety in Industry, Jaico Publisher House, 1996.

22OIT01 DATA STRUCTURES 3 0 0 3

Course Objectives

- To understand the basic concepts such as Abstract Data Types, Linear and Non-Linear Data structures
- To analyze the performance of algorithms using time and space complexity.
- To understand the behavior of Linear and Non-Linear data structures
- To choose the appropriate data structures for a specified application
- To write programs in C++ to solve problems using various data structures.

Programme Outcomes (POs)

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

PSO1: Design and develop cost effective, secure, reliable IT, network and web-based solutions with professional expertise in the domains including banking and healthcare and communications.

Course Outcomes (COs)

1. Analyze the performances of the sorting and searching algorithms.
2. Apply linked list linear data structures operations using dynamic memory allocation.
3. Apply stack and Queue data structure operations to solve computational problems.
4. Design tree data structures and hashing techniques for effective searching of data.
5. Create algorithms for solving real world problems using Graph data structure.

Articulation Matrix

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

UNIT I **8 Hours**

INTRODUCTION

Introduction to data structures-types of data structures- Pseudo code - Abstract data types - ADT Implementations performance analysis- time complexity and space complexity- basics of OOPS concepts.

UNIT II **9 Hours**

SORTING AND SEARCHING TECHNIQUES

Searching methods: Linear and binary search methods, Sorting techniques: Insertion Sort - Selection Sort - Bubble Sort - Merge sort - Quick sort.

UNIT III **11 Hours**

LINEAR DATA STRUCTURES

Stack operation - Stack ADT - Applications of stack - Queues operations - Queue ADT - Queue applications – Linked List - Circular - Doubly linked list.

UNIT IV **11 Hours**

TREE

Basic Tree concepts - Binary Trees - Tree Traversals - Binary Search Trees – B Tree - Heap concepts - Heap ADT.

UNIT V **6 Hours**

GRAPHS

Introduction – types of graphs- Shortest Path Algorithms: Unweighted Shortest Paths - Dijkstra's Algorithm. Minimum Spanning Tree: Prim's Algorithm - Kruskal's Algorithm- graph search methods DFS, BFS

Total: 45 Hours

Reference(s)

1. A Abirami, Priya R L, Advanced Data Structures and Algorithms, BPB publisher, 2023 March.
2. Data Structures using C++, Special Edition-MRCET, Tata McGraw-Hill Publishers 2017.
3. Data structures and Algorithms in C++, Michael T.Goodrich, R.Tamassia and Mount, Wiley student edition, John Wiley and Sons, 2011.
4. Data structures and Algorithm Analysis in C++, Mark Allen Weiss, Pearson Education. Ltd., Second Edition, 2013.
5. D.S. Malik, Data Structures Using C++, Second Edition, 2010.

22OIT02 C++ PROGRAMMING 2 0 2 3

Course Objectives

- To understand the concept of Object-Oriented Programming.
- To apply the Object-Oriented concepts to solve problems using C++.

Programme Outcomes (POs)

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PSO1.Design and develop cost effective, secure, reliable IT, network and web-based solutions with professional expertise in the domains including banking and healthcare and communications.

Course Outcomes (COs)

1. Implement C++ programs using classes and objects.
2. Create C++ programs using the concept of Inheritance.
3. Design applications using virtual functions.
4. Implement the concept of operator overloading.
5. Create GUI applications using C++ library classes.

Articulation Matrix

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

UNIT I 5 Hours

BASICS OF C++ PROGRAMMING

C++ Program Structure, Character Set and Tokens, Data Type, Type Conversion, Preprocessor Directives, Namespace, Input/output Streams and Manipulators, Dynamic Memory Allocation with new and delete, Control Statements. Functions: Function Overloading, Inline Functions, Default Argument, Pass by Reference, Return by Reference, Scope and Storage Class. Pointers: Pointer variables declaration & initialization, Operators in pointers, Pointers and Arrays, Pointer and Function.

UNIT II 6 Hours

CLASSES & OBJECTS

A Simple Class and Object, accessing members of class, Initialization of class objects: (Constructor, Destructor), Default Constructor, Parameterized Constructor, Copy Constructor, The Default Copy Constructor, Objects as Function Arguments, Returning Objects from Functions, Structures and Classes, Memory allocation for Objects, Static members, Member functions defined outside the class.

UNIT III **7 Hours**

OPERATOR OVERLOADING & INHERITANCE

Fundamental of operator overloading, Restriction on operator overloading, Operator functions as a class member, Overloading unary and binary operator, Introduction to inheritance, Derived Class and Base Class, Access Specifiers (private, protected, and public), Types of inheritance.

UNIT IV **6 Hours**

VIRTUAL FUNCTION & POLYMORPHISM

Concept of Virtual functions, Late Binding, Abstract class and pure virtual functions, Virtual Destructors, Virtual base class, Friend function and Static function, Assignment and copy initialization, Copy constructor, This pointer, Concrete classes, Polymorphism and its roles.

UNIT V **6 Hours**

FUNCTION TEMPLATES AND EXCEPTION HANDLING

Function templates, Function templates with multiple arguments, Class templates, templates and inheritance, Exceptional Handling (Try, throw and catch), Use of exceptional handling.

EXPERIMENT 1 **3 Hours**

Introduction to Object Oriented Programming- Classes and Objects.

EXPERIMENT 2 **5 Hours**

Programs using Constructor, Destructor

EXPERIMENT 3 **4 Hours**

Programs on operator overloading.

EXPERIMENT 4 **5 Hours**

Programs on Inheritance

EXPERIMENT 5 **3 Hours**

Programs on Virtual Function

EXPERIMENT 6 **3 Hours**

Programs on Friend Function

EXPERIMENT 7 **3 Hours**

Programs on exception handling

EXPERIMENT 8 **4 Hours**

Programs on Function and Class Templates

Total 60 Hours

Reference(s)

1. E Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill Publishing, New Delhi, 2011.
2. Robert Lafore, Object Oriented Programming in C++, Galgotia Publication, 2010.
3. B Trivedi, Programming with ANSI C++, Oxford University Press, 2010.
4. H M Deitel and P J Deitel, C++ How to Program, Seventh Edition, Prentice Hall, 2010.
5. K R Venugopal, Rajkumar and T Ravishankar, Mastering C++, Tata McGraw Hill Publishing, New Delhi, 2010.

22OIT03 PROGRAMMING IN JAVA 2 0 2 3

Course Objectives

- To understand the concept of Object-Oriented Programming
- To develop console applications using Java.
- To develop GUI applications using Java library classes.

Programme Outcomes (POs)

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PSO1.Design and develop cost effective, secure, reliable IT, network and web-based solutions with professional expertise in the domains including banking and healthcare and communications.

Course Outcomes (COs)

1. Implement Java programs using classes and objects.
2. Execute Java programs using the concept of Inheritance.
3. Design applications using functions, files and exceptions.
4. Create console applications using Java OOPS.
5. Create GUI applications using Java library classes.

Articulation Matrix

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

UNIT I **6 Hours**

INTRODUCTION TO OOP AND JAVA FUNDAMENTALS

Object Oriented Programming - Abstraction - objects and classes- Encapsulation- Inheritance- Polymorphism- OOP in Java - Characteristics of Java - The Java Environment -Java Source File -Structure - Compilation. Fundamental Programming Structures in Java - Defining classes in Java - constructors, methods -access specifiers - static members -Comments, Data Types, Variables, Operators, Control Flow, Arrays, Packages- JavaDoc comments.

UNIT II **6 Hours**

INHERITANCE AND INTERFACES

Inheritance -Super classes- sub classes –Protected members - constructors in sub classes- the Object class - abstract classes and methods- final methods and classes - Interfaces - defining an interface, implementing interface, differences between classes and interfaces and extending interfaces - Object cloning -inner classes, Array Lists - Strings.

UNIT III **6 Hours**

EXCEPTION HANDLING AND I/O

Exceptions - exception hierarchy - throwing and catching exceptions - built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics - Streams -Byte streams and Character streams - Reading and Writing Console - Reading and Writing Files

UNIT IV **6 Hours**

MULTITHREADING AND GENERIC PROGRAMMING

Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads, thread groups. Generic Programming - Generic classes - generic methods -Bounded Types - Restrictions and Limitations.

UNIT V **6 Hours**

EVENT DRIVEN PROGRAMMING

Graphics programming - Frame - Components -working with 2D shapes - Using colour, fonts, and images - Basics of event handling -event handlers -adapter classes -actions - mouse events -AWT event hierarchy- Introduction to Swing- layout management - Swing Components -Text Fields, Text Areas -Buttons- Check Boxes -Radio Buttons -Lists- choices- Scrollbars -Windows -Menus - Dialog Boxes.

EXPERIMENT 1 **4 Hours**

Introduction to Object Oriented Programming- Classes and Objects.

EXPERIMENT 2 **5 Hours**

Programs using inheritance and polymorphism

EXPERIMENT 3 **5 Hours**

Programs on operator overloading.

EXPERIMENT 4 **5 Hours**

Programs on exception handling

EXPERIMENT 5 **5 Hours**

Programs on multi-threading in java

EXPERIMENT 6 **6 Hours**

Programs on java swing

Total 60 Hours

Reference(s)

1. Herbert Schildt, Java: The Complete Reference, Eleventh Edition, McGraw-Hill Education, 2018.
2. D.T. Editorial Services, Java 8 Programming Black Book, second edition, Dream tech Press, 2015.
3. Vaskaran Sarcar, Interactive Object-Oriented Programming in Java, Second edition, A press, 2019.

22OAG01 RAINWATER HARVESTING TECHNIQUES 3 0 0 3

Course Objectives

- To enhance the awareness about water resources management and conservation
- To acquire knowledge about water harvesting techniques and their implementation.
- To practice the design aspects of sustainable rainwater harvesting solutions for communities.

Programme Outcomes (POs)

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

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

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

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

PSO2. Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

Course Outcomes (COs)

1. Assess the sources, availability and challenges in water resources management.
2. Assess various water harvesting systems in practice.
3. Execute design considerations for comparing surface runoff harvesting methods.
4. Compare the characteristics and impacts of flood water harvesting techniques.
5. Evaluate various rainwater harvesting methods for groundwater recharging.

Articulation Matrix

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

UNIT I **8 Hours**

WATER RESOURCES AND CONSERVATION CHALLENGES

Global water distribution – primary and secondary sources of water – technical, social and cultural aspects; Global challenges in water and climate – water scarcity – water pollution – Indian scenario; Water resources management – public participation – integrated approach; Water governance – water sharing plans – policy, schemes and concerns.

UNIT II **10 Hours**

WATER RESOURCES

Principles of water harvesting for rural and urban – collection at micro and macro levels, flow control, storage and uses; Rainwater harvesting systems – traditional and contemporary – groundwater recharge; Water resources inventory – site analysis – database collection – water allocation principles based on demand and supply; Traditional water harvesting systems – practices in India – references in old texts – reasons for their deterioration – way forward; Watershed-based approach – project planning at micro and macro levels – community participation – rain centres.

UNIT III **9 Hours**

SURFACE RUNOFF HARVESTING

Short-term and micro-level harvesting techniques for runoff – terracing and bunding – rock and ground catchments; Long-term and macro-level harvesting techniques for runoff – farm ponds – percolation ponds and nala bunds; Design considerations – site selection – selection of runoff coefficients – computation of rainwater runoff volume – hydrograph analysis – cost estimation; Design of storage structures – storage capacity – selection of component – methods of construction.

UNIT IV **9 Hours**

FLOOD WATER HARVESTING

Floods – causes of urban floods and droughts – characteristics of water spread – impacts; Flood water harvesting – permeable rock dams – water spreading bunds – flood control reservoir; Design considerations – computation of flood water quantity; Trenching and Diversion Structures – types – site selection – design criteria – most economic section – design consideration of ditch system.

UNIT V **9 Hours**

GROUNDWATER HARVESTING

Rooftop rainwater harvesting – recharge pit – recharge trench – tube well – recharge well; artificial recharge – gully plug – dug well – percolation tank – nala bunds – recharge shaft; Groundwater harvesting – aquifer characteristics – subsurface techniques – infiltration wells – recharge wells – groundwater dams; Design of drainage system – types – design criteria – filter design – causes of failures

Total: 45 Hours

Reference(s)

1. Theib YO, Dieter P, Ahmed YH, Rainwater Harvesting for Agriculture in the Dry Areas, CRC Press, Taylor and Francis Group, London, 2012.
2. Lancaster, Brad. Rainwater Harvesting for Drylands and Beyond, Volume 1, 3rd edition, Rain source Press. 2019.
3. Das M, Open Channel Flow, Prentice Hall of India Pvt. Ltd., New Delhi, 2008.
4. Michael AM, Ojha TP, Principles of Agricultural Engineering, Volume II, 4th Edition, Jain Brothers, New Delhi, 2003.
5. Suresh R, Soil and Water Conservation Engineering, Standard Publisher Distributors, New Delhi, 2014.
6. Singh G, Venkataramanan C, Sastry G, Joshi BP, Manual of Soil and Water Conservation Practices, CSWCR&TI, Dehradun, 1990.
7. https://onlinecourses.swayam2.ac.in/cec21_ge14/preview
8. https://archive.nptel.ac.in/content/storage2/courses/105101010/downloads/Lecture10.pdf

22OEE01 VALUE ENGINEERING 3 0 0 3

Course Objectives

- To understand the concept of value engineering in order to reduce cost of product or process or service.
- To implement creative and innovative techniques using FAST diagram.
- To study benefits of Value Engineering for various industries.

Programme Outcomes (POs)

PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11.Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1. Design, analyze, and evaluate the performance of real-world problems in the field of Electrical and Electronics using contemporary tools
PSO2. Apply knowledge skills and attitude to conduct experiments and interpret data to solve complex engineering problems in the power systems network, power electronics, electric drives and develop control strategies by considering economic and environmental constraints.

Course Outcomes (COs)

1. Apply the concepts of value and value engineering to prepare a job plan.
2. Analyze the cost and worth of a product/service using the principles of economics.
3. Evaluate the value of a product/service to take managerial decisions.
4. Apply the soft skills in understanding team building, team work and report writing.
5. Asses the functions and values of product/services in industries using case studies.

Articulation Matrix

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

UNIT I **8 Hours**

INTRODUCTION TO VALUE ENGINEERING

Historical perspective of Value Engineering, Aims and objectives of Value Engineering, Concept of Value, Value Engineering concerned with Economic Value, Value Engineering Job plan.

UNIT II **9 Hours**

FUNCTIONAL ANALYSIS

Function-Cost-Worth analysis: Function Analysis System Technique (FAST); Review of principles of engineering economics.

UNIT III **10 Hours**

EVALUATION OF VALUE ENGINEERING

Evaluation of function, Problem setting system, problem solving system, setting and solving management - decision - type and services problem, evaluation of value.

UNIT IV **9 Hours**

HUMAN ASPECTS IN VALUE ENGINEERING

Team building; Life cycle costing; Managing Value Engineering Study; Value Engineering Report writing; Presentation Skill - Individual and Team Presentations; Implementation and follow-up.

UNIT V **9 Hours**

BENEFITS OF VALUE ENGINEERING

Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-increase safe Value Engineering Case studies in the Industries like Manufacturing; Construction; Health Care; Process.

Total: 45 Hours

Reference(s)

1. Anil Kumar Mukhopadhyaya, Value Engineering Mastermind - From Concepts to Certification, Response. Business Books from SAGE, Los Angeles / London / New Delhi / Singapore / Washington DC, 2014.
2. Anil Kumar Mukhopadhyaya, Value Engineering -Concepts, Techniques and Applications, Response Books, A Division of SAGE Publications, New Delhi / Thousand Oaks / London, 2003.
3. R. D. Miles, Techniques of Value analysis & Engineering, McGraw Hill, 2000.
4. E. Midge Arthur, Value Engineering -A Systematic Approach, McGraw Hill Book Co., New York, 2000.
5. Zimmerman, Value Engineering - A Practical Approach, CBS Publishers & Distributors, New Delhi, 2000.
6. https://www.investopedia.com/terms/v/value-engineering.asp#:~:text=Value%20engineering%20promotes%20the%20substitution,is%20also%20called%20value%20analysis.
7. https://cleartax.in/glossary/value-engineering/

22OEE02 ELECTRICAL SAFETY 3 0 0 3

Course Objectives

- To provide knowledge on basics of electrical fire and statutory requirements for electrical safety.
- To understand the causes of accidents due to electrical hazards.
- To know the various protection systems in Industries from electrical hazards.
- To know the importance of earthing.
- To distinguish the various hazardous zones and applicable fire proof electrical devices.

Programme Outcomes (POs)

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

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

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

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

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

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

PSO1. Modeling, design and Analysis of Electrical and Electronic Systems using design principles and software tools.

PSO2. Apply the core knowledge and technical skills to develop reliable and sustainable solutions to real world problems.

Course Outcomes (COs)

1. Analyze the basic concepts in electrical circuit and hazards involved in it.
2. Analyze the electrical hazards in the workplace and its impacts.
3. Evaluate the operation of various protection systems from electrical hazards.
4. Analyze the various safety procedures involved in the industries.
5. Evaluate the different hazardous zones in Industries and their safety measures.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Objectives of safety and security measures - Hazards associated with electric current and voltage - principles of electrical safety - working principles of major electrical equipment - Typical supply situation - Indian electricity act and rules - statutory requirements from electrical inspectorate-International standards on electrical safety.

UNIT II **9 Hours**

ELECTRICAL HAZARDS

Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity- Energy leakage-clearances and insulation-classes of insulation-voltage classifications-excess energy- current surges-over current and short circuit current-heating effects of current- Lightning, hazards, lightning arrestor, -national electrical safety code ANSI.

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UNIT III **9 Hours**

ELECTRICAL SAFETY EQUIPMENT

Fuse, circuit breakers and overload relays - safe distance from lines - capacity and protection of conductor joints and connections, overload and short circuit protection - earth fault protection. FRLS insulation - insulation and continuity test - system grounding - equipment grounding - earth leakage circuit breaker (ELCB) - ground fault circuit interrupter - electrical guards - Personal protective equipment.

UNIT IV **9 Hours**

ELECTRICAL SAFETY OPERATION AND MAINTENANCE

Role of environment in selection - protection and interlock - discharge rod and earthing devices - safety in the use of portable tools - preventive maintenance - installation – earthing, specifications, earth resistance, earth pit maintenance - Fire Extinguishers - CO2 and Dry Powder schemes.

UNIT V **9 Hours**

HAZARDOUS AREAS

Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-increase safe equipment-their selection for different zones-temperature classification-grouping of gases-use of barriers and isolators-equipment certifying agencies – electrical safety standards. (IS, API and OSHA standards).

Total: 45 Hours

Reference(s)

1. Fordham Cooper, W., "Electrical Safety Engineering, Butterworth and Company", London, Third Edition, 2013.
2. "Indian Electricity Act and Rules", Government of India.
3. "Power Engineers", Handbook of TNEB, Chennai, 2010.
4. "Accident prevention manual for industrial operations", N.S.C., Chicago, 1982.
5. John Cadick, P.E., Mary Capelli-Schellpfeffer, Dennis K. Neitzel, Al Winfield, "Electrical Safety Handbook", Fourth Edition, Tata McGraw Hill, 2014.
6. https://egyankosh.ac.in/handle/123456789/59158
7. https://tnebes.org/archive/2019/May19/safetymanual%20.pdf
8. https://electricalsafety.lbl.gov/resources/standards/

22OIT04 FUNDAMENTALS OF DATABASE MANAGEMENT SYSTEMS

2 0 2 3

Course Objectives

- To Understand functional components of the Database Management System
- To Understand need for concurrency and transaction property
- To compare and contrast various indexing strategies in different database systems.

Programme Outcomes (POs)

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

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

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

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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

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

PSO1. Design and develop cost effective, secure, reliable IT, network and web-based solutions with professional expertise in the domains including banking and healthcare and communications.

Course Outcomes (COs)

1. Analyze the essential concepts and key issues involved in the design of a relational database.
2. Apply the concepts of normalization and ER model to guarantee an efficient database.
3. Analyze the concurrent execution of transaction process and various recoveries from failures
4. Apply indexing and query optimization techniques for a database design.
5. Analyze the various advanced database systems for efficient data storage and NOSQL concepts.

Articulation Matrix

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

UNIT I **6 Hours**

RELATIONAL DATABASES

Purpose of Database System - Views of data - Data Models - Database System Architecture - Introduction to relational databases - Relational Model - Keys - Relational Algebra - SQL fundamentals - Advanced SQL features.

UNIT II **6 Hours**

DATABASE DESIGN

Entity-Relationship model - E-R Diagrams - Enhanced-ER Model - ER-to-Relational Mapping - Functional Dependencies - First, Second, Third Normal Forms, - Boyce/Codd Normal Form- Multivalued Dependencies and Fourth Normal Form

UNIT III **6 Hours**

TRANSACTION

Transaction Concepts - ACID Properties - Schedules - Serializability - Concurrency Control -Need for Concurrency - Locking Protocols - Two-Phase Locking - Deadlock - Transaction Recovery - Save Points - Isolation Levels.

UNIT IV **6 Hours**

FILE AND QUERY PROCESSING

RAID - File Organization - Organization of Records in Files - Indexing and Hashing -Ordered Indices - Static Hashing - Dynamic Hashing - Query Processing Overview - Algorithms for SELECT and JOIN operation.

UNIT V **6 Hours**

ADVANCED DATABASES

Distributed Databases: Architecture, Data Storage, Transaction Processing - Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL - Graph Database.

EXPERIMENT 1 **5 Hours**

Data Definition Commands, Data Manipulation Commands for inserting, deleting, updating and retrieving Tables with suitable examples.

EXPERIMENT 2 **5 Hours**

Implementation of different types of operators in SQL.

- Arithmetic Operators
- Logical Operators
- Comparison Operator
- Special Operator
- Set Operation

EXPERIMENT 3 **3 Hours**

Database Querying - Simple queries, Nested queries, Sub queries & Joins.

EXPERIMENT 4 **3 Hours**

Implement

- Group By & having clause
- Order by clause
- Indexing

EXPERIMENT 5 **4 Hours**

Create a student database table currently stored as a single table. Normalize these structures to meet the 3NF requirements and draw ER model Diagram

EXPERIMENT 6 **5 Hours**

Implementation of Database Backup & Recovery commands, Rollback, Commit & Save point.

EXPERIMENT 7 **5 Hours**

Develop database for a Book Publishing Company

Total 60 Hours

Reference(s)

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, Database System Concepts, Sixth Edition, Tata McGraw Hill, 2011.
2. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, Sixth Edition, Pearson Education, 2011.
3. C.J.Date, A.Kannan, S.Swamynathan, An Introduction to Database Systems, Eighth Edition, Pearson Education, 2006.
4. "Raghu Ramakrishnan, Database Management Systems, Fourth Edition, McGraw-Hill College Publications, 2015.
5. G.K.Gupta,Database Management Systems, Tata McGraw Hill, 2011.
6. https://www.geeksforgeeks.org/introduction-of-dbms-database-management-system-set-1/
7. https://www.javatpoint.com/dbms-tutorial
8. https://onlinecourses.nptel.ac.in/noc22_cs91

22OCB01 INTERNATIONAL BUSINESS MANAGEMENT 3 0 0 3

Course Objectives

- To enable the students to understand the fundamentals of international business.
- To provide competence to the students on making international business decisions.
- To enable the students to understand the financial and promotional assistance available for exporters

Programme Outcomes (POs)

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

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

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

Course Outcomes (COs)

1. Evaluate the role and importance of digital marketing in today's rapidly changing business environment.
2. Create the techniques to help organizations to utilize social media for digital marketing.
3. Analyse the key elements and campaign effectiveness of E-mail marketing and mobile marketing.
4. Evaluate the effectiveness of a digital marketing campaign using Google Analytics.
5. Apply advanced practical skills to plan, predict and manage digital marketing campaign.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Definition, Drivers of International Business, Domestic Vs. International Business, Trade and Investment Theories: Interventionist Theories, Free Trade Theories, Theories Explaining Trade Patterns: PLC Theory, The Porter Diamond, Factor Mobility Theory.

UNIT II **9 Hours**

GLOBALIZATION

Globalization: Implications, Challenges - Protectionism: Tariff Barriers, Non-Tariff Barriers- Forms of Integration, Role of WTO and IMF in International Business, Economic, Political, Cultural and Technological Environments.

UNIT III **9 Hours**

INTERNATIONAL BUSINESS STRATEGIES

Market Entry Strategies, Multinational Strategy, Production Strategy, Marketing Strategy, Human Resource Strategy.

UNIT IV **9 Hours**

FOREIGN EXCHANGE

Foreign Exchange Market – Functions, Theories of Exchange Rate Determination, Exchange Rate Forecasting, Convertibility of Currency, Risks associated with Foreign Exchange.

UNIT V **9 Hours**

EXPORTS AND ETHICS IN INTERNATIONAL BUSINESS

Exports – Risks, Management of Exports, Regulatory frameworks, Export financing, Countertrade, Ethics – Issues, Dilemma and Theory.

SUGGESTED SELF-STUDY TOPICS:

Liberalization, GATT, Standardization Vs. Differentiation, FEMA, EXIM Policy

Total: 45 Hours

References:

1. John D Daniels, Lee H.Radebaugh, and Sullivan, "International Business", New Delhi: Pearson Education, 2018.
2. Charles W L Hill and Arun Kumar Jain, "International Business", New Delhi: Tata McGraw Hill, 2017.
3. Francis Cherunilam, "International Business", New Delhi: Prentice Hall of India, 2020.
4. Simon Collinson, Rajneesh Narula, Alan M. Rugman, "International Business", New Delhi: Pearson Education, 2020.
5. K.Aswathappa, "International Business", New Delhi: Tata McGraw Hill, 2020.

22OCE02 COST MANAGEMENT OF ENGINEERING PROJECTS **3 0 0 3**

Course Objectives

• To introduce fundamental quantitative techniques, including linear programming, PERT/CPM, and optimization models, for effective cost management.
• To develop analytical skills for solving transportation and assignment problems to enhance resource allocation and cost efficiency.
• To apply learning curve theory in project planning and cost estimation to improve productivity and financial forecasting.
• To enable the use of quantitative decision-making tools for optimizing project scheduling, budgeting, and overall cost control.

Programme Outcomes (POs)

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

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

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

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

PO11. Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

PSO1 Graduates will be able to demonstrate technical skills with inter-disciplinary approach for executing Infrastructural projects ensuring safety, cost-effectiveness and sustainability.

Course Outcomes (COs)

1. Analyze the cost concepts to support decision-making and operational control through a structured cost database.
2. Analyze stakeholder roles to optimize project performance and mitigate cost overruns.
3. Analyze project execution and cost control techniques to support strategic decision-making and optimize project financial performance.
4. Evaluate costing strategies and budgetary control techniques in the service sector.
5. Apply quantitative techniques to optimize cost management and decision-making in projects.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO COSTING CONCEPTS

Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT 2 **9 Hours**

INTRODUCTION TO PROJECT MANAGEMENT

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as a conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance of the Project site: Data required with significance, Project contracts

UNIT 3 **9 Hours**

PROJECT EXECUTION AND COSTING CONCEPTS

Project execution, Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle costing.

UNIT 4 **9 Hours**

COSTING OF SERVICE SECTOR AND BUDGETARY CONTROL

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT 5 **9 Hours**

QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity Based Cost

References:

1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991.
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988.
3. Charles T. Horngren et al Cost Accounting a Managerial Emphasis, Prentice Hall of India, New Delhi, 2011.
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003.
5. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007.