# B.E. (Agriculture Engineering)

# 2018 Regulations, Curriculum & Syllabi

**BANNARI AMMAN INSTITUTE OF TECHNOLOGY**
(An Autonomous Institution Affiliated to Anna University, Chennai Approved by AICTE - Accredited by NAAC with 'A' Grade) **SATHYAMANGALAM – 638 401 Erode District Tamil Nadu**
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# BANNARI AMMAN INSTITUTE OF TECHNOLOGY, SATHYAMANGALAM
# REGULATIONS 2018
## (CHOICE BASED CREDIT SYSTEM)
(Common to all B.E./B.Tech. Degree Programmes)

Regulation 2018 has been prepared in accordance with the guidelines given by the University Grants Commission, All India Council for Technical Education and affiliating University incorporating the features of the Choice Based Credit System (CBCS). The Regulation 2018 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 2018-2019 for Regular admission (Academic year 2019-2020 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 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 / Directorate of Technical Education (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 Directorate of Technical Education from time to time.

(or)

1.2.2 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 Directorate of Technical Education 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**

i. Aeronautical Engineering
ii. Agricultural Engineering
iii. Automobile Engineering
iv. Civil Engineering
v. Computer Science and Engineering
vi. Electronics and Communication Engineering
vii. Electrical and Electronics Engineering
viii. Electronics and Instrumentation Engineering
ix. Mechanical Engineering
x. Mechatronics

**B. Tech. Programmes**

i. Biotechnology
ii. Fashion Technology
iii. Food Technology
iv. Information Technology
v. 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:

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

(ii) **Basic Engineering** courses including Engineering Graphics, Engineering Practices, Basics of Electrical, Electronics, Civil, Mechanical Engineering, Engineering Mechanics and Computer Programming.

(iii) **Humanities and Social Science** courses including Language Courses, Management Courses, Soft Skills and Professional Ethics.

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

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

The medium of instruction is English for all the Courses, 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 | Credits |
|---|---|
| 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 First Semester. In the Second Semester, they will be divided into two streams based on their English language proficiency assessed in the Continuous Assessment during semester I, in which the upper segment will be provided an option to enroll and study Communicative English II / German / Japanese / French / Chinese / Hindi while the lower segment will study Communicative English II.

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

3.5 However, out of nine electives, every student shall be required to opt for, a minimum of one and subject to a maximum of three courses as open elective from the list of electives of the branch / branches other than his / her branch of specialisation, if he/she satisfies the prerequisite for that particular course.

3.6 Students can also opt for **one-credit courses** of 15 to 20 hour 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 VII 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 pre-requisites or the courses that may not require any pre-requisites. 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) 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 VIII, he / she can do so by exercising his / her option in writing to the respective Head of the Department during the beginning of the VIII Semester, following the equivalence norm, that one **regular elective** (in the **VIII Semester**) is equivalent to **three one-credit courses** completed by the student during the previous semesters, IV to VII. 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 III 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 only one online course with the approval of the Departmental Consultative Committee constituted by the Head of the Department, subject to a maximum of three credits. The student needs to obtain certification or credit to become eligible for writing the End Semester Examination to be conducted by the CoE. A student can get exemption for a maximum of 3 credits during the entire programme (in lieu of Core elective or Open elective). The Head of the Department may identify a faculty member as coordinator for the course, who is responsible for the evaluation process. The course shall be evaluated through the End Semester Examination only. The evaluation methodology may be decided by the course faculty coordinator.

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 Mark Sheet. If the student earns three credits in Industrial Training / Internship, the student may drop one Professional Elective. 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, in lieu of Industrial training.

| Duration of Training / Internship | Credits |
|---|---|
| 2 Weeks | 1 |
| 1 Month | 2 |
| 2 Months | 3 |

3.10 **Socially Relevant Projects**

A Student may be permitted to carry out a socially relevant project 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 the 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.

## 4. VALUE ADDED COURSES

A Student can opt for the Value Added Courses offered by the various Department / Centres from Semester II to VII. Head of the Department / Centre shall submit the list of such courses, duly approved / ratified by the Academic Council, to the Controller of Examinations to administer the examination process. A separate Certificate will be issued on successful completion of the course by the Office of the Controller of Examinations.

## 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 90 working days. Head of the Department shall ensure that every faculty member teaches the subject / course as prescribed in the approved curriculum and syllabi.

5.4 Special Theory / Practical Sessions may be conducted for students who require additional inputs over and above the number of periods normally specified (Remedial Classes), 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 Every student shall enroll for the courses of the succeeding semester, in the current semester. However, the student shall confirm the enrollment by registering for the courses within the first five working days after the commencement of the semester concerned.

6.3 After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the End Semester Examinations.

6.3.1 Each student, on admission to the programme, shall register for **all the courses prescribed in the curriculum** in the **first Semester of study (III Semester** for students admitted under **lateral entry stream).**

6.3.2 The enrollment for all the courses of the Semester II will commence 10 working days prior to the last working day of Semester I. The student shall confirm the enrollment by registering for the courses within the first five working days after the commencement of the Semester II. In case, if a student fails to register in course(s), he/ she may be permitted to register the same, as specified in the Clause 6.5, in the subsequent semesters or when it is offered.

6.3.3 The enrollment for the courses of the Semesters III to VIII will commence 10 working days prior to the last working day of the preceding semester. The student shall enroll for the courses with the guidance of the student's Faculty Advisor. If a student wishes, the student may drop or add courses (vide Clause 6.4) within **five** working days after the commencement of the semester concerned and complete the registration process duly authorized by the Faculty Advisor.

**6.4 Flexibility to Add or Drop courses**

6.4.1 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.

6.4.2 From the III to VIII semesters (from IV to VIII Semesters in case of lateral entry students), the student has the option of registering for additional courses or dropping existing courses. The total number of credits that a student can add or drop is limited to 8, subject to a maximum of 2 courses in a given Semester. In such cases, the attendance requirement as stated in Clause 7 is mandatory.

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

**6.5 Reappearance Registration**

6.5.1 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.

6.5.2 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.

6.5.3 However, if a student wishes to improve his/ her continuous assessment, in the second attempt during reappearance, he/she shall satisfy the Clause 6.5.5 and appear for continuous assessment as given for that particular course.

6.5.4 If the theory course, in which the student has failed, is either a professional elective or an open elective, the student may register for the same or any other professional elective or open elective course, respectively in the subsequent semesters. However, the change of elective courses is permitted only once.

6.5.5 In this case (Clause 6.5.4), the student shall attend the classes, satisfy the attendance requirements (vide Clause 7), earn Continuous Assessment marks and appear for the End Semester Examination.

6.5.6 The student who fails in any continuous assessment courses (Laboratory/ Project work / Seminar or any other HSS/EEC courses) shall register for the same in the subsequent semesters or when offered next, and **repeat** the course as per Clause 6.5.5.

6.5.7 If a student is prevented from writing the end semester examination of a course or several courses due to lack of attendance, the student has to register for that / those course(s) again, when offered next, attend the classes and fulfill the requirements as per Clause 6.5.5 & 6.5.6. If the course, in which the student has 'lack of attendance', is a Core Elective or an Open Elective, the student may register for the same or any other Core Elective or Open Elective course(s) respectively in the subsequent semesters and appear in the examination as per Clause 6.5.5.

6.5.8 If a student fails to secure a pass in any theory courses (including elective) he/she is given a maximum of three arrear attempts to complete the courses. If the student still fails to secure a pass, he/she shall register for the same when offered next and repeat the course.

## 7. REQUIREMENTS FOR APPEARING FOR THE END SEMESTER EXAMINATION 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 End Semester 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% attendance course wise taking into account the number of periods required for that course as specified in the curriculum.

7.2 If a student, secures attendance between 70% and 79% in any course(s) 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 Department (along with Condonation form). Such certificates along with the condonation forms shall be forwarded to 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 (regardless the number of courses).

7.3 A student shall normally be permitted to appear for End Semester 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% attendance in a course will not be permitted to write the End-Semester Examination of that course. The student has to register and repeat this course in the subsequent semesters or when it is offered next (vide Clause 6.5).

7.5 If a student has shortage of attendance in all the registered courses, he/she would not be permitted to move to the higher semester and has to repeat the current semester in the subsequent year.

7.6 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.

7.7 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 shall be:

- To inform the students about the various facilities and activities available to enhance the student's curricular and co-curricular activities.
- To guide student enrollment 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 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, Common Course Committee (without the student representatives) shall meet to ensure uniform evaluation through the common question papers during Continuous Assessment and End Semester 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) End Semester examination at the end of the semester for the regular courses or as given in the Clause 16. However, the final examination in the case of certificate / value added courses may be conducted, as and when the course is completed, through the office of the Controller of Examinations.

10.2 Each course, both theory and laboratory including project work, shall be evaluated as per the Scheme of Assessment given in Clause 16.

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

10.4 For the End Semester examinations, both theory and project work, the internal and external examiners (from Academia or Industry) 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 End Semester Examinations. If the student gets <50% of marks in End Semester Examination, then the student will be awarded only RA (Reappearance) grade.

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 6.5.4, 6.5.5, 6.5.6 and 6.5.7. However, from the third attempt onwards, the student shall be declared to have passed the course if he/she secures a minimum of 6 Grade Points (B Grade) in the course prescribed during the End Semester 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 End semester 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** | | |
| Aeronautical Engineering | 172 | 135 |
| Agricultural Engineering | 172 | 134 |
| Automobile Engineering | 170 | 133 |
| Civil Engineering | 171 | 133 |
| Computer Science and Engineering | 171 | 133 |
| Electronics and Communication Engineering | 172 | 131 |
| Electrical and Electronics Engineering | 170 | 131 |
| Electronics and Instrumentation Engineering | 170 | 131 |
| Mechanical Engineering | 170 | 131 |
| Mechatronics | 170 | 132 |
| **B.Tech. Programmes** | | |
| Biotechnology | 172 | 134 |
| Fashion Technology | 172 | 134 |
| Food Technology | 170 | 132 |
| Information Technology | 170 | 132 |
| Textile Technology | 171 | 133 |

11.5 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 Institution, if a student migrates from other Autonomous institutions to Bannari Amman Institution of Technology or rejoins from previous regulation to this regulation.

11.6 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 End Semester Examinations and / or Continuous Assessment, carrying marks as specified in Clause 16. Letter Grades (based on Credit Point and Grade Point) are awarded to the students based on the performance in the evaluation process.

12.2 Credit Point is the product of Grade Point and 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 the 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 minimum number of students for applying relative grading system is 30. If the students' strength is less than 30 then absolute grading system will be applied. The relative grading system shall not be applied for laboratory and EEC courses.

12.4 The performance of a student will be reported using Letter Grades in absolute grading, each carrying certain points as detailed below: In relative grading, grades will be decided by the faculty concerned. A student who earns a minimum of 6 grade points in a course is declared to have successfully passed the course.

| Range of Total Marks (as specified in Clause 16) / Specific Reason | Grade Points | Letter Grade |
|---|---|---|
| 91 to 100 | 10 | O (Outstanding) |
| 81 to 90 | 9 | A + (Excellent) |
| 71 to 80 | 8 | A (Very Good) |
| 61 to 70 | 7 | B + (Good) |
| 50 to 60 | 6 | B (Above average) |
| 0 to 49 | 0 | RA (Reappearance Registration) |
| Incomplete | 0 | I |
| Withdrawal | 0 | W |
| Absent | 0 | AB |
| Shortage of Attendance | 0 | SA |

‘RA’ ---Reappearance registration is required for that particular course

‘I’ --- Continuous evaluation is required for that particular course in the subsequent examinations.

‘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) is 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.

12.6 A student who does not appear for the End Semester 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 the Clause 16 and shall not be counted for the computation of SGPA/CGPA.

For the Co-curricular activities such as NCC / NSS / NSO / YRC, a satisfactory / not satisfactory grading will appear in the mark 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 during the first year of the programme. However, for valid reasons, the Head of the Institution may permit a student to complete this requirement in the second year. A satisfactory grade in the above co-curricular activities is compulsory for the award of degree.

12.8 **Revaluation:** A student, who seeks the re-valuation of the answer script, is directed to apply through proper application to the Controller of Examinations in the prescribed format through the Head of the Department. The Controller of Examinations shall arrange for the revaluation and declare the results. Revaluation is not permitted to 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 **Supplementary Examinations**: If a student fails to secure a pass in theory course(s) of VIII semester examination, he/she is eligible to appear for a one time Supplementary Examination which shall be conducted at the end of VIII semester, for the subjects of VIII semester alone within 30 days from the date of declaration of the results.

12.10 **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 End-Semester examinations and passed all the courses prescribed in all the 8 semesters within a maximum period of 7 years 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.

## 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 to 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, which includes authorized 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 end semester examination due to lack of attendance in any of the courses.

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, which includes one year of authorized break of study (if availed) or prevention from writing the End Semester Examination due to lack of attendance (if applicable).
- Should have secured a CGPA of **not less than 7.00**

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.

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 TEN working days before the commencement of the end semester examination in that course or courses and also recommended by the Head of the Department.

14.3 Notwithstanding the requirement of mandatory TEN 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 end semester examinations, he/she shall register the same in the subsequent semester and write the end semester 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 end semester examinations in the final semester, only if the period of study of the student concerned does not exceed 5 years 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 (for one academic semester or 6 months, whichever is earlier). 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 rejoin 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 rejoining in new Regulations shall apply to the Dean Academics 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 name of the student shall be deleted permanently from the college enrollment. Such students are not entitled to seek readmission under any circumstances.

## 16. SCHEME OF ASSESSMENT

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

| | | |
|---|---|---|
| **I** | **THEORY COURSES** | **Marks** |
| | **Continuous Assessment** | **50** |
| | **Distribution of marks for Continuous Assessment:** | |
| | *Periodical Test I (10)* | |
| | *Periodical Test II (10)* | |
| | *Innovative Practices (30)* | |
| | **End Semester Examination** | **50** |
| | **Total Marks** | **100** |
| **II** | **THEORY COURSES WITH LAB COMPONENT** | **Marks** |
| | **Continuous Assessment** | **50** |
| | **Distribution of marks for Continuous Assessment:** | |
| | *Periodical Test I (10)* | |
| | *Periodical Test II (10)* | |
| | *Innovative Practices (30)* | |
| | *(Laboratory Assessment & Report)* | |
| | **End Semester Examination** (QP pattern as per (I)) | **50** |
| | **Total Marks** | **100** |
| **III** | **LABORATORY COURSES** | **Marks** |
| | **Continuous Assessment** | **100** |
| | **Distribution of marks for Continuous Assessment:** | |
| | *Conduct of Experiment* | |
| | *i. Preparation (20)* | |
| | *ii. Experiment and Analysis of Results (20)* | |
| | *iii. Record (10)* | |
| | *Test – Cycle I (25)* | |
| | *Test – Cycle II (25)* | |
| | **Total Marks** | **100** |
| **IV** | **PROJECT WORK I** | **Marks** |
| | **Continuous Assessment** | **50** |
| | **Distribution of marks for Continuous Assessment:** | |
| | *Review I* | |
| | *Literature Survey (5)* | |
| | *Identification of topic and Justification (5)* | |
| | *Work plan (10)* | |
| | *Review II* | |
| | *Approach & Results (15)* | |
| | *Conclusion (15)* | |

| | | |
|---|---|---|
| | **End Semester Examination** | **50** |
| | *Report# (20)* | |
| | *Presentation (20)* | |
| | *Viva voce (10)* | |
| | **Total Marks** | **100** |
| **V** | **PROJECT WORK II** | **Marks** |
| | **Continuous Assessment** | **50** |
| | **Distribution of marks for Continuous Assessment:** | |
| | *Review I* | |
| | *Progress (10)* | |
| | *Review II* | |
| | *Approach & Results (10)* | |
| | *Review III* | |
| | *Conclusion & Final Presentation (10)* | |
| | *Report (15)* | |
| | *Publication of Paper in Conferences / Journals (5)* | |
| | **End Semester Examination** | |
| | *Presentation (30)* | **50** |
| | *Viva voce (20)* | |
| | **Total Marks** | **100** |
| **VI** | **LANGUAGE ELECTIVE (CONTINUOUS ASSESSMENT ONLY)** | **Marks** |
| | Test 1 | |
| | *Listening (5)* | |
| | *Speaking (10)* | **25** |
| | *Reading (5)* | |
| | *Writing (5)* | |
| | Test 2 | |
| | *Listening (5)* | |
| | *Speaking (10)* | **25** |
| | *Reading (5)* | |
| | *Writing (5)* | |
| | Oral Exam | **50** |
| | **Total Marks** | **100** |
| **VII** | **ONE-CREDIT COURSE (CONTINUOUS ASSESSMENT ONLY)** | **Marks** |
| | Test I | **50** |
| | Quiz/ Assignment | **50** |
| | **Total Marks** | **100** |

# *Reports / Record Note / Integrated Lab Manual to be retained for 1 year for Academic Audit, by respective Department*

| | | |
|---|---|---|
| **VIII** | **INDUSTRIAL TRAINING/ INTERNSHIP (CONTINUOUS ASSESSMENT ONLY)** | **Marks** |
| | Assessment by Industry | **30** |
| | Viva-voce | **20** |
| | *Presentation* | **30** |
| | Case Study / Report | **20** |
| | **Total Marks** | **100** |

| | | |
|---|---|---|
| **IX** | **SOFT SKILLS (CONTINUOUS ASSESSMENT ONLY)** | **Marks** |
| | Test I | **25** |
| | Test II | **25** |
| | Final Examination | **50** |
| | **Total Marks** | **100** |
| | Grades (Excellent / Good / Satisfactory) | |

| | | |
|---|---|---|
| **X** | **VALUE ADDED / CERTIFICATE COURSES (CONTINUOUS ASSESSMENT ONLY)** | **Marks** |
| | Test I | **25** |
| | Test II | **25** |
| | Final Evaluation / Test | **50** |
| | **Total Marks** | **100** |
| | Grades (Excellent / Good / Satisfactory) | |

| | | |
|---|---|---|
| **XI** | **ENGINEERING GRAPHICS** | **Marks** |
| | **Continuous Assessment** | **100** |
| | **Distribution of marks for Continuous Assessment:** | |
| | *Exercise (Minimum 10 Exercises/Modelling)* | **60** |
| | *Model Examination* | **40** |
| | **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 not conducted for the courses under the categories III, IV, V, VI, VII, VIII, IX, X and XI listed above.*

**17. 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.

**18. 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 during the first year. The attendance of the personality and character development courses / events shall be maintained on the regular basis by the concerned First Year Co-ordinators and made available in the Office of the Controller of Examinations before the commencement of Semester examinations of Semester I or Semester II.

**19. 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 End Semester / Continuous Assessments, he / she shall be liable for punitive action as prescribed by the Institution / University from time to time.

**20. REVISION OF REGULATIONS, CURRICULUM AND SYLLABI**

The Institution reserves the right to revise/amend/change the Regulations, Curriculum, Syllabi, Scheme of Examinations and date of implementation and to introduce Additional Electives, Open Electives, One Credit Courses and Value Added Courses through the Academic Council.

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)**

**Graduates of the B.E. Agricultural Engineering will be able to**

1. Excel in academic/professional carrier by acquiring knowledge and skill in engineering principles involved in Agriculture
2. Analyze and improve agricultural operations through farm mechanization, land and water management, post-harvest handling and energy conservation to increase yield and land use efficiency
3. Develop professionalism in management, entrepreneurship, continuous learning and follow ethics to serve the society

## PROGRAMME OUTCOMES (POs)

**The students will possess**

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

b. **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.

c. **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.

d. **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.

e. **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.

f. **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.

g. **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.

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

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

j. **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.

k. **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.

l. **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.

## Programme Specific Objective(s)

| **S. No** | **Programme Specific Objective(s)** |
|---|---|
| PSO I | Model, design and analyze agricultural machineries and implement to increase productivity, improve land use and conserve resources like seed, water, fertilizer, pesticide and fuel |
| PSO II | To improvise better ways to minimize the crop loss from field damage during post-harvest management and energy utilization, sorting, processing and packaging |

## MAPPING WITH PEOS AND POS

| POs | a | b | c | d | e | f | g | h | i | j | k | l |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PEO I** | X | | X | X | X | | | | X | | | |
| **PEO II** | | X | X | X | X | | | X | | | | X |
| **PEO III** | | | | | | X | X | X | X | X | | |

## Programme Specific Objective(s)

| S. No | Programme Specific Objective(s) |
|---|---|
| PSO I | Model, design and analyze agricultural machineries and implement to increase productivity, improve land use and conserve resources like seed, water, fertilizer, pesticide and fuel |
| PSO II | To improvise better ways to minimize the crop loss from field damage during post-harvest management and energy utilization, sorting, processing and packaging |

# Degree: B.E (AGRI. ENGG)

**DEPARTMENT OF AGRICULTURE ENGINEERING**

**Minimum Credits to be Earned : 172**

**I SEMESTER**

| Code No. | Course | L | T | P | C | Hours /Week | Maximum Marks | | | Category |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | CA | ES | Total | |
| 18AG101 | ENGINEERING MATHEMATICS I | 3 | 1 | 0 | 4 | 4 | 50 | 50 | 100 | BS |
| 18AG102 | ENGINEERING PHYSICS I | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | BS |
| 18AG103 | ENGINEERING CHEMISTRY I | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | BS |
| 18AG104 | BASIC ELECTRICAL ENGINEERING | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | ES |
| 18HS101 | COMMUNICATIVE ENGLISH I | 1 | 0 | 2 | 2 | 3 | 100 | 0 | 100 | HSS |
| 18AG105 | ENGINEERING DRAWING | 1 | 0 | 4 | 3 | 5 | 100 | 0 | 100 | ES |
| **Total** | | **11** | **1** | **12** | **18** | **24** | **400** | **200** | **600** | - |

**II SEMESTER**

| Code No. | Course | L | T | P | C | Hours /Week | Maximum Marks | | | Category |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | CA | ES | Total | |
| 18AG201 | ENGINEERING MATHEMATICS II | 3 | 1 | 0 | 4 | 4 | 50 | 50 | 100 | BS |
| 18AG202 | ENGINEERING PHYSICS II | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | BS |
| 18AG203 | ENGINEERING CHEMISTRY II | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | BS |
| 18AG204 | COMPUTER PROGRAMMING I | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | ES |
| | LANGUAGE ELECTIVE | 1 | 0 | 2 | 2 | 3 | 100 | 0 | 100 | HSS |
| 18AG205 | PRINCIPLES OF CROP PRODUCTION TECHNOLOGY | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | PC |
| 18AG206 | ENGINEERING PRACTICES LABORATORY | 0 | 0 | 4 | 2 | 4 | 100 | 0 | 100 | ES |
| **Total** | | **12** | **1** | **14** | **20** | **27** | **450** | **250** | **700** | - |

**III SEMESTER**

| Code No. | Course | L | T | P | C | Hours /Week | Maximum Marks | | | Category |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | CA | ES | Total | |
| 18GE301 | ENGINEERING MATHEMATICS III | 3 | 1 | 0 | 4 | 4 | 50 | 50 | 100 | BS |
| 18AG302 | ENGINEERING THERMODYNAMICS | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | ES |
| 18AG303 | FLUID MECHANICS | 3 | 0 | 2 | 4 | 5 | 50 | 50 | 100 | ES |
| 18AG304 | STRENGTH OF MATERIALS | 3 | 1 | 0 | 4 | 4 | 50 | 50 | 100 | ES |
| 18AG305 | SOIL MECHANICS | 3 | 0 | 2 | 4 | 5 | 50 | 50 | 100 | PC |
| 18AG306 | SURVEYING AND LEVELING | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PC |
| 18AG307 | COMPUTER PROGRAMMING II | 1 | 0 | 4 | 3 | 5 | 50 | 50 | 100 | ES |
| 18AG308 | SURVEYING AND LEVELLING LABORATORY | 0 | 0 | 2 | 1 | 2 | 100 | 0 | 100 | PC |
| 18GE301 | SOFT SKILLS - VERBAL ABILITY | 0 | 0 | 2 | - | 2 | 100 | 0 | 100 | EEC |
| **Total** | | **19** | **2** | **12** | **26** | **33** | **650** | **350** | **1000** | **-** |

**IV SEMESTER**

| Code No. | Course | L | T | P | C | Hours /Week | Maximum Marks | | | Category |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | CA | ES | Total | |
| 18AG401 | NUMERICAL METHODS AND STATISTICS | 3 | 1 | 0 | 4 | 4 | 50 | 50 | 100 | ES |
| 18AG402 | HEAT AND MASS TRANSFER | 3 | 0 | 2 | 4 | 5 | 50 | 50 | 100 | PC |
| 18AG403 | HYDROLOGY | 3 | 1 | 0 | 4 | 4 | 50 | 50 | 100 | PC |
| 18AG404 | PRODUCTION TECHNOLOGY OF HORTICULTURAL CROPS | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | PC |
| 18AG405 | TRACTOR AND FARM ENGINES | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PC |
| 18AG406 | FARM STRUCTURES AND GREEN HOUSE TECHNOLOGY | 3 | 1 | 0 | 4 | 4 | 50 | 50 | 100 | PC |
| 18AG407 | TRACTOR AND FARM ENGINES LABORATORY | 0 | 0 | 4 | 2 | 4 | 100 | 0 | 100 | PC |
| 18AG408 | COMPUTER AIDED DESIGN LABORATORY | 0 | 0 | 4 | 2 | 4 | 100 | 0 | 100 | PC |
| 18HS001 | ENVIRONMENTAL SCIENCE | 2 | 0 | 0 | 0 | 0 | 100 | 0 | 100 | HSS |
| 18GE401 | SOFT SKILLS – BUSINESS ENGLISH | 0 | 0 | 2 | - | 2 | 100 | 0 | 100 | EEC |
| **Total** | | **19** | **3** | **16** | **26** | **34** | **700** | **300** | **1000** | |

**V SEMESTER**

| Code No. | Course | L | T | P | C | Hours/ Week | Maximum Marks | | | Category |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | CA | ES | Total | |
| 18AG501 | FARM IMPLEMENTS AND EQUIPMENT | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PC |
| 18AG502 | SOIL AND WATER CONSERVATION ENGINEERING | 3 | 0 | 2 | 4 | 5 | 50 | 50 | 100 | PC |
| 18AG503 | UNIT OPERATIONS IN AGRICULTURAL PROCESS ENGINEERING | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PC |
| 18AG504 | IOT IN AGRICULTURAL SYSTEMS | 3 | 0 | 2 | 4 | 5 | 50 | 50 | 100 | PC |
| | PROFESSIONAL ELECTIVE I | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| | PROFESSIONAL ELECTIVE II | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG507 | FARM IMPLEMENTS AND EQUIPMENT LABORATORY | 0 | 0 | 2 | 1 | 2 | 100 | 0 | 100 | PC |
| 18AG508 | UNIT OPERATIONS IN AGRICULTURAL ENGINEERING PROCESS LABORATORY | 0 | 0 | 2 | 1 | 2 | 100 | 0 | 100 | PC |
| 18GE501 | SOFT SKILLS - APTITUDE I | 0 | 0 | 2 | - | 2 | 100 | 0 | 100 | EEC |
| **Total** | | **18** | **0** | **10** | **22** | **28** | **600** | **300** | **900** | **-** |

**VI SEMESTER**

| Code No. | Course | L | T | P | C | Hours /Week | Maximum Marks | | | Category |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | CA | ES | Total | |
| 18HS002 | PROFESSIONAL ETHICS IN ENGINEERING | 2 | 0 | 0 | 2 | 2 | 50 | 50 | 100 | HSS |
| 18AG602 | IRRIGATION AND DRAINAGE ENGINEERING | 3 | 0 | 0 | 3 | 5 | 50 | 50 | 100 | PC |
| 18AG603 | POST HARVEST TECHNOLOGY OF AGRICULTURAL CROPS | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PC |
| 18AG604 | TRANSFER OF AGRICULTURE TECHNOLOGY | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PC |
| | PROFESSIONAL ELECTIVE III | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| | PROFESSIONAL ELECTIVE IV | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG607 | IRRIGATION ENGINEERING LABORATORY | 0 | 0 | 2 | 1 | 2 | 100 | 0 | 100 | PC |
| 18AG608 | POST HARVEST TECHNOLOGY OF AGRICULTURAL CROPS LABORATORY | 0 | 0 | 2 | 1 | 2 | 100 | 0 | 100 | PC |
| 18GE601 | SOFT SKILLS - APTITUDE II | 0 | 0 | 2 | - | 2 | 100 | 0 | 100 | EEC |
| **Total** | | **17** | **0** | **6** | **19** | **25** | **650** | **350** | **1000** | **-** |

**VII SEMESTER**

| Code No. | Course | L | T | P | C | Hours/ Week | Maximum Marks CA | ES | Total | Category |
|---|---|---|---|---|---|---|---|---|---|---|
| 18HS003 | PRINCIPLES OF MANAGEMENT | 2 | 0 | 0 | 2 | 2 | 50 | 50 | 100 | HSS |
| 18AG702 | RENEWABLE ENERGY RESOURCES | 3 | 0 | 2 | 4 | 5 | 50 | 50 | 100 | PC |
| 18AG703 | FOOD AND DAIRY ENGINEERING | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PC |
| 18AG704 | RS AND GIS FOR NATURAL RESOURCE MANAGEMENT | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PC |
| | PROFESSIONAL ELECTIVE V | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| | PROFESSIONAL ELECTIVE VI | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG707 | RS AND GIS LABORATORY | 0 | 0 | 2 | 1 | 2 | 100 | 0 | 100 | PC |
| 18AG708 | FOOD AND DAIRY ENGINEERING LABORATORY | 0 | 0 | 2 | 1 | 2 | 100 | 0 | 100 | PC |
| | PROJECT WORK I | 0 | 0 | 6 | 3 | 6 | 50 | 50 | 100 | EEC |
| **Total** | | **17** | **0** | **12** | **23** | **29** | **600** | **400** | **1000** | |

**VIII SEMESTER**

| Code No. | Course | L | T | P | C | Hours/ Week | Maximum Marks CA | ES | Total | Category |
|---|---|---|---|---|---|---|---|---|---|---|
| | PROFESSIONAL ELECTIVE VII | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| | PROFESSIONAL ELECTIVE VIII | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| | PROFESSIONAL ELECTIVE IX | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| | PROJECT WORK II | 0 | 0 | 18 | 9 | 18 | 50 | 50 | 100 | EEC |
| **Total** | | **9** | **0** | **18** | **18** | **27** | **200** | **200** | **400** | |

| ELECTIVES | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **LANGUAGE ELECTIVES** | | | | | | | | | | |
| **Code No.** | **Course** | **L** | **T** | **P** | **C** | **Hours/Week** | **Maximum Marks** | | | **Category** |
| | | | | | | | **CA** | **ES** | **Total** | |
| 18HSH01 | HINDI | 1 | 0 | 2 | 2 | 3 | 100 | 0 | 100 | HSS |
| 18HSG01 | GERMAN | 1 | 0 | 2 | 2 | 3 | 100 | 0 | 100 | HSS |
| 18HSJ01 | JAPANESE | 1 | 0 | 2 | 2 | 3 | 100 | 0 | 100 | HSS |
| 18HSC01 | CHINESE | 1 | 0 | 2 | 2 | 3 | 100 | 0 | 100 | HSS |
| 18HSF01 | FRENCH | 1 | 0 | 2 | 2 | 3 | 100 | 0 | 100 | HSS |
| **PHYSICS ELECTIVES** | | | | | | | | | | |
| 18GE0P1 | NANOMATERIALS SCIENCE | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | BS |
| 18GE0P2 | SEMICONDUCTOR PHYSICS AND DEVICES | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | BS |
| 18GE0P3 | APPLIED LASER SCIENCE | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | BS |
| **CHEMISTRY ELECTIVES** | | | | | | | | | | |
| 18GE0C1 | CORROSION SCIENCE AND ENGINEERING | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | BS |
| 18GE0C2 | ENERGY STORING DEVICES | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | BS |
| 18GE0C3 | POLYMER SCIENCE | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | BS |
| **DISCIPLINE ELECTIVES** | | | | | | | | | | |
| 18AG001 | BUILDING MATERIALS, ESTIMATION AND COSTING | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG002 | REFRIGERATION AND COLD STORAGE | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG003 | STORAGE AND PACKAGING TECHNOLOGY | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG004 | TECHNOLOGY OF SEED PROCESSING | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG005 | FAT AND OIL PROCESSING | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG006 | HORTICULTURAL CROP PROCESS ENGINEERING | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG007 | SUGAR TECHNOLOGY | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG008 | BIO AND THERMO CHEMICAL CONVERSION OF BIOMASS | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG009 | SOLAR AND WIND ENGINEERING | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG010 | ENERGY CONSERVATION IN AGRO BASED INDUSTRY | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG011 | CO-GENERATION AND WASTE HEAT RECOVERY SYSTEMS | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |

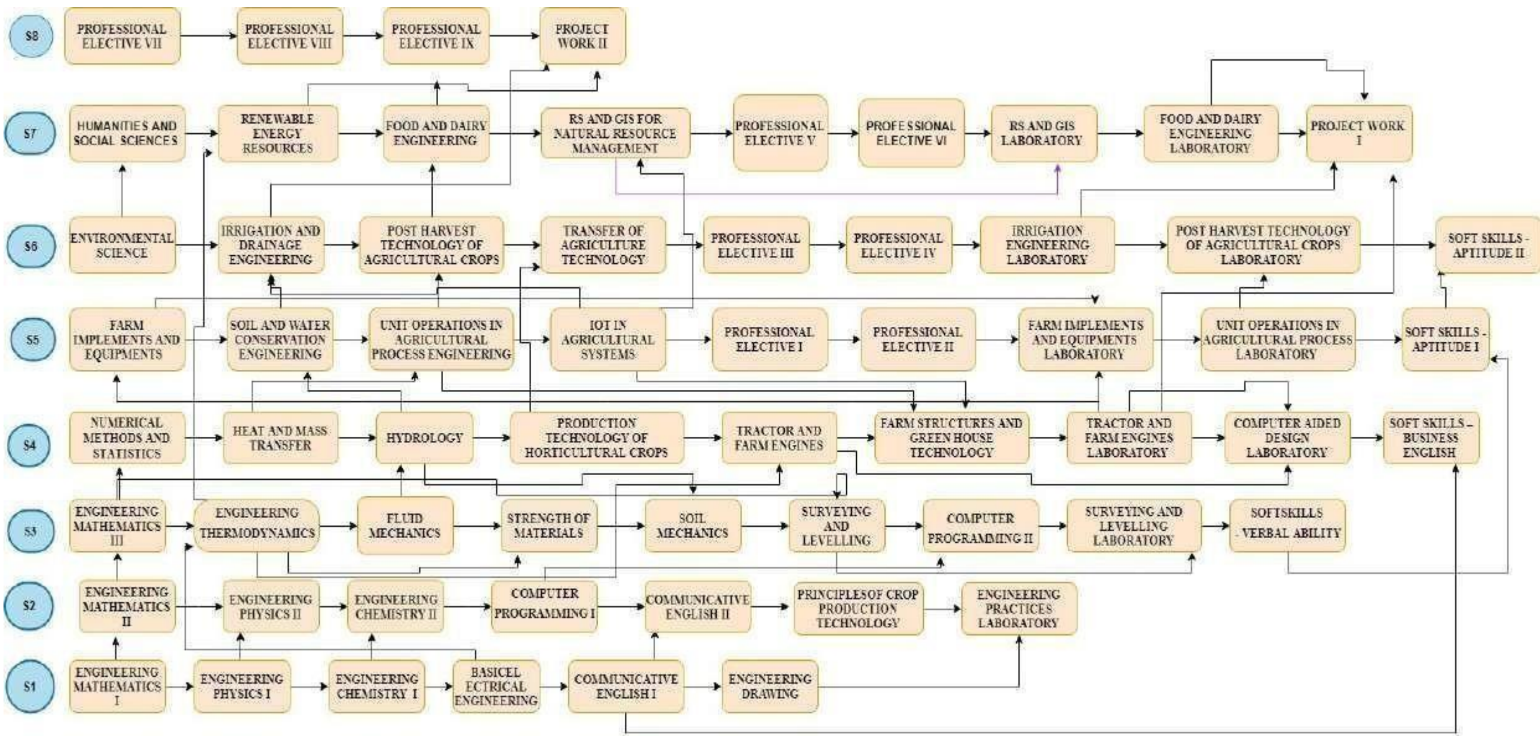
| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 18AG012 | PROTECTED CULTIVATION | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG013 | WATERSHED PLANNING AND MANAGEMENT | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG014 | RESERVOIR AND FARM POND DESIGN | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG015 | DESIGN OF MICRO IRRIGATION SYSTEMS | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG016 | MECHANICS OF TILLAGE AND TRACTION | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG017 | PRODUCTION TECHNOLOGY OF AGRICULTURAL MACHINERY | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG018 | HUMAN ENGINEERING AND SAFETY | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG019 | DISASTER MANAGEMENT | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG020 | CDM AND CARBON TRADING TECHNOLOGY | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG021 | CLIMATE CHANGE AND ADOPTION | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG022 | AGRICULTURAL MARKETING | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG023 | PLANT PROTECTION | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG024 | EMERGING TECHNOLOGIES IN FOOD PROCESS ENGINEERING | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG025 | MUSHROOM PRODUCTION TECHNOLOGY | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG026 | AGRI BUSINESS MANAGEMENT AND ENTREPRENEURSHIP | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG027 | AGRICULTURAL FINANCE, BANKING AND CO-OPERATION | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG028 | DESIGN OF AGRICULTURE MACHINERY | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| **OPEN ELECTIVES** | | | | | | | | | | |
| 18AG0YA | ENTREPRENEURSHIP DEVELOPMENT AND FOOD QUALITY MANAGEMENT IN FOOD INDUSTRY | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG0YB | HUMAN ENGINEERING AND SAFETY IN AGRICULTURE | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG0YC | ENERGY MANAGEMENT IN AGRICULTURE | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| 18AG0YD | FARM MECHANIZATION | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PE |
| **ONE CREDIT COURSES** | | | | | | | | | | |
| 18AG0XA | OPERATION AND MAINTENANCE OF MICRO IRRIGATION SYSTEM | 0 | 0 | 0 | 1 | | 100 | 0 | 100 | EEC |
| 18AG0XB | TRAINING ON THE MANUFACTURE OF AGRICULTURAL IMPLEMENTS | 0 | 0 | 0 | 1 | | 100 | 0 | 100 | EEC |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 18AG0XC | TRAINING ON MAINTENANCE ASPECTS OF TRACTOR /COMBINE HARVESTER/POWER TILLER | 0 | 0 | 0 | 1 | | 100 | 0 | 100 | EEC |
| 18AG0XD | CUSTOM HIRING CENTRE | 0 | 0 | 0 | 1 | | 100 | 0 | 100 | EEC |
| 18AG0XE | AGRO PROCESSING CENTRE | 0 | 0 | 0 | 1 | | 100 | 0 | 100 | EEC |
| 18AG0XF | LANDSCAPE DESIGNING AND ARCHITECTURE | 0 | 0 | 0 | 1 | | 100 | 0 | 100 | EEC |
| 18AG0XG | MILLET PROCESSING AND COOKIES | 0 | 0 | 0 | 1 | | 100 | 0 | 100 | EEC |
| 18AG0XH | COCONUT PROCESSING AND VALUE ADDITION | 0 | 0 | 0 | 1 | | 100 | 0 | 100 | EEC |

## SUMMARY OF CREDIT DISTRIBUTION

| S.NO | CATEGORY | CREDITS PER SEMESTER | | | | | | | | TOTAL CREDIT | CREDITS in % | Range of Total Credits | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | V I | VII | VIII | | | Min | Max |
| 1 | BS | 10 | 10 | 4 | 4 | - | - | - | - | 28 | 16 | 15% | 20% |
| 2 | ES | 6 | 5 | 14 | - | - | - | - | - | 25 | 15 | 15% | 20% |
| 3 | HSS | 2 | 2 | - | - | - | 2 | 2 | - | 8 | 5 | 5% | 10% |
| 4 | PC | - | 3 | 8 | 22 | 16 | 11 | 12 | - | 72 | 41 | 30% | 40% |
| 5 | PE | - | - | - | - | 6 | 6 | 6 | 9 | 27 | 16 | 15% | 20% |
| 6 | EEC | | | | - - - | - | - | 3 | 9 | 12 | 7 | 7% | 10% |
| **Total** | | **18** | **20** | **26** | **26** | **22** | **19** | **23** | **18** | **172** | **100** | **-** | **-** |

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


S8
PROFESSIONAL ELECTIVE VII
PROFESSIONAL ELECTIVE VIII
PROFESSIONAL ELECTIVE IX
PROJECT WORK II
S7
HUMANITIES AND SOCIAL SCIENCES
RENEWABLE ENERGY RESOURCES
FOOD AND DAIRY ENGINEERING
RS AND GIS FOR NATURAL RESOURCE MANAGEMENT
PROFESSIONAL ELECTIVE V
PROFESSIONAL ELECTIVE VI
RS AND GIS LABORATORY
FOOD AND DAIRY ENGINEERING LABORATORY
PROJECT WORK I
S6
ENVIRONMENTAL SCIENCE
IRRIGATION AND DRAINAGE ENGINEERING
POST HARVEST TECHNOLOGY OF AGRICULTURAL CROPS
TRANSFER OF AGRICULTURE TECHNOLOGY
PROFESSIONAL ELECTIVE III
PROFESSIONAL ELECTIVE IV
IRRIGATION ENGINEERING LABORATORY
POST HARVEST TECHNOLOGY OF AGRICULTURAL CROPS LABORATORY
SOFT SKILLS - APTITUDE II
S5
FARM IMPLEMENTS AND EQUIPMENTS
SOIL AND WATER CONSERVATION ENGINEERING
UNIT OPERATIONS IN AGRICULTURAL PROCESS ENGINEERING
IOT IN AGRICULTURAL SYSTEMS
PROFESSIONAL ELECTIVE I
PROFESSIONAL ELECTIVE II
FARM IMPLEMENTS AND EQUIPMENTS LABORATORY
UNIT OPERATIONS IN AGRICULTURAL PROCESS LABORATORY
SOFT SKILLS - APTITUDE I
S4
NUMERICAL METHODS AND STATISTICS
HEAT AND MASS TRANSFER
HYDROLOGY
PRODUCTION TECHNOLOGY OF HORTICULTURAL CROPS
TRACTOR AND FARM ENGINES
FARM STRUCTURES AND GREEN HOUSE TECHNOLOGY
TRACTOR AND FARM ENGINES LABORATORY
COMPUTER AIDED DESIGN LABORATORY
SOFT SKILLS – BUSINESS ENGLISH
S3
ENGINEERING MATHEMATICS III
ENGINEERING THERMODYNAMICS
FLUID MECHANICS
STRENGTH OF MATERIALS
SOIL MECHANICS
SURVEYING AND LEVELLING
COMPUTER PROGRAMMING II
SURVEYING AND LEVELLING LABORATORY
SOFTSKILLS - VERBAL ABILITY
S2
ENGINEERING MATHEMATICS II
ENGINEERING PHYSICS II
ENGINEERING CHEMISTRY II
COMPUTER PROGRAMMING I
COMMUNICATIVE ENGLISH II
PRINCIPLES OF CROP PRODUCTION TECHNOLOGY
ENGINEERING PRACTICES LABORATORY
S1
ENGINEERING MATHEMATICS I
ENGINEERING PHYSICS I
ENGINEERING CHEMISTRY I
BASICEL ECTRICAL ENGINEERING
COMMUNICATIVE ENGLISH I
ENGINEERING DRAWING

## 18AG101 ENGINEERING MATHEMATICS I 3 1 0 4

**Course Objectives**

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

**Programme Outcomes (POs)**

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

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

**Articulation Matrix**

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

**UNIT I** **9 Hours**

**COMPLEX NUMBERS, VECTORS AND MATRICES**

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

**UNIT II** **9 Hours**

**CALCULUS**

Limits and Continuity of Functions: Limits of functions, types of limits, evaluation of limits, continuity of functions, properties of continuous functions. Derivatives: Derivatives, differentiability, rules and

Properties, differentiation of transcendental functions, higher order derivatives, implicit differentiation, and differentiation of hyperbolic functions. Integration: Anti-derivatives, Riemann Sum, indefinite and definite integration, Mean Value Theorem for definite integral, Fundamental Theorem of Calculus

**UNIT III** **9 Hours**

**INTEGRATION METHODS**

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

**UNIT IV** **9 Hours**

**APPLICATIONS OF DERIVATIVES AND INTEGRATIONS**

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

**UNIT V** **9 Hours**

**MULTIPLE INTEGRALS**

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

**Total: 60 Hours**

**Reference(s)**

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

## 18AG102 ENGINEERING PHYSICS I 2 0 2 3

**Course Objectives**

- Illustrate the Newtons laws of motion and wave motion with applications
- Explain the applications of laser and fiber optics
- Implement the principles of quantum physics in the respective engineering fields

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
i. 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. Assess the Newton's three laws of motion and apply the same to solve the real world problems involving elevator, at wood machine and acceleration of objects
2. Implement the different types of laser, optical fiber and its application in optic fiber communication system
3. Execute the properties, generation and applications of ultrasonic waves in engineering.
4. Assess seven crystal systems and compute the packing of atoms in crystal structures
5. Apply the basics of quantum mechanics, to setup one dimensional Schrodinger's wave equation and its application to the matter wave system

**Articulation Matrix**

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

**UNIT I** **6 Hours**

**MECHANICS**

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

**UNIT II** **6 Hours**

**OSCILLATIONS AND WAVES**

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

**UNIT III** **6 Hours**

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

**UNIT IV** **6 Hours**

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

**UNIT V** **6 Hours**

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

**1** **5 Hours**

## EXPERIMENT 1
Determination of resultant of system of concurrent coplanar forces-Parallelogram law of forces

**2** **5 Hours**

## EXPERIMENT 2
Determination of moment of inertia-Torsional pendulum

**3** **5 Hours**

## EXPERIMENT 3
Determination of wavelength of mercury spectral lines-spectrometer

**4** **4 Hours**

## EXPERIMENT 4
Determination of refractive index of solid and liquid-travelling microscope

**5** **3 Hours**

## EXPERIMENT 5
Determination of wavelength of laser-diffraction grating

**6** **4 Hours**

**EXPERIMENT 6**

Determination of frequency of a tuning fork-Melde apparatus

**7** **4 Hours**

**EXPERIMENT 7**

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

**Total: 60 Hours**

**Reference(s)**

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

## 18AG103 ENGINEERING CHEMISTRY I 2 0 2 3

**Course Objectives**

- Identify the metals used in agricultural machinery and its mechanical properties
- Compare the different types of corrosion and its protection methods
- Identify composition and applications of ferrous and non-ferrousalloys
- Recall the different heat treatment methods used in formation of alloys
- Explain the basic concepts of polymers, its preparation and processing methods

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**Course Outcomes (COs)**

1. Find the properties of metal used for agricultural structures and machinery
2. Analyze the type of corrosion, factors influencing rate of corrosion on metals and identify suitable corrosion protection method
3. Assess the composition and properties of ferrous and non-ferrous alloys in agricultural applications
4. Find out the heat treatment method for production of alloys in agricultural machinery application
5. Differentiate polymers based on its source, properties and applications

**Articulation Matrix**

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

**UNIT I** **6 Hours**

**MECHANICAL PROPERTIES OF METALS AND ITS APPLICATIONS IN FARM EQUIPMENTS**

Mechanical properties of metals - deformation - elastic and plastic deformation - stress and strain - tensile strength - hardness - ductility - toughness - brittleness - creep -malleability -resilience - stiffness - yield strength. Metals (iron, copper, zinc, lead, tin, aluminum) used in agricultural machinery manufacturing (axles, wheel spindles, shafts, gears) and structural applications (frames, roofing, doors)

**UNIT II** **6 Hours**

**CORROSION IN AGRICULTURE**

Types - chemical corrosion and electrochemical corrosion. Electrochemical corrosion: Galvanic corrosion and differential aeration corrosion. Factors influencing corrosion rate - corrosion control methods: Sacrificial anode and impressed current cathodic protection. Organic coating - paint, constituents and functions.

**UNIT III** **6 Hours**

**FERROUS AND NON-FERROUS ALLOYS**

Alloys: Purpose of alloying - function and effects of alloying elements - properties of alloys - classification of alloys. Composition - types - properties and applications of ferrous alloys (steel, cast iron, nichrome and stainless steel)- Non-ferrous alloys (brass and bronze).

**UNIT IV** **6 Hours**

**HEAT TREATMENT**

Heat treatment of steel: Annealing - stress relief -recrystallization and spheroidizing - normalizing - hardening - tempering of steel - carburizing - nitriding - cyaniding - carbonitriding - flame and induction hardening.

**UNIT V** **6 Hours**

**POLYMER CHEMISTRY**

Monomers - polymers - polymerization - functionality - degree of polymerization - classification of polymers based on source and applications. Types of polymerization - Preparation, properties and applications of thermosetting (epoxy resin and bakelite) and thermoplastics (poly(vinyl chloride) and poly(tetrafluoroethylene)). Compounding of plastics - injection and extrusion moulding

**FURTHER READING**

Application of polymers in agriculture.Prevention of corrosion in agriculture machinery. Electrochemical instrumentation system for agriculture and the plant sciences.

**1** **4 Hours**

**EXPERIMENT 1**

Laboratory Rules and Safety

**2** **3 Hours**

**EXPERIMENT 2**

Estimation of copper deposited on iron rod using complexometric titration.

**3** **4 Hours**

**EXPERIMENT 3**

Determination of electrical conductivity of different types of soil water

**4** **4 Hours**

**EXPERIMENT 4**

Measurement of rate of corrosion on mild steel in aerated / neutral / acidic / alkaline medium by weight loss method

**5** **3 Hours**

**EXPERIMENT 5**

Determination of Fe (II) in the given sample by spectrophotometrically

**6** **4 Hours**

**EXPERIMENT 6**

Determination of the strength of Fe(II) in the given sample by potentiometric method.

**7** **4 Hours**

**EXPERIMENT 7**

Estimation of the amount of mineral acid in soil by pH meter

**8** **4 Hours**

**EXPERIMENT 8**

Determination of molecular weight of a polymer by Ostwald viscometer

**Total: 60 Hours**

**Reference(s)**

1. Bhaduri, Amit , Mechanical properties and working of metals and alloys, Springer Singapore, 2018
2. Jain and Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2013.
3. A. Pahari and B. Chauhan, Engineering Chemistry, Infinity Science press LLC, New Delhi, 2010.
4. M. Munjal and S.M. Gupta, Wiley Engineering Chemistry, Second edition, Wiley India Pvt. Ltd, New Delhi, 2013.
5. R. Gowariker, N. V. Viswanathan, J. Sreedhar, Polymer Science, 1st Edition, New age International Publishers, New Delhi, 2014.

## 18AG104 BASIC ELECTRICAL ENGINEERING 2 0 2 3

**Course Objectives**

- To understand the basic concepts of electric circuits and magnetic circuits.
- To illustrate the construction and operation of various electrical machines and semiconductor devices.
- To learn the fundamentals of communication systems.

**Programme Outcomes (POs)**

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

d. 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.
g. 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.
l. 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 measurement of electrical parameters and various meters used in the field of agriculture
2. Select a wiring layout for electric fence and farm house
3. Find the characteristics of induction motor in agriculture machineries
4. Analyze the need for safety in handling agriculture machineries and accessories used for protection
5. Assess the construction and operating characteristics of sensors used in agriculture applications

**Articulation Matrix**

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

**UNIT I** **6 Hours**

**MEASUREMENTS AND INSTRUMENTATION**

Measurement of voltage, current, power, energy and power factor; Data loggers-grain, soil, water analyzers, soil compaction testers, soil tensiometers, lysimeter, lux meters

**UNIT II** **6 Hours**

**FARM WIRING**

Selection of wiring materials switches, wires, fuse and starters-single phase and three phase wiring-wiring layout for farm house and battery operated electric fence, types of battery, testing of battery: water level, voltage level, cable connections and temperature- charging methods

**UNIT III** **6 Hours**

**ELECTRICAL MACHINES AND DRIVES**

Construction and operating characteristics: Single and Three phase induction motor-selection of motors for agriculture drive systems: seeding, mowing and stripping applications.

**UNIT IV** **6 Hours**

**SAFETY AND ACCESSORIES**

Safety and maintenance of processing machineries: harvester -thresher -size reduction machines and farm house-pump house-MCB, ELCB, types of switches, safety equipment and earthing

**UNIT V** **6 Hours**

**SENSORS**

Operation and wiring layout: Location sensors-optical sensors- electrochemical sensors-dielectric sensors-soil moisture and temperature sensor -airflow sensors

**FOR FURTHER READING**

Voltage Regulator, Stepper motor, Energy meter, SMPS, Satellite and Optical communication.

**1** **6 Hours**

**EXPERIMENT 1**

Charging and discharging of Lead- acid battery, Lithium-Ion battery, Nickel-Cadmium battery and Nickel- Zinc battery.

**2** **6 Hours**

**EXPERIMENT 2**

House wiring: Loop-in system consists of single switch, two way switch, sockets with switches for light load and heavy load with ups wiring

**3** **6 Hours**

**EXPERIMENT 3**

Wiring of water pump motor with main switch, starter, MCB, ELCB and earthing

**4** **6 Hours**

**EXPERIMENT 4**

Earthing methods in battery operated electric fence and farm house

**5** **6 Hours**

**EXPERIMENT 5**

Solar PV generation and storage system.

**Total: 60 Hours**

**Reference(s)**

1. R. Muthusubramanian, S. Salivahanan, Basic Electrical and Electronics Engineering, Tata McGraw-Hill Education, Reprint 2012.
2. T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011.
3. Smarjith Ghosh, Fundamentals of Electrical and Electronics Engineering, Prentice Hall (India) Pvt. Ltd., 2010.

## 18HS101 COMMUNICATIVE ENGLISH I 1 0 2 2

**Course Objectives**

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

**Programme Outcomes (POs)**

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

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

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**UNIT I** **9 Hours**

**GRAMMAR**

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

**UNIT II** **9 Hours**

**READING**

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

**UNIT III** **9 Hours**

**WRITING**

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

**UNIT IV** **9 Hours**

**LISTENING**

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

**UNIT V** **9 Hours**

**SPEAKING**

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

**Total: 45 Hours**

**Reference(s)**

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

## 18AG105 ENGINEERING DRAWING 1 0 4 3

**Course Objectives**

- To provide knowledge on fundamentals of engineering drawings and conic sections.
- To impart skill on developing orthographic projections of points and lines.
- To familiarize about 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 orthographic to isometric projections and vice versa

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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. Create an engineering drawing as per industrial standard.
2. Construct orthographic projections of points and lines.
3. Create projection of planes and simple solids.
4. Develop section of solids and surfaces
5. Design the conversion of orthographic to isometric and vice versa

**Articulation Matrix**

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

**UNIT I** **15 Hours**

**FUNDAMENTALS OF ENGINEERING DRAWINGS**

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

**UNIT II** **15 Hours**

**PROJECTION OF POINTS**

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

**UNIT III** **15 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

**UNIT IV** **15 Hours**

**SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES**

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

**UNIT V** **15 Hours**

**ORTHOGRAPHIC AND ISOMETRIC PROJECTION**

Orthographic and isometric projection of components used in engineering applications.

**Total: 75 Hours**

**Reference(s)**

1. K Venugpoal, Engineering Drawing and Graphics, Third edition, New Age International, 2005.
2. Basant Agrawal, Mechanical drawing, Tata McGraw-Hill Education, 2008.
3. Engineering Drawing Practice for Schools & Colleges, Bureau of Indian Standards-Sp46, 2008
4. N. D. Bhatt and V. M. Panchal, Engineering Drawing, Charotar Publishing House Pvt. Limited, 2008.
5. K.V. Natarajan, A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 2013.

## 18AG201 ENGINEERING MATHEMATICS II 3 1 0 4

**Course Objectives**

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

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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 various parameters in partial differentiation and characterize the maxima and minima functions for signals and systems.
2. Apply multiple integral concepts to calculate the area and volume by appropriate vector integral theorems.
3. Analyse the convergence and divergence of sequences and series by various tests.
4. Construct first order differential equations from real time phenomena and solve it by suitable method.
5. Execute the appropriate method to solve the second order differential equations.

**Articulation Matrix**

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

**UNIT I** **9 Hours**

**PARTIAL DIFFERENTIATION**

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

**UNIT II** **9 Hours**

**MULTIPLE INTEGRALS**

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

**UNIT III** **9 Hours**

**SEQUENCES AND SERIES**

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

**UNIT IV** **9 Hours**

**FIRST ORDER DIFFERENTIAL EQUATIONS**

Separable differential equations, homogeneous differential equations, exact differential equations, integrating factor, Bernoullis equation, applications.

**UNIT V** **9 Hours**

**SECOND ORDER DIFFERENTIAL EQUATIONS**

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

**Total: 60 Hours**

**Reference(s)**

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

## 18AG202 ENGINEERING PHYSICS II 2 0 2 3

**Course Objectives**

- To impart knowledge in crystallography and the crystal growth methods
- To understand the properties of conductors and semiconductors
- To familiarise basic concepts of force and system of forces in real worldenvironment
- To analyse the properties of surface and friction between thesurfaces

**Programme Outcomes (POs)**

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

b. 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.

i. 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. Assess the seven crystal systems, crystal planes and the stacking sequences in metallic crystal structures
2. Execute the elastic behaviour of materials and assess the streamline and turbulent flow of liquids
3. Apply the conceptual knowledge to solve problems of particles and rigid bodies in two dimension under equilibrium conditions
4. Organize the properties of surfaces and solids using the parallel and perpendicular axis theorems
5. Differentiate between static and dynamic friction and analyse the equilibrium of bodies and on an inclined plane

**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 | | | | | | | 2 | | | | | |
| 4 | 2 | 2 | | | | | | | 2 | | | | | |
| 5 | 2 | 2 | | | | | | | 2 | | | | | |

**UNIT I** **6 Hours**

**CRYSTAL PHYSICS**

Lattice - unit cell -Bravais lattice -lattice planes -miller indices -d-spacing in cubic lattice - calculation of number of atoms per unit cell - atomic radius - coordination number - packing density for SC, BCC, FCC and HCP structures -crystal growth: Bridgman and Czochralski techniques - X- ray diffraction.

**6 Hours**

**UNIT II**

**ELASTICITY AND VISCOSITY**

Elasticity: elastic and plastic materials - Hookes law - modulii of elasticity - Poissons ratio and its significance - elastic behaviour of a material stress - strain diagram uses - factors affecting elasticity - Youngs modulus - uniform bending and non-uniform bending - Viscosity: coefficient of viscosity - Reynold's number - streamline and turbulent flow of liquid

**UNIT III** **6 Hours**

**EQUILIBRIUM OF PARTICLES AND RIGID BODIES**

Introduction - system of forces - resultant force - determination of resultant force of concurrent force system. Equilibrant - Equilibrium of a particle Lamis theorem - free body diagram - types of supports and their reactions - moment of force - Varignons theorem - determination of resultant force systems: parallel, non-parallel, non-concurrent coplanar forces - equilibrium of rigid bodies in two dimensions

**UNIT IV** **7 Hours**

**PROPERTIES OF SURFACES AND SOLIDS**

Determination of area, volume and mass of centroid - Pappus and Guldinus theorem - moment of inertia of plane and area - parallel axis theorem - perpendicular axis theorem - product of inertia - mass moment of inertia - radius of gyration

**UNIT V** **5 Hours**

**FRICTION**

Frictional force - laws of Coulomb friction - angle of friction -cone of friction -equilibrium of bodies on an inclined plane - ladder friction-wedge friction-belt friction

**1** **4 Hours**

## EXPERIMENT 1

Determination of Young's modulus of the given beam using non-uniform bending method

**2** **4 Hours**

## EXPERIMENT 2

Determination of coefficient of viscosity of a given liquid using Poiseuilles method

**3** **4 Hours**

## EXPERIMENT 3

Experimental verification of parallelogram law of forces

**4** **4 Hours**

## EXPERIMENT 4

Experimental verification of Lamis theorem

**5** **4 Hours**

## EXPERIMENT 5

Determination of centroid of laminas

**6** **4 Hours**

## EXPERIMENT 6

Experimental analysis of the reaction forces of a simply supported beam and compare with the analytical results

**7** **3 Hours**

**EXPERIMENT 7**

Demonstration of tipping and sliding

**8** **3 Hours**

**EXPERIMENT 8**

Determination of coefficient of friction between two surfaces

**Total: 60 Hours**

**Reference(s)**

1. Charles Kittel, Introduction to Solid State Physics, 8th Edition, Wile, India Pvt limited New Delhi 2012
2. Arthur Beiser, Shobjit Mahaja and S Rai Choudhury, Concepts of Modern Physics, 6th Edition, Tata McGraw Hil Education Pvt Ltd New Delhi, 2010
3. F.P. Beer, and Jr. E.R Johnston, Vector Mechanics for Engineers Statics and Dynamics, Tata McGraw-Hill Publishing Company, New Delhi, 2007
4. N. H. Dubey, Engineering Mechanics - Statics and Dynamics, Tata McGraw-Hill Education Private Limited, New Delhi, 2013
5. D. P. Sharma, Engineering Mechanics, Dorling Kindersley (India) Pvt. Ltd., New Delhi, 2010
6. S. Rajasekaran and G. Sankarasubramanian, Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt. Ltd., New Delhi, 2010

## 18AG203 ENGINEERING CHEMISTRY II 2 0 2 3

**Course Objectives**

- Summarize the classical concepts of soil chemistry and familiarize students with modern developments in chemistry of soils in relation to using soils as a medium for plant growth
- Identify the chemical methods to use to check the soil properties
- Outline the fundamentals of soil biochemistry
- Outline the basic concepts of food and its structure
- Interpret concept of nano chemistry and their characterization techniques

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
g. 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. Execute the morphology of soil and electrometric properties of soil
2. Analyse the chemical impurities (metals & organics) present in the soil
3. Organize the type of nutrients present in soil and identify suitable biodegradation methods
4. Differentiate food molecules based on its physical and chemical properties
5. Select a suitable method for nanomaterial preparation and its characterization using AFM, SEM & TEM

**Articulation Matrix**

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

**UNIT I** **6 Hours**

**SOIL CHEMISTRY I**

Chemical (elemental) composition of the earth's crust and soils. Soil colloids: inorganic and organic colloids - origin of charge, concept of point of zero-charge (PZC) and its dependence on variable-charge soil components, surface charge characteristics of soils; diffuse double layer theories of soil colloids, zeta potential, stability, coagulation/flocculation and peptization of soil colloids; electrometric properties of soil colloids; sorption properties of soil colloids.

**UNIT II** **6 Hours**

**SOIL CHEMISTRY II**

Soil organic matter - fractionation of soil organic matter and different fractions, clay-organic interactions.Chemistry of acid soils; active and potential acidity; lime potential, chemistry of acid soils; sub-soil acidity. Chemistry of salt-affected soils and amendments; soil pH, EC , ESP, SAR and important relations; soil management and amendments. Chemistry and electrochemistry of submerged soils. Heavymetals in contaminated soils and plants.

**UNIT III** **6 Hours**

**SOIL BIOCHEMISTRY**

Microbial transformations of nitrogen, phosphorus, sulphur, iron and manganese in soil; biochemical composition and biodegradation of soil organic matter and crop residues, humus formation; cycles of important organic nutrients. Decomposition of organic matter in soil.

**UNIT IV** **6 Hours**

**FOOD CHEMISTRY**

Moisture in foods - structure - properties, types of water in food and their specific function. Lipids-classification - structures, physical and chemical properties. Carbohydrates - definition -classification - functions, properties of simple and complex carbohydrates. Proteins - introduction - classification and structures, physico-chemical properties, nutritive and supplementary value of food proteins. Pigments - introduction and significance of natural pigments in food - Chlorophylls, Carotenoids, Haemoglobin and Myoglobin, Anthocyanins, Flavonoids, Betalains Tannins.

**UNIT V** **6 Hours**

**NANOTECHNOLOGY AND GREEN CHEMISTRY**

Nano Materials: classification - properties - applications. carbon nanotubes: types (single and multiwall) - synthesis - top down and bottom up method (definition only) -Arc discharge method -pulsed laser deposition - chemical vapour deposition. Properties and applications of fullerenes, graphene C-60 buckyball. Green chemistry: Twelve basic principles - need of green chemistry - applications. Designing of safer chemicals - alternative solvents. Microwave assisted synthesis.

**FURTHER READING**

Soil and water chemistry
The surface chemistry of natural particle

**1** **3 Hours**

## EXPERIMENT 1

Potentiometric and conductometric titration of soil humic

**2** **3 Hours**

## EXPERIMENT 2

Estimation of soil organic carbon

**3** **3 Hours**

## EXPERIMENT 3

Estimation of calcium content in the soil using EDTA method

**4** **3 Hours**

## EXPERIMENT 4

Estimation of chloride content in water by Argentometric method

**5** **3 Hours**

**EXPERIMENT 5**
Estimation of chromium content in tannery effluent

**6** **3 Hours**

**EXPERIMENT 6**
Estimation of protein from milk and egg by colorimetric methods

**7** **3 Hours**

**EXPERIMENT 7**
Estimation of starch by (a) titrimetric method (b) calorimetric method

**8** **3 Hours**

**EXPERIMENT 8**
Estimation of fat in the given sample

**9** **3 Hours**

**EXPERIMENT 9**
Estimation of total ash content

**10** **3 Hours**

**EXPERIMENT 10**
Preparation of metal (Ag and Cu) nano particles and its characterization

**Total: 60 Hours**

**Reference(s)**

1. Bolt GH & Bruggenwert MGM. Soil Chemistry. Elsevier,1978.
2. Greenland DJ & Hayes MHB. Chemistry of Soil Processes. John Wiley & Sons, 1981.
3. McBride MB. Environmental Chemistry of Soils. Oxford Univ. Press. 1994.
4. Sposito G. The Chemistry of Soils. Oxford Univ. Press. 1989. McLaren AD & Peterson GH. Soil Biochemistry. Vol. XI. MarcelDekker.1967. Paul EA & Ladd JN, Soil Biochemistry, Marcel Dekker,1981.
5. Fennema, Owen R, Food Chemistry, 3rd Ed., Marcell Dekker, New York, 1996. Potter,N.N.and Hotchkiss,J.H, Food Science, 5th Ed., Chapman & Hall,1995. DeMan, J.M., Principles of Food Chemistry, AVI, NewYork, 1980. Siavsankar B, Food Processing and Preservation, Prentice Hall India, 2004.
6. V K Ahluwalia, Green Chemsitry, ANE books, 2012. T Pradeep,Nano the essentials: understanding nano science and nanotechnology, Tata Mcgraw Hill, 1st edition, 2013.

## 18AG204 COMPUTER PROGRAMMING I 1 0 4 3

**Course Objectives**

- Understand the basics of C primitives, operators and expressions.
- Gain knowledge about the different primitive and user defined data types.
- Impart knowledge about the structural programming concepts.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
e. 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 C programs using operators, type conversion and input-output functions.
2. Apply decision making and looping statements in writing Cprograms.
3. Develop C programs using the concepts of Arrays and strings.
4. Design applications using functions in C.
5. Apply the concepts of structures and files in writing C programs.

**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 | | | 3 | | | | | | | | | |
| 3 | 2 | 3 | - | | 3 | | | | | | | | | |
| 4 | 1 | 3 | | | 3 | | | | | | | | | |
| 5 | 1 | 3 | | | 3 | | | | | | | | | |

**UNIT I** **3 Hours**

**INTRODUCTORY CONCEPTS**

Introduction to C- Planning and writing a C program- Operators and Expressions- Arithmetic - Relational - Logical - Increment and decrement - Conditional - Bitwise - Comma - Sizeof() - Assignment - Shift operator Precedence and order of evaluation

**UNIT II** **3 Hours**

**CONTROL STATEMENTS**

Decision Making and Branching- Decision Making and Looping -Jump Statements.

**UNIT III** **3 Hours**

**ARRAYS AND STRINGS**

Arrays- Introduction, declaration - Initialization of one dimensional array, two-dimensional arrays, initializing two dimensional arrays. Strings- String handling functions.

**UNIT IV** **3 Hours**

**FUNCTIONS**

User Defined Functions- Elements of user defined functions - categories of function - call by value and call by reference - recursion

**UNIT V** **3 Hours**

**STRUCTURES AND FILES**

Structures - Introduction - defining a structure - declaring structure variables - accessing structure members -File Management in C.

**FURTHER READINGS**

Problem solving - Logical thinking - logic - symbolic logic - truth tables - Math puzzles - magic triangles - magic squares - alphabetic puzzles - Cross number puzzles.

**1** **3 Hours**

## EXPERIMENT 1

Implement a C program which include a Fundamental Data types Integer, Float, double and Character.

**2** **6 Hours**

## EXPERIMENT 2

Implement a C program to perform the Arithmetic Operations using primitive data types.

**3** **6 Hours**

## EXPERIMENT 3

Implementation of logical, relational, bitwise, increment/decrement and conditional Operators in C.

**4** **6 Hours**

## EXPERIMENT 4

Implementation of Simple if else Conditional Statement.

**5** **5 Hours**

## EXPERIMENT 5

Implementation of nested if else Conditional Statement.

**6** **3 Hours**

## EXPERIMENT 6

Implementation of Switch Case Statement.

**7** **3 Hours**

## EXPERIMENT 7

Implement a C program using for Looping Statement.

**8** **3 Hours**

**EXPERIMENT 8**
Implement a C program using Do-While Looping Statement

**9** **3 Hours**

**EXPERIMENT 9**
Implement a C program using While Looping Statement.

**10** **3 Hours**

**EXPERIMENT 10**
Implementation of Jumping Statements

**11** **3 Hours**

**EXPERIMENT 11**
Implementation of One Dimensional Array.

**12** **6 Hours**

**EXPERIMENT 12**
Implementation of Two Dimensional Array.

**13** **3 Hours**

**EXPERIMENT 13**
Implement a C program to perform String Manipulation Functions.

**14** **4 Hours**

**EXPERIMENT 14**
Implement a C program using structures.

**15** **3 Hours**

**EXPERIMENT 15**
Implement a C program which includes four categories of functions and recursive functions.

**Total: 75 Hours**

**Reference(s)**

1. Herbert Schildt, C -The complete Reference, Tata McGraw-Hill, 2017
2. Byron Gottfried , Programming with C, Schaum's Outlines, Tata Mcgraw-Hill, 2013
3. E.Balagurusamy, Programming in ANSI C, Tata McGraw-Hill, 2012
4. Kernighan B W and Ritchie O M, The C programming Language. Prentice-Hall of India, 2009
5. Kelley A and I. Pohl, A Book on C : Programming in C, Pearson Education, 1998
6. Ashok.N.Kamthane,Programming in C,Pearson education,2013

## 18AG205 PRINCIPLES OF CROP PRODUCTION TECHNOLOGY

**2 0 2 3**

**Course Objectives**

- To study about the basic principles of crop production aspects
- To learn the cultivation practices of varies field crops to increase the foodproduction
- To impart basic knowledge of insect pest and diseases and their losses caused to crops.
- To study various methods of plant protection to get more yield in agricultural crops

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
g. 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.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

l. 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. Implement the concepts and principles of crop growth, climate influence, soil fertility and tillage for increase the crop productivity
2. Apply the various agronomic inputs for raising different crops under organic or intensive cultivation through use of improved varieties or hybrids and the liberal use of irrigation, fertilizers and weed management to increase the food production.
3. Assess the groups of insects, diseases and their damage symptoms to identify the better management practices
4. Apply the various cultivation practices for major cereals, millets, minor millets and pulse crops
5. Apply the various cultivation practices for major oil seeds, cotton and sugarcane

**Articulation Matrix**

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

**UNIT I** **6 Hours**

**PRINCIPLES OF AGRONOMY**

Definition of agriculture and agronomy - Factors affecting crop growth - climate and weather parameters - Soil fertility and productivity - tillage and tilth - objective and principles - different kinds of tillage - Organic farming - principles and practices

**UNIT II** **7 Hours**

**AGRONOMIC INPUTS AND CROPPING SYSTEM**

Seeds of varieties or hybrids - seed treatment - sowing and planting methods - Manures and fertilizers - source, nutrient contents and methods of application - Irrigation techniques for different soils and crops - Weeds - classification of weeds - principles and methods of weed management - Intensive cultivation - monoculture and multiple cropping - inter, mixed, relay, strip and multitier cropping - Practices of organic crop cultivation

**UNIT III** **8 Hours**

**PLANT PROTECTION**

Group of pests and Diseases - Methods of control - Cultural, Physical, Chemical and Biological - Pest management in major crops - Organic way of plant protection.

**UNIT IV** **5 Hours**

**AGRONOMY OF FIELD CROPS I**

Package of practices for important field crops - rice, maize, sorghum, finger millet and small millets - Pulses - red gram, black gram, green gram, soybean

**UNIT V** **4 Hours**

**AGRONOMY OF FIELD CROPS II**

Package of practices for groundnut, gingelly and sunflower, cotton, sugarcane

**FOR FUTHRE READING**

Modern techniques used to cultivate the major field crops and organic way of food production-Mode of spread of pest and diseases, prophylactic measures to manage pests mode of action of pesticides, complex problems in plant protection

**1** **2 Hours**

## EXPERIMENT 1

Acquiring skill on the organizational setup of the agricultural farm and studying basic requirements of crop production

**2** **3 Hours**

**EXPERIMENT 2**
Studies of climatic factors on crop growth - meteorological instruments

**3** **2 Hours**

**EXPERIMENT 3**
Practicing different sowing / planting methods; fertilizers and irrigation methods

**4** **3 Hours**

**EXPERIMENT 4**
Practicing different weed management practices; cropping system in intensive or organic farming

**5** **3 Hours**

**EXPERIMENT 5**
To identify the damage symptoms of pest and diseases

**6** **3 Hours**

**EXPERIMENT 6**
Study the integrated pest and diseases management practices

**7** **2 Hours**

**EXPERIMENT 7**
Practicing cultivation operations of major cereal crops

**8** **4 Hours**

**EXPERIMENT 8**
Practicing cultivation operations of major pulse crops

**9** **4 Hours**

**EXPERIMENT 9**
Practicing cultivation operations of major oil seed crops

**10** **4 Hours**

**EXPERIMENT 10**
Practicing cultivation operations of cotton and sugarcane crop

**Total: 60 Hours**

**Reference(s)**

1. SP. Palaniappan, and S. Sivaraman. 1998. Cropping systems in the tropics- Principles and Management, New Age international publishers, New Delhi, (2nd edition), 1998.
2. P.Balasubramain and SP. Palniappan. 2001. Principles and Practices of Agronomy, Agrobios publishers, Ludhiana.
3. T. Yellamanda Reddy and G.H. Sankara Reddi. 2014. Principles of Agronomy, Kalyani publishers, Ludhiana

4. B.Chandrasekaran, B., K. Annadurai and E. Somasundaram. 2007. A Text book of Agronomy, Scientific publishers, Jodhpur.
5. N. Dhandapani and S. Uthamasamy. 2000. Integrated pest Management. TNAU Publications, Coimbatore.p.181.
6. K. Justin. 2004. Crop protection. TNAU, petchipaarai, kanyakumari Dt.p.379.

## 18AG207 ENGINEERING PRACTICES LABORATORY

**0 0 4 2**

**Course Objectives**

- To provide hands on training for fabrication of components using carpentry, sheet metal and welding equipment / tools.
- To gain the skills for making fitting joints and household pipe line connections using suitable tools.
- To develop the skills for preparing the green sand mould and to make simple household electrical connection
- To provide hands on training for dismantling and assembling of petrol engines, gear box and pumps.
- To develop the skills for making wood/sheet metal models using suitable tools

**Programme Outcomes (POs)**

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

**Course Outcomes (COs)**

1. Fabricate simple components using carpentry, sheet metal and welding equipment/tools
2. Make fitting joints and household pipe line connections using suitable tools.
3. Prepare electrical connections for farm structures using suitable tools
4. Dismantle and assemble petrol engines, gear box and pumps.
5. Make simple models using wood and sheet metal.

**Articulation Matrix**

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

**1** **6 Hours**

### EXPERIMENT 1

Forming of simple object in sheet metal using suitable tools (Example: Float for weeder )

**2** **6 Hours**

### EXPERIMENT 2

Fabrication of a simple component using thin and thick plates. (Example: Weeder frame and pegtooth)

**3** **6 Hours**

### EXPERIMENT 3

Making a simple component using carpentry power tools. (Example: Door ,window frames for farm structures).

**4** **6 Hours**

**EXPERIMENT 4**
Prepare a "V" (or) Half round (or) Square joint from the given mild Steel flat.

**5** **6 Hours**

**EXPERIMENT 5**
Construct a pipe line connections using pipes, Tee joint, Four way joint, elbow, union, bend, Gate way and Taps

**6** **6 Hours**

**EXPERIMENT 6**
Construct a pipe connections of farm application centrifugal pump using pipes, bend, gate valve, flanges, pressure relive valve and foot valve.

**7** **6 Hours**

**EXPERIMENT 7**
Construct a domestic electrical wire connections using indicator, one way switch

**8** **6 Hours**

**EXPERIMENT 8**
Dismantling and assembly of Centrifugal Monoblock / Gear Pump / Gear box.

**9** **6 Hours**

**EXPERIMENT 9**
Dismantling and assembly of two stroke and four stroke petrol engine.

**10** **6 Hours**

**EXPERIMENT 10**
Mini Project (Fabrication of Small Components).

**Total: 60 Hours**

## 18AG301 ENGINEERING MATHEMATICS III 3 1 0 4

**Course Objectives**

- Understand the concepts of Fourier series, Transforms and Boundary Conditions, which will enable them to model and analyze the physical phenomena
- Implement the Fourier analysis, an elegant method in the study of heat flow, fluid mechanics and electromagnetic fields
- Summarize and apply the mathematical aspects that contribute to the solution of one dimensional wave equation

**Programme Outcomes (POs)**

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

b. 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.

c. 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 the periodicity of a function and formulate the same as a combination of sine and cosine using Fourier series
2. Execute a function in frequency domain whenever the function is defined in time domain.
3. Compute a partial differential equation and able to solve them.
4. Apply the concepts of probability in Agriculture engineering to forecast the yields ofcrops.
5. Apply basic statistical inference techniques, to science/engineering problems.

**Articulation Matrix**

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

**UNIT I** **10 Hours**

**FOURIER SERIES**

Fourier series for periodic functions. Orthogonal functions. The Euler coefficients- Harmonic analysis.

**UNIT II** **9 Hours**

**FOURIER TRANSFORMS**

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

**UNIT III** **9 Hours**

**PARTIAL DIFFERENTIAL EQUATION**

Introduction to partial differential equations. One-dimensional wave equation. Method of separation of variables. De Alemberts solution of the wave equation. Heat equation. Laplace equation. Telegraph equations.

**UNIT IV** **10 Hours**

**PROBABILITY THEORY**

Probability. Random variables, probability densities and distributions, mean and variance of a distribution. Conditional probability. Bayes theorem. Binomial, Poisson and normal distributions.

**UNIT V** **9 Hours**

**BASIC STATISTICS**

Mean, Median, Mode, Variance, Standard Deviation, Covariance, Correlation and Regression

**Total: 60 Hours**

**Reference(s)**

1. Kreyszig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley,1993
2. Johnson Richard A. and Bhaltacharyya Gouri K., Statistics, Principles and Methods, 3rd Edition, John Wiley, 1996.
3. ONeil Peter V., Advanced Engineering Mathematics, 4th Edition, PWS-Kent, 1995.
4. Milton J. S. and Arnold Jesse C., Introduction to Probability and Statistics: Principles and Applications for Engineering and The Computing Sciences, McGraw Hill Inc, 3rd Edition,1995
5. James Glyn, Advanced Modern Engineering Mathematics, Addison-Wesley, 1993.

## 18AG302 ENGINEERING THERMODYNAMICS 3 0 0 3

**Course Objectives**

- To study the fundamentals of thermodynamics and zeroth law
- To provide the knowledge on first law of thermodynamics
- To impart the knowledge on second law of thermodynamics and entropy
- To study the thermodynamic properties of pure substances and its phase change processes
- To learn about gas power cycles and properties of gas mixtures

**Programme Outcomes (POs)**

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

b. 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.

c. 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.

d. 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.

e. 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.

f. 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.

g. 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.

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

j. 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.

l. 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 basic concepts and zeroth law of thermodynamics
2. Apply the first law of thermodynamics to closed and open systems
3. Solve the problems related to cycles and cyclic devices using second law of thermodynamics
4. Determine the thermodynamic properties of pure substances and its phase change processes
5. Evaluate the air standard performance of heat engines and properties of gas mixtures

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 | | | | | 1 | | | 2 | | 3 | | |
| 3 | 3 | 3 | | | | | 2 | | | | | 3 | | |
| 4 | 3 | 3 | | | 1 | | 2 | | | 2 | | 3 | | |
| 5 | 3 | 3 | 1 | 1 | 1 | 2 | | - | | 2 | | 3 | | |

**UNIT I** **9 Hours**

**CONCEPTS AND FIRST LAW OF THERMODYNAMICS**

Basic Concepts - concept of continuum, Macroscopic approach. Thermodynamic systems - Closed, Open. Control volume. Thermodynamic properties and equilibrium state of a system. Path and process. Quasi Static process. Modes of work. Zeroth law of thermodynamics. Concept of temperature and heat. First law of thermodynamics - Applied to closed and open systems-isolated systems. Internal energy. Specific heat at constant volume (Cv) and Specific heat at constant pressure (Cp). Enthalpy-Limitations of Laws of thermodynamics.

**UNIT II** **9 Hours**

**SECOND LAW OF THERMODYNAMICS**

Second law of thermodynamics - Kelvin Planck and Clausius statements. Reversibility and Irreversibility. Clausius inequality. Entropy concept-a point function or a property of a system efficiency, Principle of increase of entropy - Change of entropy during thermodynamic processes. Carnot theorem- absolute entropy- availability.CARNOT CYCLE Coefficient of Performance of heat pumps and refrigerator.

**UNIT III** **9 Hours**

**PROPERTIES OF PURE SUBSTANCES**

Thermodynamic properties of pure substances in solid, liquid and vapour phases, Pressure-Volume (P-V), Pressure - Temperature (P-T), Temperature - Volume (T-V), Temperature - Entropy (T-S), Enthalpy - Entropy (H-S), Pressure-Volume-Temperature (P-V-T) diagrams. Thermodynamic properties of steam - Calculations of work done and heat transfer in non-flow and flow process

**UNIT IV** **9 Hours**

**PROPERTIES OF GASES, THERMODYNAMIC RELATIONS**

Concept of ideal and real gases. Equation of state. Avagadro's law. Vander Waal's equation of states. Dalton's law of partial pressure. Properties of mixture of Gases. Maxwell relations. Temperature-Change in entropy (T-dS) equation. Clausius-Clayperon equations. Joule Thomson Coefficient. Amagat's Law. Gibbs Function.

**UNIT V** **9 Hours**

**AIR STANDARD CYCLES AND PSYCHROMETRY**

Air standard cycles - Otto, Diesel and Dual, Calculation of mean effective pressure and Air standard efficiency. Rankine cycle concept of ideal- Psychrometric chart.

**Total: 45 Hours**

**Reference(s)**

1. Y. Cengel and Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi, 2003
2. Rayner Joel, Basic Engineering Thermodynamics, Pearson Publications, 2012.

3. S. Khurmi, text book of thermodynamics and Heat transfer, S. Chand Publications, New Delhi, 2002.
4. C. P. Arora, Thermodynamics, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2003.
5. R. S. Khurmi, Steam table with Psychometric chart, S. Chand Publications, New Delhi, 2002.
6. Merle C. Potter, Craig W. Somerton, Thermodynamics for Engineers, Schaum Outline Series, Tata McGraw Hill Publishing Company Private Limited, New Delhi, 2004.

## 18AG303 FLUID MECHANICS 3 0 2 4

**Course Objectives**

- To study the different properties of fluids
- To analyze pattern and nature of the flow of fluids in pipes and open channel
- To gain an understanding of flow measurements and hydraulic machines

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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. Execute the fundamental properties of fluids and measures of pressure in fluid statics
2. Organize the fluid flow and its pattern
3. Assess the rate of flow of fluids using flow measuring devices
4. Design the most economical channel section and measure the flow in channels.
5. Assess the performance of pumps based on characteristic curves

**Articulation Matrix**

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

**UNIT I 9 Hours**

**PROPERTIES OF FLUIDS**

Properties of fluids- definition -units of measurement - Measurement of pressure by various types of manometers - Hydrostatic forces on surfaces -total pressure and center of pressure – Horizontal vertical and inclined plane surface - Archimedes principles - buoyancy - metacenter -metacentricheight

**UNIT II 9 Hours**

**FLUID FLOW ANALYSIS**

Types of fluid flow - velocity and acceleration of a fluid particle - Flow pattern-velocity potential stream function. Principles of conservation of mass -energy-momentum - continuity equation in Cartesian co-ordinates.

**UNIT III 9 Hours**

**FLOW MEASUREMENTS**

Euler's equation of motion - Bernoulli's equation - applications - Venturimeter - orifice meter, Rotometer -

Pitot tube- Flow through pipes - laminar and turbulent flow in pipes - Darcy Weisbach equation for friction head loss - Chezy's formula - Major and minor losses in pipes-turbines s

**UNIT IV** **9 Hours**

**OPEN CHANNEL FLOW**

Types of flow in channel - Most economical section of channel - rectangular -trapezoidal. Specific energy and critical depth - Specific force - critical flow - computation. Flow measurement in channels - notches - rectangular, triangular

**UNIT V** **9 Hours**

**PUMPS AND DIMENSIONAL ANALYSIS**

Centrifugal pumps - components- working - specific speed - characteristics curves. Submersible pumps - Jet pump- reciprocating pump-Dimensional analysis -concept of geometric, kinematic and dynamic similarity. Important non dimensional numbers.

**FOR FURTHER READING**

Newtonian and Non Newtonian fluids- Stream line, Streak line, Path line, Time line - Application of Bernoulli's Equation - Pipes in series - Equivalent pipe - Model and Prototype - Similitude

**1** **2 Hours**

## EXPERIMENT 1

Find the friction factor of fully developed flow through pipes of various diameters.

**2** **2 Hours**

## EXPERIMENT 2

Determination of Co-efficient of discharge of Venturimeter

**3** **2 Hours**

## EXPERIMENT 3

Determination of Co-efficient of discharge of V-notch

**4** **2 Hours**

## EXPERIMENT 4

Determination of Co-efficient of discharge of orifice meter

**5** **4 Hours**

## EXPERIMENT 5

Conduct a test and submit the characteristic report on Centrifugal pump

**6** **4 Hours**

## EXPERIMENT 6

Conduct a test and submit the characteristic report on Submersible pump

**7** **4 Hours**

## EXPERIMENT 7

Conduct a test and submit the characteristic report on Reciprocating pump

**8** **4 Hours**

**EXPERIMENT 8**
Conduct a test and submit the characteristic report on Jet pump

**9** **2 Hours**

**EXPERIMENT 9**
Conduct a test and submit the characteristic report on Gear Pump

**10** **2 Hours**

**EXPERIMENT 10**
Study on the performance characteristics of Francis turbine

**11** **2 Hours**

**EXPERIMENT 11**
Study on the performance characteristics of Pelton wheel turbine

**Total: 75 Hours**

**Reference(s)**

1. Yunus A. Cengel, John M. Cimbala, Fluid Mechanics-Fundamentals and Applications, Tata McGraw Hill Publishing Co, New Delhi, 2006.
2. R.K. Bansal, A text book of Fluid Mechanics and Hydraulic Machinery, Laxmi publications (P) Ltd, New Delhi, 2002.
3. K. Subramanya, Flow in Open Channels, Tata McGraw Hill Publishing Co, New Delhi, 2009.
4. P.N. Modi and S.M. Seth, Hydraulics and Fluid mechanics, Standard Publishers & Distributors, New Delhi.
5. RJ. Grade, Fluid mechanics through problems, Wiley eastern Ltd, Chennai, 2002.
6. Jagadish Lal, Hydraulic machines, Metropolitan book house, New Delhi, 2000.

## 18AG304 STRENGTH OF MATERIALS 3 1 0 4

### Course Objectives

- To impart the knowledge on heat transfer mechanisms in fluids and solids, and their applications in various heat transfer equipment
- To analyze heat exchangers and methods of evaluating the performance
- To introduce non-dimensional numbers and their effects in governing various modes of mass transfer

### Programme Outcomes (POs)

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

b. 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.

c. 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.

d. 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.

e. 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.

f. 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.

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

### Course Outcomes (COs)

1. Find the stresses and strains for different geometries
2. Asses the concepts and types of convertion in heat transfer mechanism
3. Resolve the radiation problems in various gcomeries
4. Analyze the performance of heat exchangers and evaporators
5. Find the various modes of mass transfer and apply them in engineering problems

### Articulation Matrix

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

**UNIT I** **9 Hours**

**BASICS OF STRESSES AND STRAINS**

Simple Stresses and Strains Hookes Law Modulus of Elasticity Principle of Superposition bars of varying sections thermal stresses and strains Elastic Constants - Poissons Ratio Bulk Modulus - Shear Modulus - interrelationships - Strain Energy and Impact Loading Proof Resilience - Modulus of Resilience - Principal Stresses and Strains = Oblique sections Analytical method - Graphical method (Mohrs Circle method)

**UNIT II** **9 Hours**

**CENTRE OF GRAVITY AND MOMENT OF INERTIA**

Centroid and Centre of Gravity -geometrical considerations - method of moments - Plane (laminae) sections - symmetrical sections - unsymmetrical sections - solid bodies and sections with cut our holes - Moment of Inertia Routh rule - method of integration - Theorem of Parallel axes - Theorem of Perpendicular axes - geometric sections - solid and hollow sections - composite and built-up sections

**UNIT III** **9 Hours**

**ANALYSIS OF FRAMED STRUCTURES (TRUSSES)**

Structures built of Frames - Types of Frames - Perfect and imperfect frames - deficient and redundant frames - Loads and stresses - Method of Joints - Method of sections - Graphical method - Bownotations - polar diagram- funicular polygon- vector diagram - cantilever trusses - freely supported trusses - King Post and Queen Post Trusses

**UNIT IV** **9 Hours**

**SHEAR FORCE, BENDING MOMENT AND DEFLECTION (BEAMS)**

Uniformly distributed load and gradually varying load -Shear Force and Bending Moment distributions - Theory of Simple Bending - Bending stress - modulus of section - deflection in beams and cantilevers - Double integration method- Macaul method.

**UNIT V** **9 Hours**

**COLUMNS, SHELLS AND SHAFTS**

Columns and struts - Slenderness ratio - Buckling and crushing - Euler Column theory - applications - Rankine formula-Johnson formula - Indian Standards - Shells -Cylindrical and spherical shells- thin and thick shells - Shafts - torsion in circular shafts - Polar Moment of Inertia - strain energy due to torsion.

**Total: 60 Hours**

**Reference(s)**

1. Rajput, R.K. Strength of Materials (Mechanics of Solids). 4th edition. S.Chand & Company Ltd. India, 2010.
2. Ramamrutham, S. Strength of Materials. 16th edition. Dhanpat Rai Publishing Co., India, 2008.
3. Khurmi, R.S. Strength of Materials (Mechanics of Solids). 24th Edition. S.Chand & Company Ltd, India, 2013.

## 18AG305 SOIL MECHANICS 3 0 2 4

**Course Objectives**

- To acquire the knowledge on engineering geology and basic geomorphic processes
- To impart knowledge on applied geomorphology and hydrogeology
- To gain knowledge on soil mechanics and the procedures to test the soil interns of dam and reservoir construction

**Programme Outcomes (POs)**

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

d. 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.
e. 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.
g. 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. Organize the basic geomorphic processes
2. Apply suitable technique/procedure in dam and reservoir construction
3. Assess the concepts of hydraulics soil process of through
4. Execute the concepts of soil and water relationship
5. Analyze the fundamental concepts of soil strength

**Articulation Matrix**

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

**UNIT I** **9 Hours**

**GEOLOGY AND APPLIED GEOLOGY**

Introduction to Geology and Engineering Geology - importance - Earth's layers -Geological Structures - Geomorphology - Concepts - Processes and Forms - Fluvial and Eolian Geomorphology-Drainage analysis-Watershed characteristics - Channel Geomorphology

**UNIT II** **10 Hours**

**ENGINEERING PROPERTIES OF SOIL**

Introduction to Soil mechanics - Physical characteristics of soil - soil texture-Particle size distribution - analysis - Grain size distribution curves - Sedimentation analysis -Stokelaw- assumptions -validity- soil structure types- Soil phase relationship, mass volume relationship, weight -volume relationship - Index properties of soils determination of specific gravity-soil water-Soil Classification field identification soil consistency - Atterberg limits - liquid limit, plastic limit and shrinkage limit-Relative density of cohesion less soils.

**UNIT III** **9 Hours**

**PERMEABILITY**

Permeability - Darcy's law-discharge velocity validity of Darcys law- seepage velocity - Factors affecting permeability - Permeability through layered soil -Measurement of permeability - Flow net construction-characteristics.

**UNIT IV** **8 Hours**

**COMPACTION AND CONSOLIDATION**

Compaction - objectives -relationship with water content- the Standard Proctor compaction test - Factors affecting compaction-methods of compaction in field - Compressibility -coefficient of Compressibility - Consolidation of soils -stages of consolidation.

**UNIT V** **9 Hours**

**STRENGTH OF SOILS**

Shear strength-concept of shearing resistance and shearing strength - Coulomblaw - Mohr's circle of stresses - Earth pressure at rest - active pressure - passive pressure - Stability of slopes - Stability of earthen embankments,-Bearing Capacity of soil -Testing &Improving Bearing Capacity of soil

**1** **2 Hours**

**EXPERIMENT 1**

Determination of Field Density by Core cutter and Sand Replacement methods

**2** **2 Hours**

**EXPERIMENT 2**

Mechanical analysis of Soil Sieving

**3** **4 Hours**

**EXPERIMENT 3**

Hydrometer analysis for Grain Size Distribution

**4** **2 Hours**

**EXPERIMENT 4**

Determination of Atterbergs Limits of Soil Consistency

**5** **4 Hours**

**EXPERIMENT 5**

Determination of Hydraulic Conductivity by Constant Permeameter, Variable Head Permeameter

**6** **4 Hours**

**EXPERIMENT 6**
Field method of determination of Coefficient of Permeability

**7** **4 Hours**

**EXPERIMENT 7**
Proctor Compaction test of soils-Consolidation test of soils

**8** **2 Hours**

**EXPERIMENT 8**
Direct Shear Test-Vane Shear Test of soils

**9** **2 Hours**

**EXPERIMENT 9**
Problems on Bearing Capacity, permeability, compaction and compressibility

**10** **4 Hours**

**EXPERIMENT 10**
Field visit Landslides areas and control measures

**Total: 75 Hours**

**Reference(s)**

1. Yunus A. Cengel, John M. Cimbala, Fluid Mechanics-Fundamentals and Applications, Tata McGraw Hill Publishing Co, New Delhi, 2006.
2. R.K. Bansal, A text book of Fluid Mechanics and Hydraulic Machinery, Laxmi publications (P) Ltd, New Delhi, 2002.
3. K. Subramanya, Flow in Open Channels, Tata McGraw Hill Publishing Co, New Delhi, 2009.
4. P.N. Modi and S.M. Seth, Hydraulics and Fluid mechanics, Standard Publishers & Distributors, New Delhi.
5. RJ. Grade, Fluid mechanics through problems, Wiley eastern Ltd, Chennai, 2002.
6. Jagadish Lal, Hydraulic machines, Metropolitan book house, New Delhi, 2000.

## 18AG306 SURVEYING AND LEVELLING 3 0 0 3

**Course Objectives**

- To acquire the knowledge on engineering geology and basic geomorphic processes
- To gain knowledge on soil mechanics and the procedures to test the soil interns of dam and reservoir construction
- To impart knowledge on applied geomorphology and hydrogeology

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
f. 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.
g. 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. Select the instruments required for conducting the chain survey in level and sloping ground
2. Determine the area of the land by chain surveying and also can apply the necessary chain corrections
3. Compute the area and volume of earth work by simple and numerical methods
4. Execute the angle between the stations by prismatic compass and conduct the plane table surveying for locating the new stations
5. Find the Reduced level for all points by using dumpy level, prepare the contour map and also identify the horizontal, vertical angle using Theodolite

**Articulation Matrix**

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

**UNIT I** **9 Hours**

**PRINCIPLES OF SURVEYING**

Introduction - Principles and basic concepts and uses of surveying - classification and basic methods of surveying- Types of chains, Ranging rod, Ranging - Direct and Indirect methods-Obstacles in chaining. Chain Surveying - Principles of chain surveying - - cross staff and optical square - Steps involved in Chain Survey

**UNIT II** **9 Hours**

**LEVELLING AND CONTOURING**

Basic terminologies of Compass traversing- Prismatic and Surveyors Compass - Checking the accuracy of traverse - Errors and mistakes in Compass survey - Plane tabling - instruments and accessories - Radiation, Traversing, Orientation - Intersection and Resection.

**UNIT III** **9 Hours**

**THEODOLITE AND MODERN SURVEYING**

Theodolite - Types - Description - Horizontal and vertical angles - Temporary and Permanent adjustments Heights and distances Tangential and Stadia Tacheometry Subtense methods - Stadia constants - Anallactic lens - Traversing - Gales table - Total Station- Global Positioning System (GPS)-GNSS

**UNIT IV** **9 Hours**

**COMPASS TRAVERSING AND PLANE TABLE SURVEYING**

Levelling - definition - Benchmarks - different types of levels - Basic principles of leveling – Theory of simple, compound, cross sectional and reciprocal levelling -Contouring - definition -contour characteristics - direct and indirect methods -gradient contour - uses

**UNIT V** **9 Hours**

**COMPUTATION OF AREA AND VOLUME**

Introduction - Formulate for calculation of cross sectional area- calculation of volume - Area computation, Mid-Ordinate rule- Average ordinate rule- Trapezoidal rules- Simpson rule and Coordinatemethod

**FOR FURTHER READING**

Merits and demerits of plane table surveying - Description and uses of theodolite - Omitted measurements - Description and uses of total station-Radial contouring - Modern Trends in surveying and advance equipment.

**Total: 45 Hours**

**Reference(s)**

1. Punmia. B.C Surveying (Vol- I & Vol-II) Laxmi publications, New Delhi. 1991.
2. Kanetkar, T.P. & Kulkarni, S.V., Surveying & leveling Part I, A.V.G. Prakashan, Poona1984.
3. Basak. V.N. 1994.Surveying and Levelling, Tata McGraw hill publications, New Delhi
4. A.M. Michael and T.P. Ojha Agricultural Engineering (Vol-II), New Delhi

**1 0 4 3**

# 18AG307 COMPUTER PROGRAMMING II

## Course Objectives

- Understand the basics of C primitives, operators and expressions.
- Gain knowledge about the different primitive and user defined data types.
- Impart knowledge about the structural programming concepts

## Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
f. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

## Course Outcomes (COs)

1. Implement Object Oriented Programming concepts and basic characteristics of Java
2. Assess the principles of inheritance and interfaces
3. Find the exceptions and use polymorphism in various functions
4. Carry-out a java application with generics classes and use I/O Streams
5. Show the importance of OOP in real-world problems.

## 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 | - | - | 3 | | | | | | | | | |
| 3 | 2 | 3 | - | - | 3 | | | | | | | | | |
| 4 | 1 | 3 | | | 3 | - | | - | | | | | | |
| 5 | 1 | 3 | | | 3 | | | | | | | | | |

**UNIT I** **7 Hours**

**BASICS OF JAVA**

Object Oriented Programming - Abstraction - Objects and Classes - Encapsulation- Inheritance - Polymorphism - Characteristics of Java - The Java Environment - Java Source File- Structure - Compilation.

Fundamental Programming Structures in Java - Defining classes in Java Constructors, Methods - Access specifiers - Comments, Data Types, Variables, Operators, Control Flow, Arrays Packages

**UNIT II** **6 Hours**

**INHERITANCE AND INTERFACES**

Inheritance- Super classes- Sub classes -Protected members - Constructors in sub classes - Abstract classes and methods -final methods and classes -Interfaces - Defining an interface, implementing interface, Differences between classes and interfaces -Strings - String Operations- String Buffer - String Builder

**UNIT III** **5 Hours**

**POLYMORPHISM AND EXCEPTION HANDLING**

Polymorphism- Abstract Classes and Methods - Varieties of Polymorphism - Polymorphic Variables- Overloading and Overriding -Exceptions - exception hierarchy - Throwing and Catching exceptions-Built-in exceptions, Creating own exceptions.

**UNIT IV** **6 Hours**

**GENERIC PROGRAMMING AND I/O STREAMS**

Generics Types - Generic Classes and Methods - Wild Cards and Type Erasure -Restrictions on Generics - Input / Output Basics - Streams - Byte streams and Character streams -Reading and Writing Console - Reading and Writing Files.

**UNIT V** **6 Hours**

**EVENT DRIVEN PROGRAMMING FILES**

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 pMenus - Dialog Boxes.

**FURTHER READINGS**

Problem solving - Logical thinking - logic - symbolic logic - truth tables - Math puzzles - magic triangles - magic squares - alphabetic puzzles - Cross number puzzles.

**1** **4 Hours**

## EXPERIMENT 1

Programs using class and methods

**2** **2 Hours**

## EXPERIMENT 2

Programs on Package implementations

**3** **4 Hours**

## EXPERIMENT 3

Inheritance implementation

**4** **2 Hours**

## EXPERIMENT 4

Inheritance via Interface and Abstract class

**5** **4 Hours**

**EXPERIMENT 5**
Application using Exception handling

**6** **2 Hours**

**EXPERIMENT 6**
Programs on Polymorphism

**7** **4 Hours**

**EXPERIMENT 7**
File handling using IO streams

**8** **2 Hours**

**EXPERIMENT 8**
Desktop applications using Applet

**9** **2 Hours**

**EXPERIMENT 9**
Implement a C program using While Looping Statement.

**10** **4 Hours**

**EXPERIMENT 10**
Implementation of Jumping Statements

**11** **5 Hours**

**EXPERIMENT 11**
Implementation of One Dimensional Array.

**12** **2 Hours**

**EXPERIMENT 12**
Implementation of Two Dimensional Array.

**13** **4 Hours**

**EXPERIMENT 13**
Implement a C program to perform String Manipulation Functions.

**14** **2 Hours**

**EXPERIMENT 14**
Implement a C program using structures.

**15** **2 Hours**

**EXPERIMENT 15**
Implement a C program which includes four categories of functions and recursive functions.

**Total: 75 Hours**

**Reference(s)**

1. Herbert Schildt, Java: The Complete Reference, 11th Edition, McGraw Hill Education, Dec 2018.
2. Cay S Horstmann, Gary Cornell, Core Java Volume - I Fundamentals,9th Edition, Prentice Hall, 2013.
3. Cay S Horstmann, Gary Cornell, Core Java Volume - II Advanced Features,9th Edition, Prentice Hall, 2013.
4. Kernighan B W and Ritchie O M, The C programming Language. Prentice-Hall of India, 2009
5. Rajkumar Buyya, S Thamarai Selvi, Xingchen Chu, Object Oriented Programming with Java: Essentials and Applications, Tata McGraw Hill Education Private Limited, 2009
6. Bert Bates, Kathy Sierra, Head First Java, 2nd Edition, OReilly Media, 2005.

## 18AG308 SURVEYING AND LEVELLING LABORATORY

**0 0 2 1**

### Course Objectives

- To impart knowledge on the basic principles of field surveying procedures
- To impart a clear understanding on the working principles and use of theodolite

### Programme Outcomes (POs)

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

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

### Course Outcomes (COs)

1. Demonstrate the various functional aspects of surveying instruments
2. Prepare topographic map including contours of any site
3. Perform a highway road alignment project and Calculate the area and volume of earthwork

### 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 | - | | - | | | | | | | | |

**1** **4 Hours**

## EXPERIMENT 1

Linear measurement and Area computation by cross staff survey and plotting

**2** **2 Hours**

## EXPERIMENT 2

Chain traversing of cropped area and error correction.

**3** **4 Hours**

**EXPERIMENT 3**
Compass Survey - radiation method-Closed compass traversing, Plotting and correction of closing error

**4** **2 Hours**

**EXPERIMENT 4**
Open compass traversing-Problems on Compass traversing

**5** **2 Hours**

**EXPERIMENT 5**
Area computation by plane table survey - radiation method

**6** **4 Hours**

**EXPERIMENT 6**
Plane table survey - intersection -Plane table traversing resection methods

**7** **2 Hours**

**EXPERIMENT 7**
Measurement of horizontal

**8** **4 Hours**

**EXPERIMENT 8**
Measurement of area using Total Station and GPS

**9** **4 Hours**

**EXPERIMENT 9**
Dumpy level- handling - shifting- Simple levelling - temporary adjustments -Differential levelling in field-Profile levelling plotting

**10** **2 Hours**

**EXPERIMENT 10**
Mid-ordinate rule, Average ordinate rule, Trapezoidal rule, Simpson rule and Coordinate method of finding area problems

**Total: 30 Hours**

**Reference(s)**

1. Punmia. B.C "Surveying (Vol- I & Vol-II)" Laxmi publications, New Delhi. 1991

## 18GE301 SOFT SKILLS - VERBAL ABILITY 0 0 2 0

**Course Objectives**

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

**Programme Outcomes (POs)**

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
k. Project Management and Finance: 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.

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**UNIT I** **15 Hours**

**INTRODUCTION**

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

**UNIT II** **15 Hours**

**BASICS OF VERBAL APTITUDE**

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

**Total: 30 Hours**

**Reference(s)**

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

## 18AG401 NUMERICAL METHODS AND STATISTICS 3 1 0 4

**Course Objectives**

- Understand the methods to solve polynomial equations and Implement the mathematical ideas for interpolation numerically.
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment
- Summarize and apply the design of experimental methodologies involved in solving problems related to engineering problems

**Programme Outcomes (POs)**

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

b. 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 equations into algebraic, transcendental or simultaneous and apply the techniques to solve them numerically.
2. Find the interpolation, differentiation and integration of functions using the numerical techniques.
3. Compute the occurrence of numerical errors.
4. Apply basic statistical inference techniques, including confidence intervals, hypothesis testing to science/engineering problems.
5. Apply the concept of design of experiment to science/engineering problems.

**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 | - | | | | | | | | | | | | |
| 4 | 3 | 3 | | | | | | | | | | | | |
| 5 | 3 | - | | | | | | | | | | | | |

**UNIT I** **10 Hours**

**NUMERICAL SOLUTION OF BOUNDARY VALUE PROBLEM**

Single and multi-variable nonlinear equations, convergence of fixed point iterations. Least squares approximation, Normal equations. Polynomial interpolation and cubic spline interpolation. Single step methods, Runge-Kutta methods. Multi-step methods. Finite Difference Methods.

**UNIT II** **10 Hours**

**NUMERICAL SOLUTIONS OF SYSTEM OF LINEAR EQUATIONS**

Systems of linear equations: The Gaussian elimination method and the Gauss-seidal method. Eigenvalues and eigenvectors by Power method, Inverse of a Matrix by Gauss-Jordan method.

**UNIT III** **6 Hours**

**ERROR ANALYSIS**

Errors, Truncation and round off errors, measurement errors, Chebychevs Polynomial and data filtering.

**UNIT IV** **10 Hours**

**MATHEMATICAL STATISTICS**

Sample mean and variance. Sampling distributions. Statistical estimation of parameters, confidence intervals. Testing of hypotheses, one-sample and two-sample inferences. Applications to statistical quality control and reliability analysis.

**UNIT V** **9 Hours**

**DESIGN OF EXPERIMENTS**

Completely randomized design - Randomized block design - Latin square design

**Total: 60 Hours**

**Reference(s)**

1. Johnson Richard A. and Bhaltacharyya Gouri K., Statistics, Principles and Methods, 3rdEdition, John Wiley, 1996.
2. Sankara Rao. K, Numerical Methods for Scientists and Engineers, Eastern Economy Edition, New Delhi.
3. Kreyszig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley,1993
4. Milton J. S. and Arnold Jesse C., Introduction to Probability and Statistics: Principles and Applications for Engineering and The Computing Sciences, McGraw Hill Inc, 3rd Edition,1995

## 18AG402 HEAT AND MASS TRANSFER 3 0 2 4

**Course Objectives**

- To impart the knowledge on heat transfer mechanisms in fluids and solids, and their applications in various heat transfer equipment
- To introduce non-dimensional numbers and their effects in governing various modes of mass transfer
- To analyze heat exchangers and methods of evaluating the performance

**Programme Outcomes (POs)**

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

b. 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.

c. 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.

d. 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.

e. 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.

f. 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.

g. 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.

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

j. 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. Assess conduction of heat in different geometries
2. Assess the concepts and types of convection in heat transfer mechanism
3. Recognize the radiation problems in various geometries
4. Analyze the performance of heat exchangers and evaporators
5. Understand the various modes of mass transfer and apply them in engineering problems

**Articulation Matrix**

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

**UNIT I** **9 Hours**

**CONDUCTION**

Basic concepts - Mechanism of Heat transfer. Conduction - Fourier"s Law, General differential equation in Cartesian and cylindrical coordinates, one dimensional steady state heat conduction, conduction through plane wall, cylinders and spherical systems.

**UNIT II** **9 Hours**

**CONVECTION**

Basic Concepts - Heat transfer coefficients, boundary layer concept. Types of convection - Forced convection, dimensional analysis, non-dimensional numbers, external flow, flow over plates, cylinders and spheres, internal flow, laminar and turbulent flow, combined laminar andturbulent.

**UNIT III** **9 Hours**

**RADIATION**

Radiation heat transfer - concept of black and grey body-Laws of Radiation - Stefan-Boltzmann Law, Kirchhoff"s Law Black body radiation - Grey body radiation - Shape factor algebra - Radiation shields

**UNIT IV** **9 Hours**

**HEAT EXCHANGERS**

Heat exchangers - Types, heat exchanger analysis, fouling factor, LMTD (Logarithmic mean temperature difference) and Effectiveness-NTU (number of transfer units) Method - Overall Heat Transfer Coefficient

**UNIT V** **9 Hours**

**MASS TRANSFER**

Mass transfer- introduction - Fick law for molecular diffusion - molecular diffusion in gases - equimolar counters diffusion in gases- diffusion through a varying cross sectional area- diffusion coefficients for gases - molecular diffusion in liquids

**FOR FURTHER READINGS**

Application of Heat and Mass transfer in Food Processing industries.

**1**

**2 Hours**

## EXPERIMENT 1

Calculate the thermal conductivity of lagged pipe

**2** **4 Hours**

**EXPERIMENT 2**
Determination of thermal conductivity of metal rod

**3** **2 Hours**

**EXPERIMENT 3**
Calculate the thermal conductivity of insulating material

**4** **2 Hours**

**EXPERIMENT 4**
Determination of heat transfer co-efficient by natural convection

**5** **2 Hours**

**EXPERIMENT 5**
Determination of heat transfer co-efficient by forced convection

**6** **2 Hours**

**EXPERIMENT 6**
Determination of heat exchanger test - parallel and counter flow

**7** **4 Hours**

**EXPERIMENT 7**
Determine the thermal conductivity of guarded hot plate

**8** **4 Hours**

**EXPERIMENT 8**
Determination of Stefan-Boltzmann constant

**9** **4 Hours**

**EXPERIMENT 9**
Determination of emissivity using emissivity apparatus

**10** **4 Hours**

**EXPERIMENT 10**
Determine the thermal conductivity of guarded hot plate

**Total: 75 Hours**

**Reference(s)**

1. R. C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, NewAgeInternational private limited, New Delhi, 2010
2. Yunus A. Cengel, Heat and Mass Transfer: a Practical Approach, Tata McGraw Hillpublishing Company private limited, New Delhi, 2007
3. J. P. Holman, Heat Transfer, Tata McGraw Hill publishing Company private limited, NewDelhi, 2009
4. C. P. Kothandaraman and S. Subramanyan, Fundamentals of Heat and Mass Transfer, NewAge International private limited, New Delhi, 2014

5. Frank P. Incropera,Fundamentals of Heat and Mass Transfer, John Wiley, New Delhi, 2007
6. Heat and Mass Transfer, S Chand and Company, New Delhi, 2009

## 18AG403 HYDROLOGY **3 1 0 4**

**Course Objectives**

- To acquire knowledge about the fundamentals of water occurrence and their exploitation
- To understand the hydrology of surface and ground water
- To understand well hydraulics so as to locate wells for the extraction of groundwater

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
f. 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.
g. 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.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel

**Course Outcomes (COs)**

1. Execute the hydrologic cycle and measure the interception losses including evaporation, transpiration, infiltration and infiltration indices
2. Organize the methods of estimation of runoff and construct the hydrographs based on different methods
3. Differentiate the types of geological formations classify the aquifer based on the occurrence of groundwater
4. Assess the ground water flow and estimate the aquifer parameters by following various methods based on the groundwater movement and geological formation
5. Inspect the well losses and yield for well development and design of open and bore well including its diameters, depth and screen

**Articulation Matrix**

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

**UNIT I** **9 Hours**

**HYDROLOGIC CYCLE AND INITIAL LOSSES**

Hydrologic cycle- Precipitation - Forms and measurement of precipitation - Water losses interception loss-evaporation- transpiration - infiltration -infiltration capacity mechanics of infiltration-Factors influencing the rate of infiltration measurement of infiltration infiltration equations Infiltration indices - index W index problems.

**UNIT II** **9 Hours**

**RUNOFF**

Stream types - run off process - phases of runoff process factors affecting run off Different methods of Estimation of runoff Intensity, duration, frequency relationship Estimation of runoff by empirical formulae Stream flow and stream gauging

**UNIT III** **9 Hours**

**HYDROGRAPH**

Hydrograph- Hydrograph components - base flow separation - Unit hydrograph - unit hydrograph theory - purposes of unit hydrograph - Derivation of unit hydrograph for multiple durations from unit hydrograph of specified duration super position technique and curve method.

**UNIT IV** **9 Hours**

**GROUNDWATER FLOW**

Groundwater- development- potential in India- Aquifer properties- Land subsidence due togroundwater withdrawal-Types of aquifer - confined unconfined perched artesian- aquifuge - aquiclude Movement of groundwater Darcys law- Water table contour maps- Flow net analysis -Groundwater flow potential, unconfined-steady 1-dflow- with recharge, confined 1d-flow-Continuity equation derivation - Hydraulics of wells- Steady radial flow into wells-Unsteady state confined aquifer-Theis method, Jacob method.

**UNIT V** **9 Hours**

**WELLS**

Recuperation test- Leaky artesian aquifer-unsteady radial flow -Unconfined aquifer- unsteady radial flow, Image well theory -Partially penetrating wells-Well losses-Step draw down test- yield -Geophysical investigation-Surface methods -Subsurface methods -Wells design-diameter- depth- screen- Open well versus bore wells- design-bore wells- infiltration galleries- Well development -yield testing.

**FOR FURTHER READING**

Flood routing and reservoir operation, well drilling machineries pumps and their maintenance.

**Total: 60 Hours**

**Reference(s)**

1. Subramanya, K., Engineering Hydrology, Tata McGraw Hill pub Co. New Delhi, 2004
2. Raghunath, H.M., Groundwater, Wiley Eastern Ltd. Madras, 2003
3. Gurmel Singh et al.Manual of soil and water conservation practices, Oxford & IBH publishing Co. New Delhi,2005
4. Suresh, R.Land and water management principles, Standard Publishers & Distributors, New Delhi,2008
5. H.P. Garg, Advances in Solar Energy Technology Volume 2, Industrial Applications of Solar Energy, ISBN: 978-94-010-8188-7 (Print), Springer Publications., 1987.
6. Jui Sheng Hsieh, Solar Energy Engineering, Prentice Hall, London, 1986

**2 0 2 3**

## 18AG404 PRODUCTION TECHNOLOGY OF HORTICULTURAL CROPS

### Course Objectives

- To impart knowledge on horticultural crops such as fruits, vegetables, flowers and plantation crops and their cultivation techniques to increase the production
- To acquire the knowledge on the nursery production techniques, landscape design and management.
- Learn the management of crops including soil / irrigation / pest and diseases management
- To learn about harvesting, handling, value addition and storage of horticultural products

### Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
f. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

k. Project Management and Finance: 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.

### Course Outcomes (COs)

1. Execute the various cultivation practices for raising different horticultural crops such as fruits, vegetables, cut flowers, potted plants, bedding plants, and bulbs and floral design
2. Implement the concepts and principles of dry land, garden land horticulture and precision farming
3. Assess the production technology of fruits and vegetables medicine plants
4. Execute the various harvesting methods for fruits and vegetables
5. Analyse the various harvesting methods, pre cooling, packaging and storage methods of horticultural crops

**Articulation Matrix**

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

**UNIT I** **6 Hours**

**FUNDAMENTALS OF HORTICULTURE**

Horticulture - Definition - scope and importance - Division and classification of horticultural crops Fruits, Vegetables, Flowers, Plantation crops, medicinal crops and their significance - Nutritive value of horticultural crops

**UNIT II** **6 Hours**

**PROPAGATION AND CROP MANAGEMENT TECHNIQUES**

Nursery techniques - propagation of Propagation - definition - propagation methods - seed propagation- vegetative propagation - Weed management - irrigation and moisture conservation - Nutrition of horticultural crops and application methods in horticultural crops

**UNIT III** **6 Hours**

**PRODUCTION TECHNOLOGY OF FRUITS AND VEGETABLES**

Production techniques of mango, banana, grapes, citrus, pomegranate, guava - Production techniques of brinjal, bhendi, tomato, chillies, cole vegetables, cucurbits viz., pumpkin, bitter gourd, snakegourd, ribbed gourd and greens

**UNIT IV** **6 Hours**

**PRODUCTION OF FLOWRS, PLANTATION AND MEDICINAL CROPS**

Cultivation practices of folwer crops viz., rose, jasmine, Tuberose, chrysanthemum - cultivation practices of plantation crops viz., coconut, arecanut, tea, coffee - cultivation of medicinal plants viz.,Coleus, Ocimum, mint

**UNIT V** **6 Hours**

**POST HARVEST TECHNOLOGY AND MACHINERIES**

Tools and machineries utilized for cultivation, protection and harvesting of horticultural crops - Postharvest techniques - processing and value addition - storage - package - marketing and export potential of horticulture produce

**FOR FURTHER READING**

Production of organic horticulture products by avoiding chemical fertilizers and pesticides -Case studies on commercial horticultural ventures and precision farming

**1**

**2 Hours**

## EXPERIMENT 1

Practicing cultivation of vegetables-bhendi/ tomato/ brinjal crops

**2** **2 Hours**

**EXPERIMENT 2**
Identification and production techniques for fruit crops.

**3** **4 Hours**

**EXPERIMENT 3**
Identification and production techniques for commercial flower crops.

**4** **4 Hours**

**EXPERIMENT 4**
Identification and production techniques for plantation crops- coconut& areca nut

**5** **2 Hours**

**EXPERIMENT 5**
Identification and production techniques for medicinal and aromatic crops.

**6** **4 Hours**

**EXPERIMENT 6**
Practicing different techniques for seeds/ seedling production/ propagation methods–budding and grafting

**7** **4 Hours**

**EXPERIMENT 7**
Practicing different Irrigation/ fertilizer application and weed management practices.

**8** **4 Hours**

**EXPERIMENT 8**
Lawn making landscape designing.

**9** **4 Hours**

**EXPERIMENT 9**
Value addition techniques for horticulture produces

**Total: 60 Hours**

**Reference(s)**

1. Thamburaj, S., M.Kannan and V.Kanthaswamy.1997. Horticultural crop varities released from TNAU.KRS offset printers Coimbatore.
2. Veeraragavathatham, D 1998. A Guide on vegetable culture. Suri Associates, Coimbatore.
3. George Acquaah. 2002. Horticulture-principles and practices, Prentice-Half of India Pvt. Ltd., New Delhi.
4. Veeraragavathatham, M 2004 Scientific fruit culture. Suri Associate, Coimbatore.
5. Sarangi, A.B and S.Datta 2015. Value addition of horticultural crops. Springer, Delhi.
6. Gupta, S.N. 2016. Instant horticulture, Jain brothers, New Delhi.

## 18AG405 TRACTOR AND FARM ENGNIES 3 0 0 3

**Course Objectives**

- To acquire an in-depth knowledge on farm tractors and engine systems
- To acquire knowledge on test procedures to assess the performance of tractors and power tillers
- To develop skills on safe and efficient use of tractors

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
l. 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.

m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel

**Course Outcomes (COs)**

1. Implement the knowledge on tractors, power tillers and their functions
2. Execute and rectify problems in the functioning of tractors and power tillers
3. Show the knowledge on test procedures to assess the performance of tractors and power tillers
4. Show the knowledge on ergonomic aspects of tractors and power tillers
5. Execute the economics of operation of tractors and power tillers

**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 | - | | 2 | 1 | | | | | | 1 | 1 | |
| 3 | 1 | 2 | 1 | | - | | | 3 | | | | | | |
| 4 | - | - | | - | 3 | 2 | - | - | | | | | | |
| 5 | - | | | 2 | | | - | | - | 3 | | | 1 | |

**UNIT I** **9 Hours**

**ENGINE SYSTEMS 1**

Classification of tractors - Tractor engines construction of engine blocks, cylinder head and crankcase - features of cylinder, piston, connecting rod and crankshaft firing order- combustion chambers.

**UNIT II** **9 Hours**

**ENGINE SYSTEMS 2**

Valves-inlet and outlet valves valve timing diagram. Air cleaner- exhaust silencer. Cooling systems - lubricating systems - fuel system governor- electrical system.

**UNIT III** **9 Hours**

**TRANSMISSION SYSTEMS**

Transmission - clutch - gear box - sliding mesh - constant mesh - synchro mesh. Differential, final drive and wheels. Steering geometry - steering systems - front axle and wheel alignment. Brake - types system- PTO and its uses.

**UNIT IV** **9 Hours**

**HYDRAULIC SYSTEMS**

Hydraulic system - working principles - uses, three point linkage - draft control - weight transfer, theory of traction - tractive efficiency tractor chassis mechanics - stability - longitudinal and lateral. Controls - visibility - operas seat.

**UNIT V** **9 Hours**

**POWER TILLER AND TRACTOR TESTING**

Power tiller - special features - clutch - gear box - steering and brake. Makes of tractors and power tillers. Types of tests- test procedure - need for testing & evaluation of farm tractor -Test code for performance testing of tractors and power tillers.

**Total: 45 Hours**

**FOR FURTHER READING**

Testing procedures available at Bhudni tractor testing centre, Madhya Pradesh- comparative evaluation of specifications of different tractors and power tillers

**Reference(s)**

1. Rajeev Kumar, Farm Power and Machinery Engineering (English), First Edition, Standard publishers and distributors, New Delhi. ISBN-10 8180140253, 2008
2. Arun Dahake, An Introduction to Farm Power and Machinery, ISBN No. 9781312800885, (Standard Copyright License), 1st Edition, www.lulu.com, 2015

3. Donnell Hunt, Farm Power and Machinery Management, Publisher: Iowa State Press, ISBN 0813805821, 1995.
4. Barger,E.L., J.B. Liljedahl and E.C. McKibben, Tractors and their Power Units, Wiley Eastern Pvt. Ltd., New Delhi, 1997
5. Jain,S.C. and C.R. Rai, Farm tractor maintenance and repair. Standard publishers and distributors, New Delhi, 1999

# 18AG406 FARM STRUCTURES AND GREEN HOUSE TECHNOLOGY

**3 1 0 4**

## Course Objectives

- To develop theoretical and practical knowledge on the various components of afarmstead
- To develop theoretical and practical knowledge on the various animal housing
- To gain the knowledge on the design of different types and components of farmstructures
- To impart knowledge on design and construction of farm structures

## Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
f. 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.
g. 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.
l. 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. Implement the basics of farmstead construction and determine suitable site for their construction
2. Design poultry house, dairy barn and aquaculture systems
3. Design farm feed and storage structures and assess the factors influencing storage structure design
4. Design roads, water supply system and septic tanks for the farms
5. Apply the knowledge to design green house structures

**Articulation Matrix**

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

**UNIT I** **9 Hours**

**FARMSTEAD PLANNING AND GRAIN STORAGE**

Different types of farm buildings- farm site selection- building arrangement- indigenous food grain storage structures- need for good storage- modern grain storage and concrete bins- threshing and dryingfloors.

**UNIT II** **9 Hours**

**HOUSING OF DAIRY CATTLE AND POULTRY**

Planning and designing dairy barns- stall barns and loose houses- milking parlor-waste management - poultry housing requirements- common types of poultry houses and their planning- introduction to aquacultural systems

**UNIT III** **9 Hours**

**FARM FEED STORAGE STRUCTURES AND MACHINERY SHED**

Silo-requirement- Types of silo, over ground, underground and others- Design of silos- covered an open spaces -Machinery sheds- Site selection-Types and shapes of building- Space requirements- Farm shops, building requirement and space requirement- Fencing, types of fences-fence posts

**UNIT IV** **9 Hours**

**RURAL ROADS, FARM WATER SUPPLY AND SEWAGE DISPOSAL**

Survey and planning- Geometrical design- Pavement design- Construction and maintenance- Typical rural culverts of different sizes, their hydraulic and structural design and construction- Sources of water supply- Estimation of quantity for different consumption-Capacity requirements of storage tanks- distribution systems- Design of septic tanks and sanitary structures

**UNIT V** **9 Hours**

**GREEN HOUSES**

Types- Functional design-Structural material and design-Orientation, ventilation, cooling and types of cladding material Type design - Water management in green houses

**Total: 60 Hours**

**Reference(s)**

1. T.P. Ojha and Michael, A. M. Principles of Agricultural Engineering, Vol.-I (Sixth Edition), Jain Brothers, New Delhi. 2012.
2. H.N. Van Lier, CIGR Handbook of Agricultural Engineering, Vol. I- Land and Water Management Engineering, ASAE, USA. 1999.
3. E. H. Bartali and W.Frederick, CIGR Handbook of Agricultural Engineering, Vol. IIAnimal Production and Aquacultural Engineering, ASAE, USA. 1999.

4. M.Raghupathi, Design of steel structures Tata McGraw Hill Pub. Com. New Delhi 110006, 2005 B.C.Punmia, Reinforced concrete structures Vol. I Laxmi publications, 7/21, Ansari Road, Dhryaganj, New Delhi 110 002, 2005.

## 18AG407 TRACTOR AND FARM ENGINES LABORATORY

**0 0 4 2**

**Course Objectives**

- To acquire an in-depth knowledge on farm tractors and engine systems
- To develop skills on safe and efficient use of tractors
- To acquire knowledge on test procedures to assess the performance of tractors and powertillers

**Programme Outcomes (POs)**

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

b. 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.

c. 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.

e. 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.

f. 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.

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

**Course Outcomes (COs)**

1. Explain on tractors, power tillers and their functions
2. Identify and rectify problems in the functioning of tractors and power tillers
3. Summarize ergonomic aspects of tractors and power tillers

**Articulation Matrix**

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

**1** **2 Hours**

**EXPERIMENT 1**
Hand tools used in garage - fault diagnosis

**2** **6 Hours**

**EXPERIMENT 2**
Dismantling of engine from tractor - engine disassembly (CI engine)

**3** **4 Hours**

**EXPERIMENT 3**
Piston and cylinder- inspection- reconditioning and assembly of cranking system.

**4** **4 Hours**

**EXPERIMENT 4**
Reconditioning and assembly of valve and valve actuation system

**5** **6 Hours**

**EXPERIMENT 5**
Servicing of fuel system assembly and adjustment

**6** **6 Hours**

**EXPERIMENT 6**
Servicing of fuel system assembly and adjustment

**7** **4 Hours**

**EXPERIMENT 7**
Servicing and assembly of cooling system components

**8** **6 Hours**

**EXPERIMENT 8**
Study of Gear transmission train - clutch - dismantling, inspection and reconditioning - adjustment

**9** **6 Hours**

**EXPERIMENT 9**
Dismantling of transmission system-assembly of gear box, differential and final drive

**10** **6 Hours**

**EXPERIMENT 10**
Brake and its adjustment-Steering system - assembly and adjustment-wheel tread adjustment

**11** **4 Hours**

**EXPERIMENT 11**
Study of tyres, rims and balancing methods of a tractor

**12** **6 Hours**

## EXPERIMENT 12

Operation of tractors and power tillers

**Total: 60 Hours**

**Reference(s)**

1. Arun Dahake, An Introduction to Farm Power and Machinery, ISBN No. 9781312800885, (Standard Copyright License), 1st Edition, www.lulu.com, 2015

## 18AG408 COMPUTER AIDED DESIGN LABORATORY 0 0 4 2

**Course Objectives**

- To impart training to draw orthographic views of machine components using CAD Modelling Software
- To develop the skill to create three dimensional models from orthographic views using CAD Modelling Software
- To create three dimensional assembly models and their animation using standard CADpackages

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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. Draw two dimensional drawings of engineering components using standard CAD Modelling package
2. Develop a three dimensional assembly model consisting of many components with tolerances.
3. Generate animations from three dimensional assembly models by applying various motion constraints.

**Articulation Matrix**

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

**1** **4 Hours**

**EXPERIMENT 1**

Introduction to modeling software: Practicing sketching, Dimensioning and Modelling Tools and Creating simple 3D models by using any CAD Modelling Software

**2** **6 Hours**

**EXPERIMENT 2**

Create a orthographic views of machine components from isometric component drawing

**3** **6 Hours**

**EXPERIMENT 3**

Create a two dimensional sketch diagrams of simple machine components

**4** **6 Hours**

**EXPERIMENT 4**

Create a three dimensional assembly model of bearing from detailed orthographic drawings

**5** **6 Hours**

**EXPERIMENT 5**

Create a three dimensional assembly model of bearing from detailed orthographic drawings

**6** **6 Hours**

**EXPERIMENT 6**

Create a three dimensional assembly model of I C Engine components from detailed orthographic drawings

**7** **6 Hours**

**EXPERIMENT 7**

Create a three dimensional assembly model of gear box from detailed orthographic drawings

**8** **6 Hours**

**EXPERIMENT 8**

Create a three dimensional assembly model of two wheeler suspension system from detailed orthographic drawings

**9** **6 Hours**

**EXPERIMENT 9**

Create a three dimensional assembly model of valves from detailed orthographic drawings

**10** **6 Hours**

**EXPERIMENT 10**

Create a three dimensional assembly model of simple mechanism and animate its working in modeling software

**11** **2 Hours**

**EXPERIMENT 11**

Create a three dimensional assembly model of simple energy conversion/power transmission system and animate its working using modeling software

**Total: 60 Hours**

## 18HS001 ENVIRONMENTAL SCIENCE 2 0 0 0

**Course Objectives**

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

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
g. 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. Execute the importance of interdisciplinary nature of environment studies, uses and exploitation of natural resources
2. Analyze the different types of ecosystems and biodiversity, its values and also role of professionals in protecting the environment from degradation
3. Find the existing environmental challenges related to pollution and its management
4. Select suitable strategies for sustainable management of components of environmental science
5. Assess 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

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food chains - food webs and ecological pyramids - Types of ecosystem: 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)

**FOR FURTHER READING**

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

**Total: 30 Hours**

**Reference(s)**

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

## 18GE401 SOFT SKILLS-BUSINESS ENGLISH 0 0 2 0

**Course Objectives**

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

**Programme Outcomes (POs)**

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

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

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**UNIT I** **15 Hours**

**LISTENING AND READING**

Listening for writing short answers - filling gaps in sentences - identifying topic, context and function - identify different functions of language in business situations - identify prompts -identify paraphrases of required information

Scanning - reading for gist - understanding sentence structure - error identification - identify paraphrases - cohesive words and phrases - understand the importance of analysing the distractors - identify grammatical and semantic relationships

**UNIT II** **15 Hours**

**WRITING AND SPEAKING**

Business emails - notes - memos to colleagues or friends - giving instructions - explaining a development - asking for comments - requesting information - agreeing to requests - explaining - apologising - reassuring - complaining - describing - summarising - recommending - persuading

turn - taking - sustaining interaction - initiating - responding - giving personal information - talking about present circumstances, past experiences and future plans - expressing opinion - speculating - organising a larger unit of discourse - giving information - expressing and justifying opinions - speculating -comparing and contrasting - agreeing and disagreeing

**Total: 30 Hours**

**Reference(s)**

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

## 18AG501 FARM IMPLEMENTS AND EQUIPMENT 3 0 0 3

### Course Objectives

- To learn about the different types of primary and secondary tillage implements, farm equipment and different ploughing methods
- To know about the tools and techniques used for a wide variety of different types of farming operations and landscaping
- To utilise the power tools and mounted implements with the tractor

### Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel

n. To improvise better ways to minimize the crop loss from field damage during post-harvest management and energy utilization, sorting, processing and packaging

### Course Outcomes (COs)

1. Execute the knowledge on tillage and its objectives
2. Execute the knowledge on farm mechanization
3. Implement and rectify problems in the functioning of farm implements and equipment

4. Assess the optimization of machine operations according to the local needs and the characteristics of the crops, thereby can help the farmers in executing precision farming to increase the agricultural production.
5. Assess the farmers to achieve increased labor productivity, improved yield, reduced input materials, reduced human work load and reduced losses.

**Articulation Matrix**

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

**UNIT I** **8 Hours**

**FARM MECHANIZATION**

Farm mechanization - objectives. Tillage - objectives - methods - primary tillage implements - secondary tillage implements - animal drawn ploughs - construction. Types of farm implements - trailed, mounted and semi mounted implements. Field capacity

**UNIT II** **10 Hours**

**PRIMARY TILLAGE IMPLEMENTS**

Mould board plough- attachments - mould board shapes and types. Forces acting on tillage tool- mould board plough. Disc plough - force representation on disc - Types of disc ploughs - Subsoiler, chisel plough - Rotary plough - spading machine - coir pith applicators.

**UNIT III** **10 Hours**

**SECONDARY TILLAGE IMPLEMENTS**

Cultivators - types - construction - adjustments. Disc harrows - Bund former - ridger - leveller. Basin lister - Wetland preparation implements - puddler - cage wheel - leveller. Hitch systems - vertical and horizontal hitching of pull type and mounted implements- force analysis on trailed, mounted and semi mounted implements.

**UNIT IV** **8 Hours**

**SOWING AND INTERCULTURAL EQUIPMENT**

Crop planting - methods - row crop planting systems. Seeding machines- Devices for metering seeds - furrow openers - furrow closers - types - Types of seed drills and planters-seed drill calibration - application of fertilizers - metering devices - seed cum fertilizer drill - application of liquid fertilizers. Plant protection equipment - sprayer - classification - types - duster - types - weeders - manual, power operated - wet, dry land.

**UNIT V** **9 Hours**

**HARVESTING, THRESHING AND TESTING OF FARM IMPLEMENTS**

Combine harvester - paddy, sugarcane, maize - grains harvester - thresher - multi crop thresher - digger - tapioca, potato, onion - cotton picker, groundnut harvester - fruit harvesting equipment. Testing of primary tillage equipment - MB plough, disc, chisel and sub soiler plough. Testing of secondary tillage equipment - cultivator, rotavator, disc harrow, testing of seed cum fertilizer drill, planter, sprayer.

**FOR FURTHER READING**

Ergonomics and Automation - Ergonomic aspects of farm implements - automation of agricultural machinery - latest developments in automation by referring to international and national journals in agricultural engineering

**Total: 45 Hours**

**Reference(s)**

1. Donnell Hunt. 2013. Farm power and machinery management. Scientific International Pvt. Ltd. New Delhi.
2. Harris Pearson Smith et al. 1996. Farm machinery and equipments. Tata McGraw-Hill pub., New Delhi.
3. Journal of Agricultural Engineering (JAE). Indian Society of Agricultural Engineers. New Delhi - 110012
4. Agricultural Engineering Today (AET). Indian Society of Agricultural Engineers. New Delhi - 110012
5. Transactions of American Society of Agricultural and Biological Engineers. ISSN-0001-2351
6. Soil and Tillage Research, ISSN-0167-1987

**3 0 2 4**

## 18AG502 SOIL AND WATER CONSERVATION ENGINEERING

**Course Objectives**

- To acquire the fundamental understanding of soil conservation practices and erosion control structures
- To develop skills on water conservation and harvesting
- To provide knowledge on watershed development and management

**Programme Outcomes (POs)**

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

d. 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.
e. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

**Course Outcomes (COs)**

1. Organize the causes of soil erosion, types of soil erosion and assess the total soil loss for watershed
2. Design the gully control structures for controlling the landslides
3. Design the agronomic and mechanical measures for controlling soil erosion
4. Organize the water harvesting structures for insitu and exsitu water conservation
5. Execute the watershed development programme with land capability classification for watershed management

**Articulation Matrix**

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

**UNIT I** **10 Hours**

**SOIL EROSION**

Problems of soil erosion - Geological and Accelerated erosion, Factors affecting water erosion, Types of water erosion - Splash, sheet and rill, Gully, stream bank and road erosion and ravines, Universal Soil Loss Equation (USLE) & soil loss tolerance, Measurement of runoff and soil loss Ã¢??Runoff plot- Multislot divisor unit - Coshocton rotating wheel sampler -Sediment yield and sedimentation, Wind erosion mechanics - Methods of estimation of wind erosion - Desertification, deforestation and shifting cultivation

**UNIT II** **10 Hours**

**EROSION CONTROL**

Erosion control measures, Contour bunds and Graded bunds, Broad beds and furrows, wide based terraces and dykes, Random tie ridging, basin listing and mulching, Bench terraces, stone walls and contour trenches, - Contour cultivation, strip cropping, mixed cropping, mixed farming, crop rotation for erosion control, Afforestation - Diversion drains and vegetative water ways,

**UNIT III** **9 Hours**

**GULLY CONTROL STRUCTURES**

Gully control and control of landslides, Temporary gully control measures, Permanent Gully Control Structures - Wind erosion control - wind breaks and shelter belts

**UNIT IV** **8 Hours**

**WATERSHED MANAGEMENT**

Watershed - concept - planning, Principles - Components of watershed development - Watershed management plan - Biological. Watershed management plan Engineering.

**UNIT V** **8 Hours**

**WATER HARVESTING**

Water harvesting methods, Farm pond - lined and unlined - Computation of capacity, Percolation pond - Selection of site - components, Dry farming techniques for improving crop production,

**FOR FURTHER READING**

Applications-Basic agronomical measures-Grassland management-watershed development twasteland development-case studies.

**1** **4 Hours**

**EXPERIMENT 1**
Problems of soil erosion - Geological and Accelerated erosion, adverse effects of water and wind erosion. Factors affecting water erosion.

**2** **4 Hours**

**EXPERIMENT 2**
Universal Soil Loss Equation (USLE)

**3** **4 Hours**

**EXPERIMENT 3**
Soil erodibility Index - erodibility nature of soils. Slope, slope length and topographical factors

**4** **4 Hours**

**EXPERIMENT 4**
Measurement of runoff and soil loss

**5** **2 Hours**

**EXPERIMENT 5**
Wind erosion mechanics and factors affecting wind erosion.

**6** **4 Hours**

**EXPERIMENT 6**
Methods of estimation of wind erosion

**7** **4 Hours**

**EXPERIMENT 7**
Desertification, deforestation and shifting cultivation.

**8** **4 Hours**

**EXPERIMENT 8**
Types of erosion control measures

**Total: 75 Hours**

**Reference(s)**

1. R. Suresh, Soil and Water Conservation Engineering, Standard Publishers & Distributors, New Delhi, 2000.
2. Ghanshyam Das, Hydrology and Soil Conservation Engineering Prentice-Hall of India Pvt Ltd., New Delhi, 2000
3. Glenn and O. Schwab, Soil and water Conservation Engineering, John Wiley and sons, New York, 1981.
4. B.C., Mal, Introduction to soil and water Conservation Engineering, Kalyani Publishers, New Delhi, 2002.
5. Gurmel Singh et al, Manual of soil and water conservation practices. Oxford & IBH Publishing Co, New Delhi, 1996.

6. A.M. Michael, and T.P. Ojha, Principles of Agricultural Engineering Vol II Jain Brothers, New Delhi, 1980

## 18AG503 UNIT OPERATIONS IN AGRICULTURAL PROCESS ENGINEERING 3 0 0 3

**Course Objectives**

- To introduce scope, importance and key concepts of agro processing
- To expose the fundamentals of various unit operations of processing industries such as evaporation, concentration, mechanical separation, size reduction equipment, etc.
- Acquire the knowledge on distillation, membrane separation needed for the extraction of liquid fuels such as ethanol, methanol, etc

**Programme Outcomes (POs)**

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

c. 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.
d. 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.
e. 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.
g. 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.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. 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.
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

**Course Outcomes (COs)**

1. Execute the evaporation process and types of evaporators for food industry
2. Analyze the principles of filtration and mechanical separation equipment
3. Assess the size reduction and grinding equipment and understand the factors affecting the process
4. Find the gas-liquid and solid-liquid equilibrium concepts and factors influencing equilibrium separation process.
5. Differentiate crystallization and distillation processes and identify processing equipment.

**Articulation Matrix**

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

**UNIT I** **8 Hours**

**EVAPORATION AND CONCENTRATION**

Unit operations in food processing - conservation of mass and energy - overall view of an engineering process-dimensions and units - dimensional and unit consistency - dimensionless ratios-evaporation - definition - liquid characteristics - single and multiple effect evaporation- types of evaporators performance of evaporators and boiling point elevation - capacity - economy and heat balance - evaporation of heat sensitive materials

**UNIT II** **8 Hours**

**MECHANICAL SEPARATION**

Filtration - definition - filter media - types and requirements-constant rate filtration constant pressure filtration - filter cake resistance-filtration equipment - rotary vacuum filter - filter press sedimentation - gravitational sedimentation of particles in a fluid - Stoke's law, sedimentation of particles in gas-cyclones - settling under sedimentation and gravitational sedimentation-centrifugal separations - rate of separations - liquid-liquid separation - centrifuge equipment

**UNIT III** **9 Hours**

**SIZE REDUCTION AND MIXING**

Size reduction - grinding and cutting - principles of comminuting - characteristics of comminuted products - particle size distribution in comminuted products-energy and power requirements in comminuting - crushing efficiency - Rittinger's, Bond's and Kick's laws for crushing-size reduction equipment - crushers - jaw crusher, gyratory crusher-crushing rolls - grinders - hammer mills-rolling compression mills - attrition, rod, ball and tube mills - construction and operation. Mixing -Characteristics of mixtures - Measurement of mixing sample size sample compositions - Particle mixing - mixing index - Rates of Mixing - mixing times - Energy Input in Mixing equipment.

**UNIT IV** **10 Hours**

**CONTACT EQUILIBRIUM SEPARATION**

Contact equilibrium separation processes - concentrations - gas-liquid and solid-liquid equilibrium - equilibrium concentration relationships - operating conditions-calculation of separation in contact equilibrium processes-gas absorption - rate of gas absorption - stage - equilibrium gas absorption and equipment-properties of tower packing - types - construction - flow through packed towers-extraction - rate of extraction stage equilibrium extraction-equipment for leaching coarse solids intermediate solids - basket extractor-extraction of fine material - Dorr agitator - continuous leaching decantation systems - extraction towers-washing equipment

**UNIT V** **10 Hours**

**CRYSTALLIZATION AND DISTILLATION**

Crystallization - equilibrium -solubility and equilibrium diagram - rate of crystal growth - equilibrium crystallization-crystallization equipment - classification - construction and operation-tank, agitated batch, Swenson-Walker vacuum crystallizers-distillation - binary mixtures - flash and differential distillation-steam distillation - theory - consumption - continuous distillation with rectification - vacuum distillation - batch distillation - operation and process - advantages and limitations - azeotropic distillation-distillation equipment - construction and operation - factors influencing the operation.

**FOR FURTHER READINGS**
Unit operations involved in various food processing.

**Total: 45 Hours**

**Reference(s)**

1. Geankoplis,C.J., Transport Process and Unit Operations, Prentice-Hall of India Private Limited, New Delhi, 1999
2. Coulson,J.M. and J.F. Richardson, Chemical Engineering, Volume I to V. The Pergamon Press, New York, 1999

## 18AG504 IOT IN AGRICULTURAL SYSTEMS

**3 0 2 4**

**COURSE OBJECTIVE**

- To know the operation of various electronic circuits and its applications.
- To get adequate knowledge about various sensors used in agriculture processes
- To learn optimization techniques and e-governance in agricultural system

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
l. 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 working operations of electronic devices and processors
2. Implement the necessity of sensor requirements to analyse the soil parameters required for the field
3. Implement various on-line measurement of plant growth and management of crop growth in green houses using various sensors
4. Assess the basic statistical tools and optimization technique that can be used to analyse the data collected in modern agriculture business
5. Implement the concept of Information Technology in governing the agricultural systems

**Articulation Matrix**

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

**UNIT I** **9 Hours**

**BASIC ELECTRONICS CIRCUITS**

Passive devices -semi conductor devices - transistors - diode circuits - amplifier circuits- oscillator circuits-thyristor circuits-Integrated circuits and operational amplifier - logic gates - flip flop - countersdigital to analog - analog to digital converters microprocessor introduction

**UNIT II** **9 Hours**

**PRECISION FARMING**

Precision agriculture and agricultural management-Ground based sensors, Remote sensing, GPS, GIS and mapping software, Yield mapping systems, Crop production modeling.

**UNIT III** **9 Hours**

**ENVIRONMENT CONTROL SYSTEM**

Artificial light systems, management of crop growth in greenhouses, simulation of CO2 consumption in greenhouses, on-line measurement of plant growth in the greenhouse, models of plant production and expert systems in horticulture. Understanding and predicting world's climate system

**UNIT IV** **9 Hours**

**AGRICULTURAL SYSTEMSMANAGEMENT**

Agricultural systems - managerial overview, Reliability of agricultural systems, Simulation of crop growth and field operations, Optimizing the use of resources, Linear programming, Project scheduling, Artificial intelligence and decision support systems.

**UNIT V** **9 Hours**

**E-G OVERNANCE IN AGRICULTURAL SYSTEMS**

Concept of Information Technology (IT) and its application potential. Role of IT in natural resources management. Expert systems, decision support systems, Agricultural and biological databases, e-commerce, e-business systems & applications, Technology enhanced learning systems and solutions, e-learning, Rural development and information society. Internet application tools and web technology.

**1** **2 Hours**

**EXPERIMENT 1**

Design an automatic control of water pump in the agricultural field based on soil moisture content

**2** **4 Hours**

**EXPERIMENT 2**

Implement the smart agricultural system to control soil pH and NPK parameters by using IOT

**3** **4 Hours**

**EXPERIMENT 3**

Design a control system for greenhouse environment and monitor the parameters on Android application

**4** **4 Hours**

**EXPERIMENT 4**

Design an IOT based hydroponic system with artificial LED light for smart home farming of lettuce

**5** **4 Hours**

**EXPERIMENT 5**

Demonstrate an IOT based weather monitoring and reporting system for specific location using Think Speak app

**6** **4 Hours**

**EXPERIMENT 6**

Implement an IOT based self-tracking solar powered irrigation system

**7** **4 Hours**

**EXPERIMENT 7**

Design a drone system for automatic spraying of pesticide in the agricultural field

**8** **4 Hours**

**EXPERIMENT 8**

Design an autonomous disease identification robot that drives around greenhouse environment by using raspberry Pi camera system

**Total: 75 Hours**

**Reference(s)**

1. Hammer, G.L., Nicholls, N., and Mitchell, C., Applications of Seasonal Climate, Springer, Germany, 20
2. Peart, R.M., and Shoup, W. D., Agricultural Systems Management, Marcel Dekker, New York, 2004.
3. National Research Council, Precision Agriculture in the 21st Century, National Academies Press, Canada, 1997.
4. H. Krug, Liebig, H.P. International Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation, 1989.

## 18AG507 FARM IMPLEMENTS AND EQUIPMENT LABORATORY

**0 0 2 1**

**Course Objectives**

- To learn about the tools and techniques used for a wide variety of different types of farming operations and landscaping
- To utilize the power tools and mounted implements with the tractor
- To develop skills on safe and efficient use of tractors and power tillers

**Programme Outcomes (POs)**

f. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
g. 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.
h. 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.
i. 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.
j. 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.
g. 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.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. 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. Utilise the power tools and mounted implements with the tractor
2. Possess skills on safe and efficient use of tractors and power tillers
3. Learn about the tools and techniques used for a wide variety of different types of farming operations and landscaping
4. Run an Agro Service Centre for Farm Machinery

**Articulation Matrix**

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

**1** **2 Hours**

**EXPERIMENT 1**

Operation of an animal drawn plough, measuring the draft

**2** **2 Hours**

**EXPERIMENT 2**

Operation of a tractor drawn mould board plough - adjustments - determination of field capacity

**3** **2 Hours**

**EXPERIMENT 3**

Operation of a tractor drawn disc plough - adjustments - determination of field capacity

**4** **2 Hours**

**EXPERIMENT 4**

Hitching of mounted implements to the tractor and ploughing with mounted implements

**5** **2 Hours**

**EXPERIMENT 5**

Operation of tractor drawn cultivator - adjustments- and determination of field capacity

**6** **2 Hours**

**EXPERIMENT 6**

Operation of a subsoiler - adjustments - determination of field capacity

**7** **2 Hours**

**EXPERIMENT 7**

Experiment on Calibration of seed drills

**8** **2 Hours**

**EXPERIMENT 8**

Operation of seed planter and centrifugal broadcasting device in the field

**9** **2 Hours**

**EXPERIMENT 9**

Operation of paddy transplanter and drum seeder in the field and determination of field capacity

**10** **2 Hours**

**EXPERIMENT 10**

Study of wetland implements - puddlers and tramplers

**11** **2 Hours**

**EXPERIMENT 11**
Operation and evaluation of dry land weeders and power operated weeder

**12** **2 Hours**

**EXPERIMENT 12**
Dismantling, parts identification and assembly of different components of knapsack power sprayer and duster.

**13** **2 Hours**

**EXPERIMENT 13**
Field-testing of rocker arm sprayer, power sprayer and boom sprayer and their

**14** **2 Hours**

**EXPERIMENT 14**
Study of different types of nozzles and analysis of spray pattern

**15** **2 Hours**

**EXPERIMENT 15**
Determination of operational cost of farm implement

**Total: 30 Hours**

**Reference(s)**

1. Lal, Radhey and Dutta, A.C. Agricultural Engineering through solved examples, Saroj Prakashan Publishers, Allahabad, 1971
2. Krutz, Gary, Thompson Lester and Claar, Paul, Design of Agricultural Machinery", John Wiley and Sons, 1984

## 18AG508 UNIT OPERATIONS IN AGRICULTURAL PROCESS ENGINEERING LABORATORY **0 0 2 1**

**Course Objectives**

- To introduce scope, importance and key concepts of agro processing
- To expose the fundamentals of various unit operations of processing industries such as evaporation, concentration, mechanical separation, size reduction equipment, etc
- To acquire the knowledge on distillation, membrane separation needed for the extraction of liquid fuels such as ethanol, methanol, etc.

**Programme Outcomes (POs)**

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

b. 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.

c. 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.

d. 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. Examine the evaporation process and types of evaporators for food industry
2. Analyze the principles of filtration and mechanical separation equipment
3. Identify the gas-liquid and solid-liquid equilibrium concepts and factors influencing equilibrium separation process.
4. Differentiate crystallization and distillation processes and identify processing equipment.

**Articulation Matrix**

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

**1** **2 Hours**

### EXPERIMENT 1

Determination of thermal efficiency and economy of evaporator

**2** **2 Hours**

### EXPERIMENT 2

Problems on single effect and multiple effect evaporators

**3** **2 Hours**

**EXPERIMENT 3**
Determination of separation efficiency of centrifugal separator

**4** **2 Hours**

**EXPERIMENT 4**
Determination of collection efficiency in cyclone separator

**5** **2 Hours**

**EXPERIMENT 5**
Determination of efficiency of liquid-solid separation by filtration

**6** **2 Hours**

**EXPERIMENT 6**
Determination of absorption efficiency in a packing tower

**7** **2 Hours**

**EXPERIMENT 7**
Performance evaluation of a sieve and determination of particle size of granular foods by sieve analysis

**8** **2 Hours**

**EXPERIMENT 8**
Determination of energy requirement in size reduction using the burr mill

**9** **2 Hours**

**EXPERIMENT 9**
Determination of energy requirement in size reduction using the ball mill and hammer mill

**10** **2 Hours**

**EXPERIMENT 10**
Determination of mixing index for solids

**11** **2 Hours**

**EXPERIMENT 11**
Determination of economy and thermal efficiency of rotary flash evaporator for concentration of juice

**12** **2 Hours**

**EXPERIMENT 12**
Performance evaluation of a steam distillation process

**13** **2 Hours**

**EXPERIMENT 13**
Visit to a solvent extraction industry

**14** **2 Hours**

**EXPERIMENT 14**

Visit to a membrane separation based industry

**15** **2 Hours**

**EXPERIMENT 15**

Visit to a sugar industry

**Total: 30 Hours**

## 18GE501 SOFT SKILLS - APTITUDE I 0 0 2 0

**Course Objectives**

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

**Programme Outcomes (POs)**

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

**Articulation Matrix**

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

**1** **2 Hours**

### NUMBER SYSTEMS

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

**2** **2 Hours**

### PERCENTAGE

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

**3** **3 Hours**

### AVERAGES AND AGES

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

**4** **3 Hours**

**RATIO, PROPORTIONS AND VARIATION**

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

**5** **2 Hours**

**PROFIT AND LOSS**

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

**6** **2 Hours**

**TIME AND WORK**

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

**7** **2 Hours**

**TIME, SPEED AND DISTANCE**

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

**8** **3 Hours**

**CODING AND DECODING**

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

**9** **2 Hours**

**SEQUENCE AND SERIES**

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

**10** **3 Hours**

**DATA SUFFICIENCY**

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

**11** **3 Hours**

**DIRECTION**

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

**12** **3 Hours**

**CRITICAL REASONING**

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

**Total: 30 Hours**

**Reference(s)**

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

**2 0 0 2**

## 18HS002 PROFESSIONAL ETHICS IN ENGINEERING

### Course Objectives

- To understand Human Values and ethical theory.
- To understand codes of ethics, work place responsibilities, rights, engineering experimentation, global issues and contemporary ethical issues.
- To understand personal ethics, legal ethics, cultural ethics and engineers responsibility.

### Course Outcomes (COs)

1. Articulate engineering ethics theory with sustained life long learning.
2. Adopt a good character and follow high professional ethical life.
3. Contribute to shape a better character by following ethical actions.
4. Confront and resolve moral issues occurred during technological activities.
5. Resolve moral and ethical problems through exploration and assessment by established experiments.

### Articulation Matrix

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

**UNIT I** **6 Hours**

**HUMAN VALUES**

Morals and Ethics - Honesty - Integrity - Values - Work Ethic - Civic Virtue - Respect for Others - Living Peacefully - Caring and Sharing - Self-Confidence - Courage - Co-operation - Commitment - Empathy.

**UNIT II** **6 Hours**

**ENGINEERING ETHICS AND PROFESSIONALISM**

Scope of Engineering Ethics- Variety of moral issues - Types of inquiry - Accepting and sharing responsibility - Ethical dilemmas - Moral autonomy - Kohlbergs and Gilligans theory - Consensus and controversy - Profession and Professionalism - Models of Professional Roles - Right action theories - Senses of corporate responsibility - Codes of ethics: Importance - justification - limitation -Abuse.

**UNIT III** **6 Hours**

**ENGINEERING AS SOCIAL EXPERIMENTATION**

Engineering as experimentation - Engineers as responsible experimenters - Balanced outlook on law - Cautious optimism - Safety and risk - Assessing and reducing risk - Safe exits - The Challenger casestudy - Bhopal Gas Tragedy - The Three Mile Island and Chernobyl.

**UNIT IV** **6 Hours**

**WORKPLACE RESPONSIBILITIES AND RIGHTS**

Fundamental Rights - Responsibilities and Duties of Indian Citizens - Teamwork - Ethical corporate climate - Collegiality and loyalty - Managing conflict - Respect for authority - Collective bargaining - Confidentiality - Conflicts of interest - Occupational crime - Professional rights - Employee rights.

**UNIT V** **6 Hours**

**GLOBAL ISSUES**

Multinational corporations: Technology transfer and appropriate technology - International rights - promoting morally just measures - Environmental ethics: Engineering, ecology - economics - Human and sentient centred - and bio and eco centric ethics - Computer ethics and internet - Engineers as managers - Consulting engineers - Engineers as expert witnesses and advisors - Moral leadership.

**FOR FURTHER READING**

Sample code of ethics like IETE,ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management.

**Total: 30 Hours**

**Reference(s)**

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering, 4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi, 2014.
2. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi, 2012.
3. R S Naagarazan, A text book on professional ethics and human values, New age international (P)limited, New Delhi,2006.
4. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
5. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics - Concepts and Cases, Wadsworth Thompson Learning, United States, 2005.
6. http://www.slideworld.org/slidestag.aspx/human-values-and- Professional-ethics

## 18AG602 IRRIGATION AND DRAINAGE ENGINEERING **3 0 0 3**

**Course Objectives**

- To acquire a fundamental understanding of different irrigation methods
- To learn about the importance of drainage in crop production and the need to control water logging and salinization
- To develop skills on design of different irrigation and drainage systems
- To gain the knowledge on management of irrigation and drainage systems

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
f. 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.
l. 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.
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

**Course Outcomes (COs)**

1. Execute the development and utilization of water resources in India as well as Tamil Nadu and estimate the evapo-transpiration using direct and indirect methods for scheduling the irrigation for various crops
2. Determine irrigation requirements of crops and plan the irrigation schedule for different crops including irrigation efficiencies.
3. Design different methods of surface irrigation and their adaptability to the specific characteristics of soil, topography and crops
4. Execute the command area development works including on farm development works, maintenance and its economics and water distribution system like warabhandhi and rotational waters supply system
5. Design, monitor and maintain the surface and sub surface drainage systems for controlling the salinity and water logging in the agricultural area.

**Articulation Matrix**

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

**UNIT I** **9 Hours**

**WATER RESOURCE**

Water Resources- River basins-Development and Utilization in India and Tamil Nadu-Irrigation - duty and delta - Rooting characteristics-Moisture use of crop, Evapotranspiration - ET Penmanmontieth equation, Blaney-criddle method.

**UNIT II** **9 Hours**

**IRRIGATION REQUIREMENT**

Crop water requirement, Effective rainfall - Scheduling - Irrigation requirement Irrigation frequency, Irrigation efficiencies.

**UNIT III** **9 Hours**

**METHODS OF IRRIGATION**

Methods of Irrigation Border irrigation, Infiltration, Flow Retardance, Advances of water front,Recession flow, Hydraulics and design & furrow irrigation, Deep percolation losses, Run off losses,Hydraulics and design - - Land grading - Land levelling methods .

**UNIT IV** **9 Hours**

**COMMAND AREA DEVELOPMENT**

Command area - Concept, Components of CADA - CADA programmes in Tamil Nadu - On Farm Development works, Materials for lining water courses and field channel, Water control and diversion structure Execution - maintenance and economics of OFD WORKS, Farmer committee and its role for water distribution and system operation, Strategic outlet command - stream size for efficient warabandhi and rotational irrigation system.

**UNIT V** **9 Hours**

**AGRICULTURAL DRAINAGE AND SYSTEM**

Agricultural drainage - Drainage coefficient; principles of flow through soils, Darcy law -infiltration theory, Surface drainage systems - Subsurface drainage - Design of subsurface drainage- Pipe materials - mole drains, drainage wells, Leaching requirements - irrigation and drainage water quality - recycling of drainage water for irrigation.

**FOR FURTHER READING**

GIS- concept-use of GIS for identifying the areas that need drainage-design of drainage systems based on the data obtained through remote sensing from satellites.

**Total: 45 Hours**

**Reference(s)**

1. A.M.Michael, 2010. Irrigation - Theory and practice, Vikas publishers, New Delhi.
2. V. Ravikumar., M.V.Ranghaswami, K.Appavu and S.Chellamuthu, 2011, Microirrigation & Irrigation Pumps, Kalyani publishers, Ludhiana
3. . Michael Raviv and J.Heinrich Lieth. ,2013, Soil less culture, Theory and Practice, Elsevier
4. Jack Keller and Rond Bleisner 1990. Sprinkler and Trickle irrigation, Van Nostrand Reinhold, New York.
5. P.N Modi, and S.M Seth, 2010, Hydraulics and fluid mechanics, Standard bookhouse

## 18AG603 POST HARVEST TECHNOLOGY OF AGRICULTURAL CROPS

**3 0 0 3**

**Course Objectives**

- To understand better the processing of cereals, pulses, oil seeds and horticultural crops
- To know the physical and thermal properties of grains
- To understand in-depth knowledge on the theory, methods, and equipment for the various unit operations of crop processing

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
f. 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.
g. 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.
l. 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.
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

**Course Outcomes (COs)**

1. Execute better exposure to the different engineering properties of biological materials and their importance
2. Implement the working principles of grain cleaning and grading devices and able to select suitable equipment for cereal grains, oilseeds, and pulses
3. Find conveying and storage systems used for agricultural products and apply knowledge on properties of product to identify systems for the better processing
4. Apply the knowledge on the various properties of the cereals, pulses, and oil seeds for processing
5. Find post-harvest operations for horticultural crops utilize the skills on post- harvest machines to increase the market value of the processed food products

**Articulation Matrix**

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

**UNIT I** **8 Hours**

**INTRODUCTION**

Post-harvest engineering: introduction, objectives, post-harvest losses of cereals, pulses and oilseeds, importance, optimum stage of harvest. Threshing: traditional methods, mechanical threshers: types, principles and operation. Engineering properties of food materials, moisture content measurement: direct and indirect methods, moisture meters, equilibrium moisture content

**UNIT II** **10 Hours**

**CLEANING, GRADING AND DRYING**

Principles, air screen cleaners: types, adjustments. Cylinder separator, spiral separator, magnetic separator, colour sorter, inclined belt separator, length separators, effectiveness of separation and performance index. Different types of graders for cereals, pulses and oil seed crops. Drying: principles and theory of drying, thin layer and deep bed drying, hot air drying, methods of producing hot air, types of grain dryers, selection, construction, operation and maintenance of dryers, design of dryers

**UNIT III** **9 Hours**

**MATERIAL HANDLING AND STORAGE**

Material handling: belt conveyor, screw conveyor, chain conveyor, bucket elevators, pneumatic conveying. Direct and indirect types of damages, sources of infestation, traditional and modern types of storage structures: vertical, horizontal and underground storages, storage structure designs.

**UNIT IV** **9 Hours**

**PROCESSING OF CEREALS, PULSES AND OILSEEDS**

Paddy processing: parboiling of paddy, methods, merits and demerits, dehusking of paddy: methods, merits and demerits; rice polishers: types, constructional details, polishing, layout of modern rice mill, performance evaluation of modern mills. Wheat milling, pulse milling methods. Oil seed processing, Sugarcane crushing, extraction recovery and processing of jaggery. Principles and operation: maize sheller, husker sheller for maize, groundnut decorticator, castor sheller.

**UNIT V** **9 Hours**

**PROCESSING OF FRUITS AND VEGETABLES**

Physical and thermal properties of fruits and vegetables, maturity indices for fruits, cleaning and grading of fruits and vegetables. Electronic colour sorting of fruits and vegetables. Unit operation of fruit processing: blanching of fruits and vegetables, thermal processing of fruit pulps. Controlled and Modified atmospheric storage and shrink film storage of fruits and vegetables.

**FOR FURTHER READING**

Project preparation - Solar drying of grains-agro processing industries-project preparation

**Total: 45 Hours**

**Reference(s)**

1. N.N. Mohsenin, Physical Properties of Plant And Animal Materials, Gordon and Breach publishers, New York, 1986
2. W.L. McCabe and J.C. Smith, Unit Operations in Chemical Engineering, McGraw Hill Kogakusha Ltd, Tokyo, 2001

## 18AG604 TRANSFER OF AGRICULTURE TECHNOLOGY

**3 0 0 3**

**Course Objectives**

- To familiarize with proper communication techniques
- To expose the students to different extension teaching methods
- Utilizing all the electronic media for transfer of technology

**Programme Outcomes (POs)**

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

b. 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.

c. 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.

d. 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.

e. 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.

f. 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.

g. 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.

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

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

j. 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.

l. 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. Select the proper ways to Communicate
2. Organise the various extension teaching methods and communication gadgets
3. Determine the use of electronic media for transfer of technology
4. Outline of Strengthen to build experiential learning
5. Demonstrate to participate in all extension activities

**Articulation Matrix**

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

**UNIT I** **8 Hours**

**COMMUNICATION**

Communication meaning, definition, types; Communication models (Aristotle, Shanon-Weaver, Berlo, Schramm, Leagans, Rogers & Shoemaker) elements and their characteristics; Barriers in communication.

**UNIT II** **9 Hours**

**EXTENSION TEACHING METHODS**

Extension teaching methods, meaning, definition, functions, classification (individual, group, mass contact methods), merits and demerits; Audio aids, Visual aids and Audio Visual aids, definition, classification, purpose, planning, selection, combination, use; Training, definition, types, training functions of FTC, KVK, EEI, MANAGE, NAARM.

**UNIT III** **10 Hours**

**E-EXTENSION**

e- Extension, Community Radio, Internet, cyber cafes, video and teleconferencing, Interactive Multimedia Compact disk (IMCD), Agri portals, Information Kiosks, Kisan Call Centre (KCC), Mobile phone, Expert System, Village Knowledge Centre (VKC), DEMIC, consultancy clinics, Geographical Information System (GIS); Agricultural journalism (Print media), definition, principles, importance, ABC of news, types of news.

**UNIT IV** **9 Hours**

**EXPERIENTIAL LEARNING, SYSTEMS THINKING**

Experiential Learning (EL), concept, three types of learning (Scientia, Techne & Praxis), Kolbs Cycle; Systems Thinking: concept, importance, Hard System vs. Soft System, Four World Views; Modelling the Farm System: production system, human activity system, marketing system, natural resource system, management system, Supra systems.

**UNIT V** **9 Hours**

**PARTICIPATORY EXTENSION, DIFFUSION OF INNOVATIONS**

Participatory Extension Approaches: RRA, PRA; Diffusion of Innovations: definition, elements; Innovation: definition, attributes; Adoption: meaning, steps in adoption process, adopter categories, factors influencing adoption of innovations; Consequences of innovations

**FOR FURTHER READING**

The Challenger case study: Bhopal Gas Tragedy: The Three Mile Island and Chernobyl case studies: Fundamental Rights, Responsibilities and Duties of Indian Citizens: Sample code of ethics like IETE, ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management.

**Total: 45 Hours**

**Reference(s)**

1. . Mike W Martin and Roland Schinzinger, Ethics in Engineering, 4th edition, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi, 2014
2. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi, 2012.
3. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited, New Delhi, 2006.
4. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey, 2004.
5. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics Concepts and Cases, Wadsworth Thompson Learning, United States, 2005.

## 18AG607 IRRIGATION ENGINEERING LABORATORY

**0 0 2 1**

**Course Objectives**

- To acquire a fundamental understanding of different irrigation methods
- To learn about the importance of drainage in crop production and the need to control water logging and salinization
- To develop skills on design of different irrigation and drainage systems
- To gain the knowledge on management of irrigation and drainage systems

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
l. 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. Design and construct irrigation structures
2. Possess a good understanding of the factors related to drainage, essential to design, construct and manage a drainage system.
3. Design, monitor and maintain drainage systems
4. Determine water requirements of crops and the irrigation schedule for different crops

**Articulation Matrix**

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

**1** **2 Hours**

## EXPERIMENT 1

Study of River basins, irrigation projects, irrigation tanks and water resources in Tamil Nadu.

**2** **2 Hours**

**EXPERIMENT 2**
Determination of soil moisture by different methods -gravimetric and tensiometer, block and neutron probe method.

**3** **2 Hours**

**EXPERIMENT 3**
Problems on duty of water - Duty and delta relationship

**4** **2 Hours**

**EXPERIMENT 4**
Estimation of water requirement by different methods

**5** **2 Hours**

**EXPERIMENT 5**
Estimation of Evapotranspiration

**6** **2 Hours**

**EXPERIMENT 6**
Land Levelling Plane method from climatologically data

**7** **2 Hours**

**EXPERIMENT 7**
Determination of irrigation efficiencies and design of basin and furrow irrigation systems

**8** **2 Hours**

**EXPERIMENT 8**
Problems on irrigation efficiencies and design of border irrigation systems

**9** **2 Hours**

**EXPERIMENT 9**
Design of Basin and Furrow irrigation Ã¢?? Problems

**10** **2 Hours**

**EXPERIMENT 10**
Design of underground pipeline system

**11** **2 Hours**

**EXPERIMENT 11**
Problems on Irrigation scheduling

**12** **2 Hours**

**EXPERIMENT 12**
OFD works in command areas

**13** **2 Hours**

**EXPERIMENT 13**

Design of surface and sub-surface drainage systems.

**14** **2 Hours**

**EXPERIMENT 14**

Field visit to command areas and observation of OFD works

**15** **2 Hours**

**EXPERIMENT 15**

Measurement of water flow using V- notch, rectangular notch, circular notch and parshall flume

**Total: 30 Hours**

**Reference(s)**

1. Dilip Kumar Majumdar, Irrigation water Management-Principles and Practice, Prentice-Hall of India Pvt. Ltd, New Delhi, 2006
2. A.M. Michael, Irrigation -Theory and Practice, Vikas publishing house, New Delhi, 1990.
3. V.V.N. Murthy, Land and water management, Kalyani publishing, New Delhi, 1998.

## 18AG608 POST HARVEST TECHNOLOGY OF AGRICULTURAL CROPS LABORATORY

**0 0 2 1**

**Course Objectives**

- To understand better the processing of cereals, pulses, oil seeds and horticultural crops
- To know the physical and thermal properties of grains
- To understand in-depth knowledge on the theory, methods, and equipment for the various unit operations of crop processing

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
f. 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.
g. 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.
l. 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. Determine the different engineering properties of biological materials and their importance
2. Design different post harvest equipment for cereals and oil seeds
3. Determine the efficiency of various grain cleaning and milling equipment

**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 | | | | | 1 | | |
| 2 | 3 | 2 | 2 | 2 | 1 | 1 | | | | | | 1 | | |
| 3 | 3 | 2 | 2 | 2 | 1 | 1 | | | | | | 1 | | |

**1** **2 Hours**

**EXPERIMENT 1**
Determination of moisture content of grains, potato slice by oven-dry method and draw the drying characteristic curves

**2** **2 Hours**

**EXPERIMENT 2**
Determination of size, true density, bulk density and porosity of grains

**3** **2 Hours**

**EXPERIMENT 3**
Determination of coefficient of friction internal

**4** **2 Hours**

**EXPERIMENT 4**
Determination of angle of repose of different grains

**5** **2 Hours**

**EXPERIMENT 5**
Determination of milling quality of different grains

**6** **2 Hours**

**EXPERIMENT 6**
Determination of shelling efficiency of groundnut decorticator

**7** **2 Hours**

**EXPERIMENT 7**
Evaluation of thermal efficiency and heat utilization factor in a grain drier

**8** **2 Hours**

**EXPERIMENT 8**
Determination of drying characteristics of grains

**9** **2 Hours**

**EXPERIMENT 9**
Visit to a processing industry to study bucket elevator and screw conveyor

**10** **2 Hours**

**EXPERIMENT 10**
Performance evaluation of paddy parboiling drum

**11** **2 Hours**

**EXPERIMENT 11**
Evaluation of efficiency of a grain cleaning cum grading machine

**12** **2 Hours**

**EXPERIMENT 12**

Evaluation of shelling efficiency of rubber roll sheller and cone polisher

**13** **2 Hours**

**EXPERIMENT 13**

Determining the oil content of oil seeds using Soxhlet apparatus

**14** **2 Hours**

**EXPERIMENT 14**

Determination of drying characteristics of fruits and vegetables

**15** **2 Hours**

**EXPERIMENT 15**

Visit to modern rice mill/ pulse/ oil milling industries

**Total: 30 Hours**

**Reference(s)**

1. W.L. McCabe and J.C. Smith, Unit Operations in Chemical Engineering, McGraw Hill Kogakusha Ltd, Tokyo, 2001

**18GE601 SOFT SKILLS-APTITUDE II** **0 0 2 0**

**Course Objectives**

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

**Programme Outcomes (POs)**

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**1** **2 Hours**

## PERMUTATION AND COMBINATION

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

**2** **2 Hours**

## PROBABILITY

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

**3** **2 Hours**

## SYLLOGISM AND VENN DIAGRAM

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

**4** **2 Hours**

## SIMPLE INTEREST AND COMPOUND INTEREST

Introduction-Definition - Effect of change of P, R, T on simple interest-Amount-Amount becomes N times the principle-Repayment of debt in equal installments-Rate and time are numerically equal-Compound

Interest-Conversion period-Basic formula-Special cases-To find the principle / Time /Rate-Difference between Compound Interest and Simple Interest-Equal annual installment to pay the borrowed amount.

**5** **2 Hours**

**MIXTURES AND ALLIGATION**

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

**6** **2 Hours**

**CUBE AND LOGARITHM**

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

**7** **2 Hours**

**DATA INTERPRETATION**

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

**8** **2 Hours**

**PROGRESSION AND LOGICAL REASONING**

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

**9** **2 Hours**

**PROBLEM ON AGES**

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

**10** **4 Hours**

**ANALYTICAL REASONING**

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

**11** **2 Hours**

**BLOOD RELATION**

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

**12** **4 Hours**

**VISUAL REASONING**

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

**13** **2 Hours**

**SIMPLIFICATIONS**

Introduction-Basic concepts-Arithmetic operations-Equation solvingmethods-Puzzles.

**Total: 30 Hours**

**Reference(s)**

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc GrawHill Publications.
2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd,

India.

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

## 18HS003 PRINCIPLES OF MANAGEMENT

**2 0 0 2**

**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.

**Course Outcomes (COs)**

1. Students will be able to understand the basic concepts of Management.
2. Have some basic knowledge on planning process and its Tools & Techniques.
3. Ability to understand management concept of organizing and staffing.
4. Ability to understand management concept of directing.
5. Ability to understand management concept of controlling.

**Articulation Matrix**

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

**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 and 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. (2017). Management, (13th ed.), Pearson Education, New Delhi.
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 McGrawHill, 2008

**18AG702 RENEWABLE ENERGY RESOURCES 3 0 2 4**

**Course Objectives**

- To acquire knowledge about the fundamentals of renewable energy resources.
- To understand the concepts and conversion systems in harnessing.
- To apply the above concepts in meeting the energy needs in farm

**Programme Outcomes (POs)**

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

c. 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.
d. 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.
e. 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.
f. 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.
g. 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.
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

**Course Outcomes (COs)**

1. Organize the energy scenario and status of renewable energy sources and production in India
2. Execute the knowledge on thermal conversion technologies
3. Execute the knowledge on biochemical conversion technology and biofuels
4. Find the way to use solar energy conversion system (secs) and wind energy conversion system (wecs) to meet the energy requirements of farms
5. Execute the knowledge on hydro and ocean energy conversion system and energy auditing

**Articulation Matrix**

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

**UNIT I** **9 Hours**

**OVERVIEW OF RENEWABLE ENERGY SOURCES**

Classification of energy sources, Renewable Energy-Potentials and Achievements. Characterization of biomass, Densification of biomass - Briqquetting

**UNIT II** **9 Hours**

**THERMOCHEMICAL CONVERSION TECHNOLOGY (TCCT)**

Biomass Combustion Technology, Gasifiers Technology, Biomass Gasification Methods, Removal of tar and impurities from gasification, Principles of pyrolysis and methods.

**UNIT III** **9 Hours**

**BIOCHEMICAL CONVERSION TECHNOLOGY-BIOGAS (BCCT) AND BIO FUELS**

Importance of biofuels, Biogas technology, Biogas plants types, Microbiology of biogas production, Size and selection for Biogas plant, Biogas plant- materials and methods for Construction. Bio-Fuels and characteristics, Bio-Diesel, Bio-Diesel production processes, Bio-Ethanol Production, BEA, running of biofuel engines.

**UNIT IV** **9 Hours**

**SOLAR ENERGY CONVERSION SYSTEM (SECS) AND WIND ENERGY CONVERSION SYSTEM (WECS)**

Basics of Solar Photovoltaics, Recent trends in solar drying-solar tunnel drier, Solar Driers, Solar PV and water pumping, Solar Water Heater. Wind energy conversion principles, Wind mill- aero generator, Wind mill- water pumping.

**UNIT V** **9 Hours**

**HYDRO AND OCEAN ENERGY CONVERSION SYSTEM AND ENERGY AUDITING**

Hydropower Energy Sources. Hydropower types sustainabiity. Ocean Energy conversion systems, Ocean Thermal Energy Conversion (OTEC) system- thermodynamic efficiency- cycle types environmental effect- technical difficulties. Energy Auditing- carbon foot print. Clean development mechanism

**FOR FURTHER READING**

Energy Auditing and Management.

**1** **2 Hours**

## EXPERIMENT 1

Problems on solar time, basic earth sun angles

**2** **2 Hours**

## EXPERIMENT 2

Study of radiation measuring instruments - Visit to meteorology station

**3** **2 Hours**

## EXPERIMENT 3

Solving problems on thermal losses and efficiency of flat plate collectors

**4** **2 Hours**

## EXPERIMENT 4

Determination of thermal efficiency of solar water heater

**5** **2 Hours**

**EXPERIMENT 5**
Determination of thermal efficiency of natural convection solar dryer

**6** **2 Hours**

**EXPERIMENT 6**
Determination of thermal efficiency of forced convection solar dryer

**7** **2 Hours**

**EXPERIMENT 7**
Determination of thermal efficiency of solar still

**8** **2 Hours**

**EXPERIMENT 8**
Study of photovoltaic cell characteristics

**9** **2 Hours**

**EXPERIMENT 9**
Study on the performance of wind generator in the lab

**10** **2 Hours**

**EXPERIMENT 10**
Performance evaluation of a SPV water pumping system

**11** **2 Hours**

**EXPERIMENT 11**
Wind Energy conversion calculations for power generation

**12** **2 Hours**

**EXPERIMENT 12**
Design of rotor blade for horizontal axis wind mill

**13** **2 Hours**

**EXPERIMENT 13**
Study of wind measuring instruments

**14** **2 Hours**

**EXPERIMENT 14**
Visit to a solar PV power plant

**15** **2 Hours**

**EXPERIMENT 15**
Experiment on duel fuel engine

**Total: 75 Hours**

**Reference(s)**

1. H. P. Garg, Treatise on Solar Energy, Vol.1 : Fundamentals of solar energy, John Wiley & sons Ltd, 1982.
2. A.John. Duffie and William A. Beckman, Solar Engineering of Thermal Processes, 4th Edition ISBN: 978-0-470-87366-3, John Wiley and Sons Ltd, 2013
3. Jui Sheng Hsieh, Solar Energy Engineering, Prentice Hall, London,
4. H.P. Garg, Advances in Solar Energy Technology Volume 2, Industrial Applications of Solar Energy, ISBN: 978-94-010-8188-7 (Print), Springer Publications. 1987.
5. Solanki Chetan Singh, Solar Photovoltaics: Fundamentals, Technologies and Applications, Prentice-Hall Of India Pvt. Limited, 2009
6. J.F.Manwell, J.G. McGswan and A.L.Rogers, Wind Energy Explained. Theory, Design and Application, John Wiley and Sons Ltd, 2004

## 18AG703 FOOD AND DAIRY ENGINEERING 3 0 0 3

**Course Objectives**

- To acquire better understanding of the food concentration and thermal processing of foods
- To know the physical and thermal properties of milk and different methods of milk processing and milk products
- To gain knowledge on the theory, methods, and equipment for the various unit operations of dairy industry

**Programme Outcomes (POs)**

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

b. 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.

c. 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.

d. 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.

e. 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.

f. 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.

g. 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.

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

m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel

n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

**Course Outcomes (COs)**

1. Execute physical, mechanical, thermal, rheological and electrical properties of food material and appraise their importance in food processing
2. Differentiate various thermal treatment techniques for food products and select suitable thermal processing method for food products based on their properties
3. Compare food drying systems and assess their limitations in applying different food products
4. Execute physical, chemical and thermal properties of milk and compare milk processing techniques
5. Design various milk processing equipment and evaluate their performance

Articulation Matrix

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

**UNIT I** **8 Hours**

**BASIC PROPERTIES OF FOOD MATERIALS**

Constituents of food and their energy valuses - Physical, mechanical, thermal, rheological, electrical and physico-chemical properties of food materials- texture of food materials - definition - Terminologies - viscometry - basic concepts - Concentrations of foods - freeze concentration - membrane concentration

**UNIT II** **12 Hours**

**THERMAL PROCESSING OF FOODS**

Thermal processing of foods - product-time-temperature relationships - cooking, blanchingpasteurization techniques- UHT Processing - sterilization of solid and liquid foods- interaction of heat energy on food components - kinetics of microbial destruction - Decimal reduction time - Temperature dependence of kinetics - Arrhenius equation - Thermal Death Time Curves-loss of nutrient in Newtonian and non-Newtonian liquid foods-batch and continuous sterilization equipment.Preservation by retort processing - principles and applications - microwave and radio frequency heating in food processing- Canning- Aseptic packaging.

**UNIT III** **9 Hours**

**DRYING AND DEHYDRATION**

Food spoilage - causes for spoilage -Moisture content - free moisture - bound and unbound moisture - equilibrium moisture content - Water activity - sorption behaviour of foods - types of dryers - drum, spray, dryers-advantages and disadvantages - dehydration - methods of dehydration osmotic dehydration

**UNIT IV** **6 Hours**

**MILK PROCESSING**

Physical, chemical, thermal and rheological properties of milk - storage tanks. Receiving handling and testing of milk - storage. Pasteurization - application- equipment - Low Temperature Long Time - High Temperature Short Time - Ultra High Temperature pasteurization

**UNIT V** **10 Hours**

**DAIRY EQUIPMENT AND PRODUCTS**

Homogenisation - theory and working of homogenisers - high pressure homogenization of milk and other food suspensions - design criteria for homogenizing equipment- cream separation principles - types of separators. Clarifiers - butter churns - ghee manufacture - equipment - whey manufacture- techniques - equipment - ice cream freezers - condensed milk - milk powder manufacturing drying equipment - spray drier - milk products - paneer - casein - probiotic dairy products - kefir- milk plant sanitation requirements - Cleaning in-place and its functions.

**FOR FURTHER READING**

Waste utilisation and energy conservation in dairy industry - Utilisation of whey for energy generation through biomethanation, energy conservation opportunities in dairy industry and packaging of dry products.

Total: 45 Hours

**Reference(s)**

1. H.G.Kessler, Food Engineering and Dairy Technology, Freising, Germany, Verlag A.Kessler, 1981
2. Norman N. Potter and Joseph H. Hotchkiss, Food Science, Fifth Edition, Food Science Text Series, 3. ISBN: 978-1-4613-7263-9 (Print) 978-1-4615-4985-7 (Online), 1995
3. Gordon L. Robertson, Food Packaging- Principles and Practice Marcel Dekker Inc, USA, 1993
4. . Sukumar De, Outlines of Dairy: Technology, Oxford University Press, 2001

## 18AG704 RS AND GIS FOR NATURAL RESOURCE MANAGEMENT 3 0 0 3

**Course Objectives**

- To introduce the students to the basic concepts and principles of various components of remote sensing
- To study the applications of Remote Sensing and GIS in agriculture, soil and water resources
- To understand in-depth the knowledge on the theory, methods, and equipment for the various unit operations of crop processing

**Programme Outcomes (POs)**

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

b. 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.

c. 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.

d. 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.

f. 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.

g. 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.

l. 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.

m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel

n. To improvise better ways to minimize the crop loss from field damage during postharvest management and energy utilization, sorting, processing and packaging

**Course Outcomes (COs)**

1. Organize the different electromagnetic radiations and evaluate its applications in remote sensing systems and satellite data processing satellite data processing
2. Use the platform and sensors and compare its applicability in available data products
3. Analyze the Geographic Information System (GIS) images and categorize according to its application
4. Show components of Geographic Information System (GIS) and select suitable database management systems (DBMS) and modeling tool
5. Use of RS &GIS tools to create a strategy on natural resource management.

**Articulation Matrix**

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

**UNIT I** **9 Hours**

**EMR AND ITS INTERACTION WITH ATMOSPHERE**

Definition of remote sensing and its components -Electromagnetic spectrum - wavelength regions important to remote sensing - Wave theory, Particle theory, Stefan-Boltzman and Wein Displacement Law -Atmospheric scattering, absorption - Atmospheric windows - spectral signature concepts - typical spectral reflective characteristics of water, vegetation and soil.

**UNIT II** **9 Hours**

**PLATFORMS AND SENSORS**

Types of platforms - orbit types, Sun-synchronous and Geosynchronous - Passive and Active sensors resolution concept - Pay load description of important Earth Resources and Meteorological satellites-Airborne and space borne TIR and microwave sensors.

**UNIT III** **9 Hours**

**IMAGE INTERPRETATION AND ANALYSIS**

Types of Data Products - types of image interpretation - basic elements of image interpretation -visual interpretation keys - Digital Image Processing - Pre processing - image enhancement techniques - multispectral image classification - Supervised and unsupervised.

**UNIT IV** **9 Hours**

**GEOGRAPHIC INFORMATION SYSTEM**

Introduction Maps Definitions Map projections types of map projections map analysis GIS definition basic components of GIS standard GIS softwares Data type Spatial and nonspatial (attribute) data measurement scales Data Base Management Systems (DBMS) Modelling in GIS Digital Elevation Modelling

**UNIT V** **9 Hours**

**RS AND GIS APPLICATIONS**

Crop Acreage estimation - Estimation of Crop Water Requirement Crop condition - Soil mapping classification of soil with digital numbers soil erosion mapping- reservoir sedimentation using image processing - Inventory of water resources water quality assessment - Application of Remote Sensing and GIS in Precision Agriculture - Monitor Crop Health - Management Decision Support Systems

**FOR FURTHER READING**

Microwave remote sensing SAR Technology and their application in Agriculture and Soils, forestry, hydrology and disaster management

**Total: 45 Hours**

**Reference(s)**

1. Lillesand, T. M., and Kiefer, R.W., Remote Sensing and Image Interpretation, John Wiley and Sons, New York, 2000.
2. P.A. Burrough, Principle of GIS for land resources assessment, Oxford Publications, 1990.
3. Ian Heywood, an Introduction to GIS, Pearson Education, New Delhi, 2001
4. Floyd F.Sabins, Remote Sensing: Principles and Interpretation, III edition, Freeman and Company, New York, 1997
5. M.Anji Reddy, Textbook of Remote Sensing and Geographical Information System, 3rd Edition, BS Publications, 2008

## 18AG707 RS AND GIS LABORATORY 0 0 2 1

**Course Objectives**

- To understand in-depth the knowledge on the theory,methods, and equipment for the various unit operations of crop processing
- study the applications of Remote Sensing and GIS in agriculture, soil and water resources

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

**Course Outcomes (COs)**

1. Identify components of Geographic Information System (GIS) and select suitable data base management systems (DBMS) and modeling tool
2. Decide on RS &GIS tools to create a strategy on natural resource management.

**Articulation Matrix**

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

**EXPERIMENT 1**
Aerial photo interpretation - visual

**2** **2 Hours**

**EXPERIMENT 2**
Satellite images interpretation - visual

**3** **2 Hours**

**EXPERIMENT 3**
Supervised classification practice

**4** **2 Hours**

**EXPERIMENT 4**
Unsupervised classification practice

**5** **2 Hours**

**EXPERIMENT 5**
Database Management Systems

**6** **4 Hours**

**EXPERIMENT 6**
Spatial data input and editing- Digitising

**7** **4 Hours**

**EXPERIMENT 7**
Raster analysis problems - Database query

**8** **4 Hours**

**EXPERIMENT 8**
GIS applications in DEM and its analysis

**9** **4 Hours**

**EXPERIMENT 9**
GIS application in watershed analysis

**10** **4 Hours**

**EXPERIMENT 10**
GIS application in rainfall-runoff modeling

**Total: 30 Hours**

## 18AG708 FOOD AND DAIRY ENGINEERING LABORATORY

**0 0 2 1**

**Course Objectives**

- To acquire better understanding of the food concentration, and thermal processing of foods
- To know the physical and thermal properties of milk and different methods of milk processing and milk products
- To gain knowledge on the theory, methods, and equipment for the various unit operations of dairy industry

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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. Explain physical, mechanical, thermal, rheological and electrical properties of food material and appraise their importance in food processing
2. Distinguish thermal treatment techniques for food products and select suitable thermal processing method for food products based on their properties
3. Compare food drying systems and assess their limitations in applying different food products

**Articulation Matrix**

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

## EXPERIMENT 1

Measurement and estimation of textural parameters of a solid food and properties of parboiled and raw rice

**2** **2 Hours**

**EXPERIMENT 2**
Estimation of microbial load in food materials

**3** **2 Hours**

**EXPERIMENT 3**
Measurement of fat globule size in milk and determination of homogenization efficiency

**4** **2 Hours**

**EXPERIMENT 4**
Determination of water activity and construction of moisture sorption isotherm of food materials

**5** **2 Hours**

**EXPERIMENT 5**
Determination of the separation efficiency of cream separator

**6** **2 Hours**

**EXPERIMENT 6**
Estimation of thermal processing time and degree of sterilization in canned food using a batch sterilizer

**7** **2 Hours**

**EXPERIMENT 7**
Determination of overall heat transfer coefficient for an evaporator used for concentration of milk.

**8** **2 Hours**

**EXPERIMENT 8**
Determination of drying of fluid entrainment and rate of drying in a drum dryer

**9** **2 Hours**

**EXPERIMENT 9**
Analysis of performance of a spray dryer in terms of outlet temperature and its effect on final quality of the dried product

**10** **2 Hours**

**EXPERIMENT 10**
Experiment on osmotic dehydration of foods

**11** **2 Hours**

**EXPERIMENT 11**
Determination of rehydration ratio of dehydrated foods and Experiment on food extruder and determination of thermal conductivity of food materials

**12** **2 Hours**

**EXPERIMENT 12**
Experiment on microwave oven heating of food

**13** **2 Hours**

**EXPERIMENT 13**
Determination of properties of milk and problems on pasteurization of milk

**14** **2 Hours**

**EXPERIMENT 14**
Experiment on homogenizer and problems on ice-cream mix calculation and freezing of ice-cream

**15** **2 Hours**

**EXPERIMENT 15**
Visit to a dairy industry

**Total: 30 Hours**

## 18AG709 PROJECT WORK I 0 0 6 3

**Programme Outcomes (POs)**

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

b. 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.

c. 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.

d. 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.

e. 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.

g. 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.

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

j. 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.

k. Project Management and Finance: 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.

n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

**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 theproject
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness
5. Prepare report and present oral demonstrations

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | 3 | 2 | - | | | | | 1 | | 1 | | | |
| 2 | 1 | 3 | | | - | | - | | 2 | | 1 | | | |
| 3 | | - | - | 2 | 3 | | | | 1 | | 1 | | | 1 |
| 4 | - | | - | 3 | 2 | | - | | 1 | | 1 | | | |
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## 18AG801 PROJECT WORK II 0 0 18 9

**Course Objectives**

- To develop knowledge to formulate a real world problem and project goals
- To identify the various tasks of the project to determine standard procedures
- To understand the guideline to prepare report for oral demonstration

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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. 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 theproject
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness
5. Prepare report and present oral demonstrations

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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## 18HSF01 FRENCH 1 0 2 2

### Course Objectives

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

### Course Outcomes (COs)

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

### Articulation Matrix

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **9 Hours**

**ENTRER EN CONTACT**

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

**UNIT II** **9 Hours**

**PARTAGER SON LIEU DE VIE**

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

**UNIT III** **9 Hours**

**VIVRE AU QUOTIDIEN**

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

**UNIT IV** **9 Hours**

**COMPRENDRE SON ENVIRONNEMENT LA CULTURE**

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

**UNIT V** **9 Hours**

**GOUTER A LA CAMPAGNE**

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

**Total: 45 Hours**

**Reference(s)**

1. Saison A1, Methode de francais
2. Hachette FLE

## 18HS201 COMMUNICATIVE ENGLISH II 1 0 2 2

**Course Objectives**

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

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**Course Outcomes (COs)**

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

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **9 Hours**

**GRAMMAR3**

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

**UNIT II** **9 Hours**

**READING**

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

**UNIT III** **9 Hours**

**WRITING**

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

**UNIT IV** **9 Hours**

**LISTENING**

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

**UNIT V** **9 Hours**

**SPEAKING**

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

**Total: 45 Hours**

**Reference(s)**

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

## 18HSC01 CHINESE 1 0 2 2

**Course Objectives**

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

**Programme Outcomes (POs)**

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

**Course Outcomes (COs)**

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

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **9 Hours**

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

**UNIT II** **9 Hours**

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

**UNIT III** **9 Hours**

1. What"s your name - In the school; -In the classroom; -In the school
The Interrogative Pronoun
2 The Sentence
3 Interrogative Sentences with

**UNIT IV** **9 Hours**

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

**UNIT V** **9 Hours**

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

**Total: 45 Hours**

## 18HSG01 GERMAN 1 0 2 2

**Programme Outcomes (POs)**

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

**Course Outcomes (COs)**

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

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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**UNIT I** **9 Hours**

**UNIT 1**

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

**UNIT II** **9 Hours**

**UNIT 2**

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

**UNIT III** **9 Hours**

**UNIT 3**

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

**UNIT IV** **9 Hours**

**UNIT 4**

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

**UNIT V** **9 Hours**

**UNIT 5**

Verbs - to be & to have - conjugation - Hobbys - 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.

## 18HSH01 HINDI — 1 0 2 2

**Course Objectives**

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

**Course Outcomes (COs)**

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

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** — **9 Hours**

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

**UNIT II** — **9 Hours**

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

**UNIT III** — **9 Hours**

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

**UNIT IV** — **9 Hours**

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

**UNIT V** — **9 Hours**

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

**Total: 45 Hours**

**Reference(s)**

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

## 18HSJ01 JAPANESE 1 0 2 2

**Course Objectives**

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

**Course Outcomes (COs)**

1. Recognise and write Japanese alphabet
2. Speak using basic sounds of the Japanese language
3. Apply appropriate vocabulary needed for simple conversation in Japaneselanguage
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 | | | | |
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| 4 | | | | | | | | | | 2 | | | | |
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**UNIT I** **9 Hours**

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

**UNIT II** **9 Hours**

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

**UNIT III** **9 Hours**

N (tool/means) de V - Word/Sentence wa Go de Nani desu ka - N (person) Ni Agemasu, etc - N (person) Ni Moraimasu etc - Mou V Mashita - Introduction to Adjectives - N wa Na adj (Na) desu - N wa II adj (II) desu - Na adj Na n - II adj (II) N - Totemo - Amari - N wa Dou desuka - N1 wa Donna N2 desuka - S1 Ga S2 - Dore N ga Arimasu - Wakarimasu - N Ga Sukidesu - Kiraidesu - Jozu desu - Heta desu - Donna N -

Yoku - Daitai - Takusan - Sukoshi - Amari - Zenzen - S1 kara S2 - Doushite - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

**UNIT IV** **9 Hours**

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

**UNIT V** **9 Hours**

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

**Total: 45 Hours**

**Text Book(s)**

1. Japanese for Everyone: Elementary Main Textbook 1-2, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

**Reference(s)**

1. Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

## 18GE0P1 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

**Outcomes (COs)**

1. Summarize the origin **Course** 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. Explain the physical properties exhibited by nanomaterials
5. Organize the nanomaterials developed for advanced technological applications

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**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- fuel cells - 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- organic LED: basic processes, carrier injection, excitons, optimization - organic photovoltaic cells- particulate and geometrical nanomagnets-magneto resistance.

**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, Aulice Scibioh M, "Fuel cells: Principles and Applications", University Press, 2009.

# 18GE0P2 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)**

**Course Outcomes (COs)**

1. Exemplify 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 PNjunction
3. Illustrate the operation of Bipolar Junction transistor at different modes and different configurations
4. Illustrate the operation of metal oxide field effect transistor and their memorydevices
5. Represent the working mechanism of opto-electronic devices

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**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

## 18GE0P3 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)**

**Course Outcomes (COs)**

1. Illustrate the transition mechanisms and the components of a laser system
2. Compare the different types of lasers based on pumping method, active medium and energylevels
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 |
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**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.

## 18GE0C1 CORROSION SCIENCE AND ENGINEERING

**3 0 0 3**

### Course Objectives

- Understand 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)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

### Course Outcomes (COs)

1. Explain if corrosion can occur under specific operating conditions in a given equipment or construction and indicate regions of immunity, corrosion and passivity of a metal
2. Compare different corrosion types on metals when exposed to air, water and at high temperatures (> 100 C)
3. Identify the corrosion mechanism on steel, iron, zinc and copper metal surfaces
4. Calculate the rate of corrosion on metals using electrochemical methods of testing
5. Propose the correct materials, design and operation conditions to reduce the likelihood of corrosion in new equipment and constructions

### Articulation Matrix

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**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

**10 Hours**

**UNIT IV**

**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 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

**FOR FURTHER READING**

Corrosion issues in supercritical water reactor (SCWR) systems

**Total: 45 Hours**

**Reference(s)**

1. Mouafak A. Zaher, "Introduction to Corrosion Engineering", CreateSpace IndependentPublishing 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.htm

## 18GE0C2 ENERGY STORING DEVICES 3 0 0 3

**Course Objectives**

- Understand the concept, working of different types of batteries and analyze batteries used in electric vehicles
- Identify the types of fuel cells and to relate the factors of energy and environment
- Analyze various energy storage devices and fuel cells

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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. Explain the parameters required for operation of a cell to evaluate the capacity of energy storage devices
2. Identify the electrodes, electrolyte and cell reactions of different types of primary, secondary batteries and infer the selection criteria for commercial battery systems with respect to commercial applications
3. Differentiate fuel cells based on its construction, production of current and applications
4. Compare different methods of storing hydrogen fuel and its environmental applications
5. Relate energy and environmental based on the importance and types of renewable energy for sustainable development

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**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 - introduction, cell reactions, cell representations and applications - lead acid, nickel-cadmium and lithium ion batteries - rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide, lithium anode cell, photogalvanic cells. Battery specifications for cars and automobiles

**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 - 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 - photobiochemical conversion cell

**Total: 45 Hours**

**Reference(s)**

1. M. Aulice Scibioh and B. Viswanathan, Fuel Cells: Principles and Applications, University Press, India, 2009
2. F. Barbir,PEM fuel cells: Theory and practice, Elsevier, Burlington, MA, Academic Press, 2013
3. M. R. Dell Ronald and A. J. David, Understanding Batteries, Royal Society of Chemistry,2001
4. J. S. Newman and K. E. Thomas-Alyea, Electrochemical Systems, Wiley, Hoboken, NJ, 2012
5. Shripad T. Revankar, Pradip Majumdar, Fuel Cells: Principles, Design, and Analysis, CRC Press, 2016
6. Thomas B. Reddy, Linden's Handbook of Batteries, 4th Edition, McGraw Hill Professional, 2010

## 18GE0C3 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 and its processing
- Identify suitable polymers for various industrial applications

**Programme Outcomes (POs)**

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

b. 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.

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

**Course Outcomes (COs)**

1. Illustrate the types of mechanism of polymerization reactions and analyze the natural and synthetic polymers
2. Identify the suitable polymerization techniques to synthesize the high quality polymers
3. Characterize the polymers to identify the structural, thermal ,mechanical and electrical features for specific applications
4. Apply the polymer processing methods to design polymer products
5. Identify and analyze the polymers used in electronic and biomedical applications

**Articulation Matrix**

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**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**

**POLYMERIZATIONTECHNIQUES**

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. Test for electrical resistance, dielectric constant, dissipation factor, arc resistance and dielectric strength - water absorption

**UNIT IV** **9 Hours**

**POLYMER PROCESSING**

Moulding: Compression - injection - extrusion and blow mouldings. Film casting - calendering. Thermoforming and vacuum formed polystyrene - foamed polyurethanes. Fibre spinning: melt, dry and wet spinning. Fibre reinforced plastics fabrication: hand-layup - filament winding andpultrusion

**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. Polymer for biomedical applications: artificial organs, controlled drug delivery, hemodialysis and hemofiltration

**FOR FURTHER READING**

Biodegradable polymers

**Total: 45 Hours**

**Reference(s)**

1. V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar, "Polymer Science", New Age International (P) Ltd., New Delhi, 2015
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, 2007
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

## 18AG001 BUILDING MATERIALS, ESTIMATION AND COSTING 3 0 0 3

**Course Objectives**

- To understand the fundamental knowledge on different building materials
- To impart knowledge on design of different aspects of building construction
- To learn to prepare detailed estimate and cost estimate of buildings

**Programme Outcomes (POs)**

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

e. 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.
g. 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.
m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

**Course Outcomes (COs)**

1. Organise rocks, bricks and clay products based on their characteristics and examine the manufacturing process of bricks including moulding, drying and burning for its properties
2. Execute the natural resources of lime, its types and timber qualities and test for water cement ratio in manufacturing Portland cement.
3. Organise foundation, stone masonry and brick masonry and compare stone masonry and brick masonry
4. Construct the buildings by considering dampness, mortar, foundation and concrete
5. Assess the cost estimate based on the public works department schedule rates.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **9 Hours**

**CONSTRUCTION MATERIALS**

Classification of rocks - Characteristics of Stones -Testing of Stones-Manufacture of Bricks - Moulding -Drying and Burning of bricks-Properties of good Brick -Classification of bricks -Clay Products-Ceramics - Tiles - Earthenware and Stoneware and uses

**UNIT II** **9 Hours**

**LIME AND CEMENT**

Lime- Natural Sources -Types of lime - Calcination-Cement -Raw materials - Water Cement RatioManufacture of Portland Cement Wet and Dry process-Standard Specifications- Storage of cement-Timber - Definition - Defects in timber-Qualities of good timber.

**UNIT III** **9 Hours**

**BRICK, STONE MASONRY AND FOUNDATION**

Concept of Foundation -Factors affecting Selection of Foundations -Types of soils-Subsurface Investigations -Bearing Capacity of soil -Testing &Improving Bearing Capacity of soil- Types of Foundations-Piles -Foundation in Black Cotton soil-Site Selection - General principles - classification of brick masonry-precautions in brick masonry -Stone Masonry -Comparison between Brick and Stone Masonry -Classification -General Principles and precautions in stone masonry

**UNIT IV** **9 Hours**

**BUILDING CONSTRUCTION**

Walls -Classification of walls - Dampness -Causes of Dampness -Methods of Preventing Dampness -Damp Proofing materials - Methods of providing Damp Proofing Materials-Mortars -Functions and Types of mortars -Concrete -Characteristics -Types and uses - Cube Strength of Concrete-Roofs - Classification - Floors -Types of Floor-Types of Plastering and Pointing -Painting and Distempering

**UNIT V** **9 Hours**

**ESTIMATING AND COSTING**

PWD schedule of rates - data sheet - detailed estimate - abstract estimate - preparation of estimate-market rate estimation

**FOR FURTHER READING**

Estimating and costing of farm structures- irrigation systems- farm ponds- poultry shed- dairy barn

**Total: 45 Hours**

**Reference(s)**

1. B.N. Datta, Estimation and costing. Published by the Author, Tagore Palli, Motilal Bose road, Lucknow, 2002

2. S.C Rangwala, Estimating and costing, Charotar book stall, Station road, Anand, 1991.
3. N.L. Arora and B.R. Gupta, Building construction. Sathyaprakasham, 16/7698, New market, New Rohtak road, New Delhi -5, 1995
4. B.L. Handoo and V.M. Mahajan, Civil engineering materials. Sathyaprakasam, 16/7698, New market, New Rohtak road, New Delhi-5, 1995
5. S.C. Rangwala, Building construction, Charotar publishing house, Anand, 2000
6. S.V Deodhar and Singhal, Civil engineering materials. Khanna publishers, 2B, Nath market, Naisark, Delhi - 2001

## 18AG002 REFRIGERATION AND COLD STORAGE 3 0 0 3

### Course Objectives

- To interpret principles of operation of different Refrigeration & Air conditioning systems
- To understand the types of compressors and expansion devices and their applications
- To combine the parameters involved in design of the various air conditioning systems

### Programme Outcomes (POs)

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

c. 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.
d. 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.
e. 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.
f. 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.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
l. 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 principles and practice of thermal comfort
2. Analyse the vapor compression and heat-driven refrigeration systems
3. Apply the knowledge on psychometric chart for designing heating and refrigeration units
4. Organize various types of air conditioning systems and their application in food industry
5. Evaluate applications and make design calculations of Heating, Ventilation and Air conditioning systems

### Articulation Matrix

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

**UNIT I** **10 Hours**

**REFRIGERATION PRINCIPLES AND COMPONENTS**

Refrigeration principles - refrigeration effect coefficient of performance -units of refrigeration - Refrigeration components -compressor-classification-principle and working- condensers- types-construction, principle and working. Evaporators - types-principle and working. Expansion device types construction, principle and working. Refrigerants properties classification comparison and advantages chloroflouro carbon (CFC) refrigerants - effect on environmental pollution - alternate refrigerants

**UNIT II** **8 Hours**

**VAPOUR COMPRESSION AND VAPOUR ABSORPTION CYCLE**

Simple vapour compression cycle - T-S diagram - p-h chart- vapour compression system-different types-vapour absorption cycle simple and practical vapour absorption system- advantages- ideal vapour absorption system- Electrolux refrigerator Lithium bromide refrigeration-construction and principles.

**UNIT III** **9 Hours**

**APPLIED PSYCHROMETRY**

Principle and properties of psychrometry, Representation of various psychometric processes on psychometric chart and their analysis, by-pass factor, sensible heat factor, room sensible heat factor, equipment sensible heat factor, grand sensible heat factor, apparatus dew point, ventilation and infiltration, energy efficiency ratio. Use of psychometric charts. Cooling and heating load calculations

**UNIT IV** **9 Hours**

**AIR CONDITIONING SYSTEM**

Air conditioning systems-equipment used-classification-comfort and Industrial air conditioning system-winter, summer and year- round air conditioning system- unitary and central air conditioning system-application of refrigeration and air conditioning-domestic refrigerator and freezer refrigerated trucks- ice manufacture- cold storage-freeze drying.

**UNIT V** **10 Hours**

**APPLICATIONS OF REFRIGERATION IN FOOD PROCESSING AND PRESERVATION**

Cooling and heating load estimation, cold storage design, types of cooling plants for cold storage. Insulation properties and types of insulation material. Cold storage for milk, meat, fruits, vegetables, poultry and marine products. Refrigerated Transport, Handling and Distribution, Cold chain, refrigerated product handling, order picking, refrigerated vans, refrigerated display.

**FOR FURTHER READING**

Design of cold storage

**Total: 45 Hours**

**Reference(s)**

1. C. P. Arora, Refrigeration and Air Conditioning, Tata McGraw Hill Publishing Company Private Limited, New Delhi, 2008
2. Langley and C. Billy, Refrigeration and Air conditioning, Ed. 3, Engle wood Cliffs (NJ), Prentice Hall of India, New Delhi, 2009
3. Roy J. Dossat, Principles of Refrigeration, Pearson Education, New Delhi, 2007
4. N. F Stoecker and Jones, Refrigeration and Air Conditioning, Tata McGraw Hill, New Delhi, 2008
5. Manohar Prasad, Refrigeration and Air Conditioning, Wiley Eastern Ltd., 2007
6. J. B Hains, Automatic Control of Heating & Air conditioning, Tata McGraw Hill Publishing Company Private Limited, 2005

## 18AG003 STORAGE AND PACKAGING TECHNOLOGY

**3 0 0 3**

### Course Objectives

- To study about the different storage structures
- To learn about the different packaging materials and various methods of packaging to improve the shelf life of the products
- To understand the concepts of Controlled Atmosphere Storage and Modified Atmosphere Packaging
- To learn about the equipment used for packaging

### Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

### Course Outcomes (COs)

1. Implement the knowledge on Storage environment and storage structures
2. Assess the importance of packaging and Acquaint with the equipment used for packaging apply
3. Determine the principles of Controlled Atmosphere Storage and Modified Atmosphere Packaging
4. Differentiate various canning systems and their application in food industry
5. Apply the knowledge to choose suitable flexible packaging film and the sealing technique for processed foods

### Articulation Matrix

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **11 Hours**

**STORAGE ENVIRONMENT AND STORAGE STRUCTURES**

Storage losses in agricultural commodities. Physical properties of grain affecting storability- Factors of spoilage- fungi and mycotoxins- Treatments for enhancing shelf life- Fumigation Processes for bag storage piles. Rural storage structures- Bag Storage and its Design. Parameters and types of storage structure. Bulk Storage in silos and large Bins Construction of Silos, Problems of Silo storage, relative Costs of Silo and Bag Storage. Quality Changes and remedial measures of Grains during storages. Design considerations and heat load calculation of cold storage

**UNIT II** **8 Hours**

**INTRODUCTION TO PACKAGING**

Introduction Protection of Food products major role and functions of food packaging Effect of environmental factors, mechanical forces and biological factors on food quality and shelf life. Estimating the shelf life requirement accelerated storage studies. Tests on packaging materials Mechanical strength (Tension, notch and tearing strengths), Gas and water vapour transmission rates

**UNIT III** **10 Hours**

**CONTROLLED ATMOSPHERE STORAGE AND MODIFIED ATMOSPHERE PACKAGING**

Introduction and concept of CA Storage Equipment for creating, maintaining and measuring controlled atmosphere - Biochemical aspects of CA storage - Static & Dynamic CA, Fruit Ripening, Hypobaric and Hyperbaric Storage. Effects of concentrations of compositional gases on Fruits and vegetables. MAP-Film & Coating types, Permeability, Gas Flushing, Perforation, Absorbents, Humidity, Temperature, Chilling Injury, Shrink wrapping, Vacuum Packing, Modified Interactive Packaging, Minimal Processing, Equilibrium Modified Atmosphere Packaging, Effect of scavengers

**UNIT IV** **10 Hours**

**CANNING**

Metal Cans and Glass Bottles as Packaging. Types of Metallic cans. Basics of Canning operations, Can closures. Glass jars and Bottles in food packaging, Design features and applications, Sterilization of bottles, advantages and problems, Bottle and jar closures, different types of caps and liners used. Can double seam can seam formation and defects, Metal cap for bottle and jars applications. Plastics used and their Specific applications - Polyethylene (LDPE and HDPE), Cellulose, Polypropylene (PP), Polyesters, Polyvinylidene Chloride (PVDC Diofan, Ixan and Saran), Polyvinyl chloride, Copolymers their applications. Closing and sealing of Rigid plastic containers Seal types.

**UNIT V** **6 Hours**

**FLEXIBLE FILMS PACKAGING**

Formation of Films and pouches, Co-extruded films and Laminates applications. Filling and Sealing of pouches and flexible plastic containers, Pouch form fill seal machines: Rigid and Semi rigid plastic packaging. Fabrication methods Thermo forming, Blow moulding, Injection moulding, Extrusion Blow moulding applications. Laminated Paper board Cartons, Fibre Board and Corrugated Card Board packaging - applications. Nano packaging and smart packaging ,Printing on packages, Bar codes, Nutrition labeling and legislative requirements.

**FOR FURTHER READING**

Active packaging and Oxygen scavenging- applications of Modified atmosphere packaging- Vacuum and Inert Gas Packaging. Transport systems or technology for CAS and MAP.

**Total: 45 Hours**

**Reference(s)**

1. Samuel Matz, The Chemistry and Technology of Cereals as Food and Feed, Chapman & Hall, 1992
2. N.L.Kent and A.D.Evans, Technology of Cereals (4th Edition) Elsevier Science (Pergaman), Oxford, UK,1994
3. Ruth H. Matthews: Pulses Ã¢?? Chemistry, Technology and Nutrition Mercel Dekker Inc., USA,1989
4. Gordon L. Robertson, Food Packaging- Principles and Practice Marcel Dekker Inc, USA, 1993
5. Donald Downing, Complete Course in Canning (3 Volumes) CTI Publications Inc, USA, 1996

## 18AG004 TECHNOLOGY OF SEED PROCESSING 3 0 0 3

**Course Objectives**

- To acquire the knowledge on the various seed production and processing technologies
- To impart knowledge on seed testing and the methods
- To impart knowledge about seed certification, legislation and industries in India

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
f. 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.
g. 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.
l. 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. Organize various technologies available in seed production
2. Implement the seed processing techniques and identify various seed processing equipment
3. Select the different methods and procedure to test the seeds
4. Use the knowledge on certification and legislation in seed industries
5. Assess the growth of seed industry and their role in India

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **9 Hours**

**SEED PRODUCTION TECHNOLOGY**

General Principles: Genetic principles, Agronomic principles, seed morphology, shape, size, seed hardness, colour; Harvesting of seed crops. Nucleus and Breeders seed, method of maintenance of nucleus and Breeders seed in self, fertilized and cross, fertilized crops, Foundation and certified seed production; Seed production of cereals, pulse, oil seeds, fibre crops, forage crops, sugar crops and their hybrid verities; physiological and harvestable maturity of different kinds of seeds.

**UNIT II** **10 Hours**

**SEED PROCESSING TECHNOLOGY**

Preparing seed for processing, Seed moisture and drying, Air screen cleaner, shape and size separators, gravity separators, surface texture separators, affinity for liquid separators, colour separators, electrical conductivity separators; seed treatment; seed elevators, conveyors, safe seed storage, seed packaging and handling, seed bins, dust removal, seed blending, seed marketing and distribution; methods for assessment of seed quality.

**UNIT III** **9 Hours**

**SEED TESTING**

Sampling methods, Determination of seed density, Tolerances, hetrogenity, Purity, genuineness of variety. Moisture estimation, Germination, equipment, seed scarification, pre sowing treatment, seed priming, pelleting; Viability: Vigour and health.

**UNIT IV** **9 Hours**

**SEED CERTIFICATION AND LEGISLATION**

Objectives and concepts of seed certification, seed certification agencies, minimum seed certification standards for breeders seed, certified seed. Field and seed inspection, methods of inspection, post harvest inspection. Seed legislation loss

**UNIT V** **8 Hours**

**SEED INDUSTRY IN INDIA AND THEIR ROLE IN AGRICULTURAL DEVELOPMENT**

Development of Seed industries in India: overview, National seeds corporation, State seeds Development Corporation. Five year plans. Private seed industries.

**FOR FURTHERREADING**

Ozone treatment of seeds

**Total: 45 Hours**

**Reference(s)**

1. J.F Harrington and J.E Douglas, Seed storage and packaging application, NSC, New Delhi,1963.
2. J.E Douglas, Seed Production Mannual, National Seeds Corporation and Rockfeller Foundation, New Delhi, 1969.
3. J.E Douglas, Seed Certification Mannual, National seeds corporation, New Delhi, 1970
4. . B.R Gregg, A.G. Law, S.S Virdi and J.S Balis Seed Processing, National seed corporation, New Delhi, 1990
5. R.L Agrawal, A text book on Seed Technology, Oxford & IBH Publication, Co Pvt Ltd, New Delhi-1992

6. L.O Copeland and M.B Mc Donald, Principles of Seed Science and Technology, Chapman and Hall, New York, 1995.

## 18AG005 FAT AND OIL PROCESSING 3 0 0 3

**Course Objectives**

- To understand about the physical and chemical properties of fats and oils
- To learn the extraction and refining processes of oils
- To learn about packaging, quality standards of fats and oils

**Programme Outcomes (POs)**

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

b. 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.

c. 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.

d. 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.

e. 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.

g. 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.

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

l. 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 various physical and chemical properties of fats and oils
2. Assess the knowledge on different oil extraction processes
3. Organize the objectives of refining and various methods used for refining oils
4. Apply the knowledge on packaging materials to select better packaging material for oils
5. Determine the industrial applications of oils and different quality standards for oils

**Articulation Matrix**

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

**UNIT I** **10 Hours**

**PHYSICAL AND CHEMICAL PROPERTIES**

Fats and oils - Physical and chemical properties - formation functions of oil in human body - fatty acids -double bonds and their position in oil Geneva type classification sources of vegetable oils production status-oil content coconut , palm, peanut , rice bran, sesame, mustard and sunflower seeds oil physical and chemical properties of fats and oils chemical reactions of oil hydrolysis hydrogenation, oxidation and polymerization.

**UNIT II** **10 Hours**

**EXTRACTION METHODS**

Oil extraction methods -mechanical expression - ghani , power ghani, rotary, hydraulic press, screw press, expellers, filter press - principle of operation and maintenance-solvent extraction process - steps involved, batch and continuous-continuous solvent extraction process for rice bran, soy bean and sunflower-oil extraction process for groundnut and cotton seed-production of special oils - palm oil, coconut oil - extraction process.

**UNIT III** **10 Hours**

**REFINING OF OILS**

Refining of oils - objectives - characterization - degumming - Zeneath process- deacidification process - continuous acid refining-bleaching of oil - continuous bleaching process - decolourising agents-deodorization process - winterization processes-hydrogenation of oil - selectivity - catalyst - batch type hydrogenation - regeneration of catalyst-vanaspathi, ghee and margarine - production process-partial sterilization, emulsification, chilling, kneading and rolling, incorporation of salt, colouring substances-production of special fats- butter - types - production and storage

**UNIT IV** **9 Hours**

**PACKAGING OF EDIBLE OILS**

Packaging of edible oils - requirements types tin plate, semi rigid, glass, Polyethylene Terephthalate, Poly Vinyl Chloride, flexible pouches-packaging for vanaspati and ghee changes during storage of oil rancidity causes atmospheric oxidation and enzyme action free fatty acid - colour-non edible oils -castor oil, linseed oil, vegetable waxes - production and processing.

**UNIT V** **6 Hours**

**INDUSTRIAL APPLICATIONS AND QUALITY STANDARDS**

Industrial applications of fats and oils - quality regulations - manufacture of soap, candle, paints and varnishes - ISI and Agmark standards - Layout of oil extraction plant- site selection for oil extraction plant- safety aspects HACCP standards in oil industries.

**FOR FURTHER READING**

Study of quality parameters of cooked oil.

**Total: 45 Hours**

**Reference(s)**

1. Harry Lawson, Food oils and Fats, Technology, Utilization and Nutrition, CBS Publishers and Distributors, New Delhi, 1997
2. . K.T. Acharia, Oil seeds and oil milling in India. Oxford and IBH publication, New Delhi, 1990.
3. . H. Panda, Essential oils Ã¢?? Hand book, National Institute of Industrial Research, ISBN, New Delhi, 2000.
4. Anonymous, Handbook of oils, fats and derivatives with refining and packaging technology,

Engineers India Research Institute, New Delhi, 2004

5. T.P. Hilditch, Industrial chemistry of the fats and waxes, Bailliere, Tindall and Cox Publishers, London, 1943.
6. . T.J. Weiss, Food Oils and their uses, The AVI Publishing Company, Inc. Westport, Connecticut, 1970.

## 18AG006 HORTICULTURAL CROP PROCESS ENGINEERING

**3 0 0 3**

### Course Objectives

- To know the physical and thermal properties of horticultural produces
- To acquire the knowledge on the theory, methods, and equipment for the various unit operations of processing of fruits and vegetables, spices, plantation crops and medicinal plant

### Programme Outcomes (POs)

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

d. 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.
e. 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.
f. 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.
l. 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 physical and thermal properties of fruits and vegetables and apply them in cleaning, grading and thermal processing of fruits and vegetables
2. Find unit operations of spices processing and design processing equipment for species
3. Execute coffee, tea and cocoa processing methods and implement them for coffee, tea, rubber, and cocoa processing
4. Find plantation crop postharvest processing methods and select processing technique for coconut, oil palm and cashew nut
5. Integrate unit operations for medicinal crop processing

### Articulation Matrix

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 3 | 1 | 2 | 3 | 1 | 1 | | | | | | | 1 | | |
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**UNIT I** **12 Hours**

**PROCESSING OF FRUITS AND VEGETABLES**

Physical and thermal properties of fruits and vegetables-maturity indices for fruits-cleaning and grading of fruits and vegetables-electronic colour sorting of fruits and vegetables-unit operation of fruit processing-blanching of fruits and vegetables, thermal processing of fruit pulps-Controlled and Modified atmospheric storage and shrink film storage of fruits and vegetables.

**UNIT II** **12 Hours**

**PACKAGING, GRADING AND QUALITY ANALYSIS OF SPICES**

Spices production and importance - stages of harvesting and harvesting methods - processing of major and minor spices - pepper, cardamom, chilli, turmeric, ginger, clove, nutmeg, vanilla - unit operations involved - equipment - principle and construction. Cleaning and grading of spices packaging and storage of spices - grading specifications - Agmark, ASTA, ESA specifications processes involved in the manufacture of oleoresins and essential oils - quality analysis of spices and their derivatives

**UNIT III** **7 Hours**

**PROCESSING OF COFFEE, TEA AND COCOA**

Processing of coffee, tea, cocoa and rubber - methods, process and equipment - value added products -grading and types - packaging and storage

**UNIT IV** **7 Hours**

**PROCESSING OF COCONUT, OIL PALM, ARECA NUT AND CASHEW**

Processing of plantation crops - production and importance - processing of coconut, oil palm, areca nut, Neera processing, cashew- harvesting and stages of harvest - drying, cleaning and grading - production of value added products - packaging and storage of produces.

**UNIT V** **7 Hours**

**PROCESSING OF MEDICINAL CROPS**

Importance of medicinal crops - production and export status - processing of medicinal crops - equipment used - principles and operations - active principles in various medicinal plants- application and uses - extraction methods.

**FOR FURTHER READING**

Processing of unexploited fruits

**Total: 45 Hours**

**Reference(s)**

1. P. H. Pandey, Post-Harvest Engineering of Horticultural Crops through Objectives, Saroj Prakasam, Allahabad, 2002.
2. J.S. Pruthi, Major Spices of India Crop Management and Post -Harvest Technology, Indian Council of Agricultural Research, Krishi Anusandhan Bhavan, Pusa, New Delhi, 1998.
3. ASTA, Official analytical methods of the American Spice Trade Association, Fourth Edition, 1997
4. J.W. Purseglove, E.G.Brown, G.L.Green and S.R.J. Robbins, Cardamom Chemistry, 1981. Spices, Vol. I, Tropical Agricultural Series, Longman, London, 1: 605
5. Indian Journal of Arecanut, Spices & Medicinal Plants

## 18AG007 SUGAR TECHNOLOGY 3 0 0 3

**Course Objectives**

- To learn about the process of crystallization
- To understand the technology involved in the manufacture of sugar

**Programme Outcomes (POs)**

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

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

**Course Outcomes (COs)**

1. Implement the knowledge possess on crystallization
2. Execute molasses conditioning and solids balance using Cobenzes diagram
3. Assess various processing steps in cane milling and identify equipment used for canemilling
4. Determine the role of centrifugal machine in sugar milling
5. Organize various processing steps and equipment in final sugar processing and utilise the knowledge if they take up a job in a sugar industry

**Articulation Matrix**

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

**UNIT I** **9 Hours**

**THEORY OF CRYSTALLIZATION**

Theory of crystallization: Crystallization zones. Graining - Graining & Graining methods, Vacuum pan, types of pan, speed of circulation, heating surface to volume ratio, pan boiling techniques. Formula for size of slurry. Methods and preparation of slurry. False grain &conglomerates, Formation of false grain &conglomerates, causes of formation false grain &conglomerates-juice extraction and preservation

**UNIT II** **9 Hours**

**MOLASSES**
Molasses conditioning, precaution during molasses conditioning .Crystallization in motion. Details about crystallization in motion Solid balance, Solids balance by CobenzeÃ¢??s diagram. Types of carriers.

**UNIT III** **9 Hours**

**CANE MILLING**
Objective, Preparation index, bulk density method, sieving method, Leaching, method, judging by eye. Cane kicker or equiliser. Cane knives. Fibrizer anvil plate, hammers. Shredder. Mill Roller (Type, design). Key points of roller maintenance, Basic concept of pressure feeder. Imbibition Importance, effect, types, method, Object of imbibitions, Imbibition efficiency

**UNIT IV** **9 Hours**

**CENTRIFUGAL MACHINE IN SUGAR PROCESSING**
Centrifugal machine, recycling self-discharging centrifugal machine 3 speed cycle, 4 speed cycle, Advantages and disadvantages of batch / continuous centrifugal machine.

**UNIT V** **9 Hours**

**FINAL SUGAR PROCESSINGSTEP**
Various parts regarding drying and cooling, rotary dryer, multitray gross hopper, fluidized bed hopper. Sugar Grader , Types of grader, dilution indicator, keeping quality factor safety factor. Sugar Dust collection system-Advantages and significance of dust collector, mechanism types. Sugar Godown Location, stocking of sugar bags.

**FOR FURTHER READING**
Refining of sugar without sulphur treatment

**Total: 45 Hours**

**Reference(s)**

1. Hand book of cane sugar Meade &Chen
2. Manufacture of sugar from sugarcane C. G. M. perk
3. Cane sugar Manufacture in India, D.P. Kulkarni.
4. Efficient Management for sugar factories -Mangal Singh

## 18AG008 BIO AND THERMO CHEMICAL CONVERSION OF BIO MASS

**3 0 0 3**

### Course Objectives

- To acquire the knowledge on the biomass characteristics and biochemical conversion technologies of biomass for energy generation
- To learn thermochemical conversion technologies for converting biomass intoenergy

### Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineeringproblems.
b. 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.
c. 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.
g. 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. Use the knowledge on the biomass characteristics and biochemical conversion technologies of biomass for energy generation
2. Execute the thermochemical conversion technologies for converting biomass into energy
3. Assess various processing steps in thermo chemical conversion by combustion
4. Determine the role of gasification and pyrolysis
5. Organize various processing steps and equipment in cogeneration and waste heat recovery

### Articulation Matrix

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **6 Hours**

**BIOMASS CHARACTERIZATION**

Biomass - types - fuel from biomass. Terms and units used in biomass production. Biomass fuel characterization - physical, chemical and thermal - energy release. Supply chain - harvesting / collection - transportation and processing. Briquetting - types pelletizing

**UNIT II** **12 Hours**

**BIOCHEMICAL CONVERSION**

Biochemical degradation - factors affecting biogas production - types of biogas plants - construction details - operation and maintenance - utilization of biogas -slurry handling, utilization and enrichment - high rate biomethanation process - landfills - bioethanol - feedstock - process - utilization-- composting - methods machinery

**UNIT III** **8 Hours**

**THERMO CHEMICAL CONVERSION BY COMBUSTION**

Thermochemical degradation. stoichiometric air requirement - Combustion process - chemistry of combustion - combustion zones - emissions. Co firing of biomass. Incinerators - layout. Combustion of wastes and MSW. Wood burning stoves - types- operation

**UNIT IV** **11 Hours**

**THERMOCHEMICAL CONVERSION BY GASIFICATION AND PYROLYSIS**

Biomass gasification - chemistry of gasification - types of gasifier - Gas cleaning & conditioning - utilization of producer gas - emissions - commercial gasifiers. Pyrolysis - product recovery - types - biochar - bio oil - operation recovery

**UNIT V** **8 Hours**

**COGENERATION AND WASTE HEAT RECOVERY**

Cogeneration technology - cycles - topping - bottoming - problems - applications - waste heat recovery. Carbon cycle- Carbon sequestration-CDM concept-CDM technologies-Carbon emission reduction calculation

**FOR FURTHER READING**

Biodiesel production technology-Sources for biodiesel production-methods-comparative evaluation of different methods

**Total: 45 Hours**

**Reference(s)**

1. C.Higmen and M.Vander Burgt, Gasification, Elsevier Science, USA, 2003
2. Ashok Pandy, Thallada Baskar, M.Stocker and Rajeev Sukumaran (Editors), Recent advances in Thermochemical conversion of Biomass. Elsevier Publications, 2015
3. A.N. Mathur and N.S. Rathore, Biogas production Management and Utilisation, Himanshu Publications, New Delhi, 1993
4. Robert C Brown, Christian Steven (Editors), Thermochemical Processing of Biomass: Conversion into Fuels, chemical and powder, Wiley Eastern Publishers, 2011
5. K.C. Khandelwal and S.S. Mahdi, Biogas Technology, Tata McGraw Hill Pub. Co. Ltd., New Delhi,1986
6. O.P.Chawla, - Advances in Biogas Technology, ICAR Publication, New Delhi, 1986

## 18AG009 SOLAR AND WIND ENGINEERING 3 0 0 3

**Course Objectives**

- To learn about the fundamental aspects of solar energy availability, solar energy conversion technologies
- To understand about the fundamental aspects of wind energy availability and windpower generators
- To acquire the knowledge on the alternate sources of energy such as geothermal energy, wave energy, tidal energy, OTEC energy, fuel cells and energy storage

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
f. 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.
g. 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 basics of solar energy and solar thermal energy conversion technologies and compare direct mode and indirect mode solar dryers
2. Analyse the principles and applications of solar thermal power stations, solar pond, and solarstills
3. Execute the wind power laws and calculate the torque and power characteristics of wind energy
4. Design wind mills and test the units for certification
5. Implement the principles of geothermal energy, wave energy, tidal energy, OTEC energy, fuel cells and analyse their applications

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **9 Hours**

**SOLAR ENERGY RADIATION AND SOLAR THERMAL COLLECTORS**

Solar radiation availability - radiation measurement -transmittance - absorptance flat plate collectors - heat transfer correlations - collector efficiency - heat balance -absorber plate - types - selective surfaces. Solar driers types heat transfer performance of solar dryers agro industrial applications.

**UNIT II** **9 Hours**

**SOLAR CONCENTRATING COLLECTORS AND PV TECHNOLOGY**

Optically concentrating collectors- types reflectors - solar thermal power stations principle and applications - solar stills- types- solar pond performance- characteristics applications. Photovoltatics types characteristic- load estimation batteries invertors operation system controls. PV system installations standalone systems- PV powered water pumping system sizing and optimization hybrid system solar technologies in green buildings.

**UNIT III** **9 Hours**

**WIND MAPPING ANALYSIS AND CHARACTERISTICS OF WIND**

Nature of wind - wind structure and measurement - wind power laws - velocity and power duration curves- aero foil - tip speed ratio - torque and power characteristics power coefficients - Betz coefficient

**UNIT IV** **9 Hours**

**WIND MILL DESIGN AND APPLICATIONS**

Turbines- Wind mill - classification - power curve. Upwind and downwind systems - transmission rotors - pumps - generators - standalone system - grid system -batteries. Wind energy storage - wind farms - wheeling and banking - testing and certification procedures.

**UNIT V** **9 Hours**

**ALTERNATE ENERGY SOURCES**

Ocean energy - off shore and on shore ocean energy conversion technologies - OTEC principles - open and closed cycles. Tidal energy - high and low tides - tidal power - tidal energy conversion. Geothermal energy - resources - classification and types of geothermal power plants. Nuclear energy - reactions -fusion, fission, hybrid reactors. Fuel cell - principle and operation - classification and types. Energy storage- pumped hydro and underground pumped hydro - compressed air - battery - flywheel - thermal.

**Total: 45 Hours**

**3 0 0 3**

## 18AG010 ENERGY CONSERVATION IN AGRO BASED INDUSTRY

### Course Objectives

- To learn the different aspects of energy auditing in the Food Industry
- To know about the energy saving opportunities in existing food processing facilities

### Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
f. 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.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
l. 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.
m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

### Course Outcomes (COs)

1. Organize the energy resources based on sources and purposes
2. Find the types of energy audits in production agriculture for rural living and scope of energy conservation
3. Find the energy efficient machinery systems and analyse the technologies and methods for conservation of energy resources
4. Organize the factors affecting energy conservation and analyse the energy economics, pricing and incentives for energy conservation
5. Integrate the case study on energy audit in agricultural fields for comparative studies

**Articulation Matrix**

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

**UNIT I** **12 Hours**

**ENERGY AUDITING, SUSTAINABILITY IN THE FOOD INDUSTRY**

Fundamentals of Energy Auditing,-Sustainability in the Food Industry -Energy Conservation Technologies Applied to Food Processing Facilities- Energy Conservation in Steam Generation and Consumption System. Energy Conservation in Compressed Air System- Energy Conservation in Power and Electrical Systems. Energy Conservation in Heat Exchanger

**UNIT II** **6 Hours**

**WASTE HEAT RECOVERY**

Waste Heat Recovery and Thermal Energy Storage in Food Processing Facilities- novel Thermodynamic Cycles Applied to the Food Industry for Improved Energy Efficiency

**UNIT III** **12 Hours**

**ENERGY SAVING OPPORTUNITIES IN EXISTING FOOD PROCESSING FACILITIES**

Energy Consumption pattern, Energy Conservation in Grains and Oilseeds Milling Facilities, in Sugar and Confectionary Processing Facilities, in Fruit and Vegetable Processing Facilities, in Dairy Processing Facilities, in Meat Processing Facilities, in Bakery Processing Facilities

**UNIT IV** **9 Hours**

**ENERGY CONSERVATION IN EMERGING FOOD PROCESSING SYSTEMS**

Membrane Processing of Foods, Energy Efficiency and Conservation in Food Irradiation, in Pulsed Electric Fields Treatment, in High-Pressure Food Processing, in Microwave Heating, in Supercritical Fluid Processing Conversion of Food Processing Wastes into Energy

**UNIT V** **6 Hours**

**FOOD PROCESSING WASTES AND UTILIZATIONS**

Concepts of Anaerobic Digestion of Food Processing Wastes, Fermentation of Food Processing Wastes into Transportation Alcohols, Bio-diesel Production from Waste Oils and Fats, Thermo- chemical Conversion of Food Processing Wastes for Energy Utilization

**FOR FURTHER READING**

Case studies on Energy auditing of Food industries-industry visit-report preparation and presentation by the students through PPT in the class

**Total: 45 Hours**

**Reference(s)**

1. L.Wang, Energy Efficiency and Management in Food Processing Facilities, CRC Press, 2009
2. R. P. Singh, Energy in Food Processing, Elsevier Publishing Co., 1986

3. B. Mattsson, and U. Sonesson, Environmentally Friendly Food Processing, CRC Press, 2003
4. Sydney Reiter,Industrial and Commercial Heat Recovery Systems, Van Nostrand Reinhold, 1985
5. Spiewak Scott A, Cogeneration and Small Power Production Manual, The Fairment Press, 1987
6. Khartchenko N.V. Green Power: Eco-Friendly Energy Engineering, Tech Books, New Delhi, 2004

## 18AG011 CO -GENERATION AND WASTE HEAT RECOVERY SYSTEMS **3 0 0 3**

**Course Objectives**

- To acquire the knowledge on the various seed production and processing technologies
- To impart knowledge on seed testing and the methods
- To impart knowledge about seed certification, legislation and industries in India

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
f. 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.
g. 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 principles of cogeneration and analyse thermodynamic power cycles
2. Evaluate the performance of cogeneration systems
3. Use the knowledge on certification and legislation in seed industries
4. Select the waste heat recovery systems and calculate their performance
5. Determine the cost economics of cogeneration systems and choose methods to reduce environmental pollution

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **9 Hours**

**INTRODUCTION**

Cogeneration principles and definition-thermodynamics power cycle analysis-Rankine and Brayton cycles-topping and bottoming cycles

**UNIT II** **8 Hours**

**COGENERATION SYSTEM**

Performance indices of cogeneration systems- Cogeneration systems based on steam turbine, gas turbine, combined cycle, and IC engines- Cogeneration systems based on Stirling Engines

**UNIT III** **10 Hours**

**APPLICATIONS OF COGENERATION**

Applications in sugar mills, rice mills, textile factories, and other process and engineering industries-Impacts of cogeneration plants- fuel- electricity

**UNIT IV** **8 Hours**

**WASTE HEAT SOURCES**

Selection criteria for waste heat recovery technologies. Recuperative and regenerative heat exchangers for waste heat recovery. Waste heat boilers- classification- design considerations- sizing- location-performance calculations. Heat pumps - types- design

**UNIT V** **10 Hours**

**COST ANALYSIS AND ENVIRONMENTAL IMPACT**

OF COGENERATION SYSTEMS Economic analysis of cogeneration and waste heat recovery systems. Regulatory and financial framework for cogeneration and waste heat recovery systems. Environmental considerations- mitigation of harmful emissions from energy production- conversion and utilization technologies- control of air, water and ground pollution

**FOR FURTHER READING**

Case studies on Cogeneration-visit to industries-report preparation and presentation by students in the class through PPT

**Total: 45 Hours**

**Reference(s)**

1. J.F Harrington and J.E Douglas, "Seed storage and packaging application", NSC, New Delhi, 1963
2. J.E Douglas, "Seed Production Mannual", National Seeds Corporation and Rockfeller Foundation, New Delhi, 1969.

3. J.E Douglas, "Seed Certification Mannual", National seeds corporation, New Delhi, 1970.
4. R.L Agrawal, A text book on "Seed Technology", Oxford & IBH Publication, Co Pvt Ltd, New Delhi-1992
5. L.O Copeland and M.B Mc Donald, "Principles of Seed Science and Technology", Chapman and Hall, New York, 1995.

## 18AG012 PROTECTED CULTIVATION 3 0 0 3

**Course Objectives**

- To impart knowledge on the protected cultivation of vegetables, fruits and flowercrops.
- To sensitize the students on hi-tech production technology of fruits and vegetables and flower crops.
- To learn and practices the various production practices of flower and other high value crops

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
f. 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.
g. 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.
l. 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 different methods of protected cultivation practices available for vegetable crops and flowers
2. Assess the technology available for vegetablecrops
3. Apply the protection technology for flower crops
4. Assess precision farming techniques using sensors and Geographic information systems for the crops
5. Find precision farming technology for horticulturecrops

**Articulation Matrix**

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

**UNIT I** **9 Hours**

**PROTECTED CULTIVATION AND ITS TYPES**

Importance and methods of protected culture in horticultural crops. Importance and scope of protected cultivation, different growing structures of protected culture viz., green house, poly house, net house, poly tunnels, screen house, protected nursery house. Study of environmental factors influencing green house production, cladding / glazing / covering material, ventilation systems, cultivation systems including nutrient film technique / hydroponics / aeroponic culture, growing media and nutrients, canopy management, micro irrigation and fertigation systems.

**UNIT II** **9 Hours**

**PROTECTED CULTIVATION OF VEGETABLE CROPS**

Protected cultivation technology for vegetable crops: Hi-tech protected cultivation techniques for tomato, capsicum nursery, cucumber, gherkins strawberry and melons, integrated pest and disease management, post harvest handling.

**UNIT III** **9 Hours**

**PROTECTED CULTIVATION OF FLOWER CROPS**

Protected cultivation technology for flower crops: Hi-tech protected cultivation of cut roses, cut chrysanthemum, carnation, gerbera, asiatic lilies, anthurium, orchids, cut foliages and fillers, integrated pest and disease management, postharvest handling.

**UNIT IV** **9 Hours**

**PRECISION FARMING TECHNIQUES**

Concept and introduction of precision horticulture: importance, definition, principles and concepts. Role of GIS and GPS. Mobile mapping system and its application in precision farming. Design, layout and installation of drip and fertigation in horticultural crops, role of commuters in developing comprehensive systems needed in site specific management (SSM), georeferencing and photometric correction. Sensors for information gathering, geostatistics, robotics in horticulture, postharvest process management (PPM), VRT, Robotics and drones ,remote sensing, information and data management and crop growth models, GIS based modeling

**UNIT V** **9 Hours**

**PRECISION FARMING OF HORTICULTURAL CROPS**

Precision farming techniques for horticultural crops: Precision farming techniques for tomato, chilli, bhendi, bitter gourd, bottle gourd, cauliflower, cabbage, grapes, banana, rose, jasmine, chrysanthemum, marigold, tuberose, china aster, turmeric, coriander, coleus and gloriosa.

**FOR FURTHER READING**

Design of green house roof trusses, sorting, grading and packing of fruits, vegetables and flowers, and their transportation to market.

**Total: 45 Hours**

**Reference(s)**

1. Lyn. Malone, Anita M. Palmer, Christine L. Vloghat Jach Dangeermond. Mapping out world: GIS lessons for Education, ESRI press, 2002
2. David Reed, Water, media and nutrition for green house crops. Ball publishing USA, 1996
3. Adams, C.R. K.M. Bandford and M.P. Early, Principles of Horticulture, CBS publishers and distributors, Darya ganj, New Delhi, 1996

## 18AG013 WATERSHED PLANNING AND MANAGEMENT

**3 0 0 3**

### Course Objectives

- To acquire the fundamental understanding of watershed planning and management
- To develop skills on water conservation and harvesting
- To prepare watershed development plans and cost estimate

### Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
l. 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. Show watershed management concepts
2. Analyse the components involved in watershed planning
3. Compare the methods of water harvesting and their structures
4. Design and construct the soil conservation structures
5. E xecute the watershed development programme

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **9 Hours**

**INTRODUCTION**

Watershed Management concepts leading to control of quality and quantity of runoff, Geomorphology of watersheds. Problems and Prospects in Watershed Management. Land Capability and its Classification, Watershed Based Land Use Planning. Watershed Characteristics:Classification and Measurement, Importance of Watershed Properties for Watershed Management.

**UNIT II** **9 Hours**

**HYDROLOGIC DATA FOR WATERSHED PLANNING**

Importance of Watershed Planning, Utility of Hydrologic Data in Watershed Planning. Watershed Delineation, Prioritization of Watersheds. Water Yield, Measurement of Water Yield from Watersheds. Hydrologic and Hydraulic Design of Recharge Structures, Design of Earthen Embankments and Diversion Structure

**UNIT III** **9 Hours**

**WATER MANAGEMENT**

Water harvesting in-situ and reservoirs. Preparation of water harvesting catchments. Common water harvesting techniques. Seepage control in reservoir. Construction of reservoirs/ponds and bunds. Control of evaporation from reservoirs.

**UNIT IV** **9 Hours**

**SOIL EROSION AND ITS CONTROL MEASURES**

Problem /Types of Water Induced Soil Erosion & Measures for its Control, Problem/ Types of Wind Induced Soil Erosion & Measures for Control. Measurements of Sediment Yield, Estimation and Modeling of Sediment Yield. Rainwater Conservation Technologies, Design of Water Harvesting Structures. Watershed Land Use/Land Cover, Effect of Land Use Land Cover on Watershed Hydrology

**UNIT V** **9 Hours**

**PROJECT PLANNING METHODS**

Preparation of project plans. Preparation reports, Cost benefit analysis. Methodologies to encourage people's participation-traditional harvesting and root top harvesting-waste and grass land-schemes.

**FOR FURTHER READING**

Optimal Land Use, Case Studies on Optimal Land Use. Need for Peoples Participation in Watershed Management, Case Studies in Peoples Participation in Watershed Management

**Total: 45 Hours**

**Reference(s)**

1. All India Soil and Land Use Survey (AISLUS), Watershed Atlas of India, All India Soil and Land Use Survey, Ministry of Agriculture, Government of India, New Delhi, India, 1990
2. K.N.Brooks, P.F.Ffolliott and J.A.Magner, Hydrology and the management of watersheds, Fourth

Edition, Wiley-Blackwell, 2013

3. United States Environmental Protection Agency (USEPA), Handbook for developing watershed plans to restore and protect our waters, USEPA, 2008
4. A.Agarwal, Drought, Try Capturing the Rain, Occasion paper, Centre for Science and Environment, New Delhi, 2000
5. Indian Journal of Arecanut, Spices & Medicinal Plan
6. A.S.Patel and D.L.Shah, Water Management, New Age International Publishers, 200

## 18AG014 RESERVOIR AND FARM POND DESIGN 3 0 0 3

**Course Objectives**

- To acquire the fundamental understanding of reservoir and farm ponds
- To develop skills on design and construction of farm ponds and reservoirs
- To analyse the economics of farm ponds and reservoirs

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
f. 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.

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

**Course Outcomes (COs)**

1. Find the suitable water harvesting structures including reservoir/dam, farm ponds, and earthen embankments for water conservation
2. Analyze the seepage, failure and damages and stability components of reservoir and farm pond
3. Construct farm pond and reservoir including operation and maintenance aspects
4. Analyze the economic aspects in the construction as well as maintenance of farm pond and reservoir
5. Organize the methods to reduce seepage and evaporation losses and analyze the water quality of harvested water for environmental consideration

**Articulation Matrix**

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

**UNIT I** **9 Hours**

**FUNDAMENTALS OF RESERVOIR AND FARM PONDS**

Introduction to Rainwater Harvesting, Hydrological Aspects of Water Harvesting, Identification of Areas Suitable for Water Harvesting, Reservoir/Dam and Farm Ponds, Earthen Embankments, Earthen Embankment Classification.

**UNIT II** **9 Hours**

**DESIGN OF TANKS, CHECK DAM AND FARM PONDS**

Components of Embankment, Basic Design Concept, Design of Dam Components. Seepage through Dam, Estimation of Seepage Flow, Determination of Location of Seepage Line, Flow Net, Seepage Analysis I, Seepage Analysis II, Failure and Damages I, Failure and Damages II, Control of Seepage Using Drainage System, Stability Analysis I, Stability Analysis II, Stability Analysis III, Stability Analysis IV, Slope Protection.

**UNIT III** **9 Hours**

**CONSTRUCTION OF TANKS, CHECK DAM AND FARM PONDS**

Construction, Operation and Maintenance of Water Harvesting System

**UNIT IV** **9 Hours**

**ECONOMIC ANALYSIS OF FARM POND AND RESERVOIR**

Introduction to Economic Analysis, Economic Indicators-Socio economics analysis and laws related to tanks

**UNIT V** **9 Hours**

**MISCELLANEOUS ASPECTS ON RESERVOIR AND FARM POND**

Water Quality of Harvested Water and Environmental Considerations, Method to Reduce Seepage and Evaporation Losses, Runoff Inducement Methods, Other Water Harvesting Structures.

**FOR FURTHER READING**

Design a Farm pond and dam components

**Total: 45 Hours**

**Reference(s)**

1. Critchley, W, Siegert, K, A Manual for the Design and Construction of Water Harvesting Schemes for Plant Production, Food and Agricultural organization, 1991
2. Owesis, T. Y., Prinz, D. and Hachum, A. Y, Rainwater harvesting for agriculture in the dry areas. CRC Press publication, 2012
3. Garg, S. K, Irrigation Engineering and Hydraulic Structures. Twenty fourth Revised Edition, 2011
4. Suresh, R, Soil and Water Conservation Engineering. Standard Publishers,2002
5. Garg, S. K. Irrigation Engineering and Hydraulic Structures. Twenty Fourth Revised Edition, pp.811-814, 2011
6. Critchley, W., C. Reij, and A. Seznec, Water Harvesting for Plant Production. Volume II: Case Studies and Conclusions for Sub-Saharan Africa. World Bank Technical Paper No. 157,1992

## 18AG015 DESIGN OF MICRO IRRIGATION SYSTEMS

**3 0 0 3**

**Course Objectives**

- To understand the basic concepts, tools, and skills used to deliver water efficiently and effectively on both a field and garden scale efficiency
- To learn about the role of irrigation water in agriculture, and the environmental factors that influence the type, frequency, and duration of irrigation
- To learn about the resources and essential skills needed to determine the proper timing and volume of irrigation, using both qualitative and quantitative methods

**Programme Outcomes (POs)**

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

e. 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.
f. 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.
g. 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.
l. 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.
m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

**Course Outcomes (COs)**

1. Organize the different types of pumps and water lifting devices based on the principle, components, and working efficiency
2. Execute the working principle of centrifugal pump as well as its characteristics with efficiencies and design the centrifugal pump including impeller design, casing and other parts of pumps
3. Determine water budgets and hydraulics used to develop irrigation schedules through micro irrigation based on crop geometry
4. Design drip and sprinkler irrigation system including, main line, sub main and laterals designs by consider pump capacity
5. Design green house irrigation system and advanced types of irrigation including lift irrigation and automation

**Articulation Matrix**

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

**UNIT I** **9 Hours**

**TYPES OF PUMPS AND OTHER WATER LIFTING DEVICES**

Indigenous water lifts, types and their working. Types of pumps: Positive displacement and variable displacement pumps. Reciprocating pump, principle, components, single acting and double acting, work done, coefficient of discharge, slip.

**UNIT II** **10 Hours**

**CENTRIFUGAL, SUBMERSIBLE AND TURBINE PUMPS**

Centrifugal pump: classification, principle and working, fundamental equations of centrifugal pumps, ideal, virtual and manometric heads of centrifugal pumps, net positive suction head, work done by centrifugal pump. Pump characteristics and efficiencies, priming and cavitation in centrifugal pumps, multistage centrifugal pumps. Design of impellers and casing, selection of centrifugal pumps. Submersible, Turbine pumps, Mixed flow, Axial flow, jet and Airlift pumps. Pump selection and installation, pump troubles and remedies

**UNIT III** **8 Hours**

**WATER BUDGETING AND DRIP IRRIGATION**

Micro irrigation: classification, Irrigation scheduling, Water Budgeting with microirrigation. Hydraulics of micro irrigation, components. Valves, planning factors. Wetting pattern, crop geometries.

**UNIT IV** **9 Hours**

**DRIP AND SPRINKLER IRRIGATION DESIGN**

Sprinkler irrigation, components, performance. Uniformity and efficiency of sprinkler systems, sprinkler discharge. Distance of throw. Distribution pattern, application rate. Droplet size. Sprinkler selection and spacing, capacity of sprinkler system. Design of laterals, tapered. Design of Main lines, pump capacity. Operation and maintenance of sprinkler irrigation system-sprinkler irrigation design and IRRICAD

**UNIT V** **9 Hours**

**SPECIAL TYPES OF IRRIGATION**

Greenhouse irrigation system, design. Lift irrigation system: Design, subsurface drip irrigation. Soil less culture, Fertigation, rain gun –automated irrigation system

**FOR FURTHER READING**

Project preparations: Design and draw the layout of a drip/sprinkler irrigation system for 10 acres, preparation of project proposal for the installation and commissioning of irrigation systems

**Total: 45 Hours**

**Reference(s)**

1. V.Ravikumar and M.V.Ranghaswami, Micro irrigation and irrigation pumps. Kalyani Publishers, Ludhiana. 2011

2. Jack Keller and Rond Belisher, Sprinkler and Trickle irrigation, Van Nostrand Reinhold, New York, 1990
3. I.J. Kavassik, Engineers Guide to Centrifugal pumps, McGraw Hill Book Company, 1964
4. A.M.Michael, Irrigation theory and practice, Vikas publishers, New Delhi, 2010
5. L.J. James, Farm Irrigation System Design, John Wiley & Sons,1988

## 18AG016 MECHANICS OF TILLAGE AND TRACTION

**3 0 0 3**

**Course Objectives**

- To impart the fundamental knowledge of mechanics and dynamics in various tillageimplements
- To study the tyres, traction and its applications

**Programme Outcomes (POs)**

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

b. 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.

c. 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.

d. 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.

e. 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.

f. 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.

l. 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. Apply the principles and concepts of mechanics of tillage while design the tillage tools
2. Apply the dimensional analysis in solid dynamics to evaluate the performance of tillage tools
3. Execute the traction and mechanics for off road traction and mobility
4. Assess the effects of tractor tyre, lug geometry, and size on tillage and traction
5. Use the geographic information system to analyse soil dynamics

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **6 Hours**

**MECHANICS OF TILLAGE**

Introduction to mechanics of tillage tools, forces acting on tillage tool- engineering properties of soil, principles and concepts, stress strain relationship- Mohrs circle- stress- soil failures- stress and strain in soil-stress distribution-strain distribution-yield in soil.

**UNIT II** **9 Hours**

**DYNAMICS OF TILLAGE**

Design of tillage tools principles of soil cutting, design equation, force analysis, application of dimensional analysis in solid dynamics performance of tillage tools-dynamic properties of soil- adhesion cohesion-dynamic versus static properties- vane shear apparatus-triaxial shear apparatus

**UNIT III** **9 Hours**

**TRACTION**

Introduction to traction and mechanics, off road traction and mobility, traction model, traction improvement, traction prediction-rolling resistance-wheel slip-traction aid- mechanics aof traction and transport- nonrolling traction devices-rolling traction devices- evaluating traction performance.

**UNIT IV** **9 Hours**

**AGRICULTURAL TYRES**

Agricultural tyres -types-Tyre size, tyre lug geometry and their effects, tyre testing- pressure-aspect ratio-oil compaction in tillage and traction-compaction behavior equations- vehicle morphology- vehicle capabilities.

**UNIT V** **9 Hours**

**APPLICATIONS**

Soil compaction and plant growth, variability and geo statistics, application of GIS in soil dynamics- the shape of contact surface-transport devices-driven wheels-tracks- auxiliary devices-operational control of design factors-vehicle on traction and transport capabilities.

**FOR FURTHER READING**

Analysis on the force requirement of different tillage tools

**Total: 45 Hours**

**Reference(s)**

1. Ralph Alcok, Tractor Implements System, AVI Publs, 1986
2. Jain S. C. and Philip Grace, Farm Machinery - an approach, Standard Publisher and Distributor, New Delhi, 2003.

## 18AG017 PRODUCTION TECHNOLOGY OF AGRICULTURAL MACHINERY

**3 0 0 3**

### Course Objectives

- To acquire an in-depth knowledge on the production technology of Agricultural machinery
- To develop skills on safe and efficient use of relevant materials for less cost and highefficiency
- To acquire knowledge on the test procedures to assess the performance agricultural machinery

### Programme Outcomes (POs)

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

e. 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.
f. 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.
g. 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.
j. 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.
k. Project Management and Finance: 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.
l. 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 agricultural machinery production industry and assess the problems faced by the industries
2. Compare and choose the materials and tools for construction of individual components of tractor and other agricultural machineries
3. Design industry lay out and serve as quality managers in industries
4. Design the components of agricultural machineries using CAD software
5. Evaluate the economics of production process and assess the techo economic feasibility of projects

**Articulation Matrix**

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

**UNIT I** **9 Hours**

**INTRODUCTION TO PRODUCTION OF AGRICULTURAL MACHINERY**

Status of agricultural machinery in Tamil Nadu and India-problems faced in the manufacture of agricultural machinery-requirements of industries-Critical appraisal- agricultural machinery manufacturing industries in Tamil Nadu-India

**UNIT II** **9 Hours**

**MATERIAL FOR AGRICULTURAL MACHINERY AND MANUFACTURING TECHNIQUES**

Material used for tractor and agricultural machinery, cutting tools, cutting tools for CNC machines, cutting tools for finishing operations. Advanced manufacturing techniques, electrical discharge machining, powder metallurgy. Heat treatment of steel, pack carburizing, shot peening, chemical vapour deposition(CVD).

**UNIT III** **9 Hours**

**INDUSTRIAL LAY OUT PLANNING AND QUALITY MANAGEMENT**

Limits, fits and tolerance, micro structure analysis of metals, industrial layout planning and quality management- Application to farm machinery scheduling problem. Application to farm - factory co-ordination - case study. System engineering function, management and problems System analysis. Role of a system analyst in design of a system and development of computer systems. Characteristics of Agricultural systems. Tools of structured analysis.-The data flow model. Object oriented approach. System design process - structured design.

**UNIT IV** **9 Hours**

**THE ROLE OF CAD IN AGRICULTURAL ENGINEERING**

Design of farm machinery with the help of CAD. Practicals on CAD software-3D printing for implements and tractor- its uses and application in design of farm machinery. Design procedures. Exercise on agricultural engineering system analysis. Description of the machinery scheduling problem in harvesting and transport system. Investigation of existing software models - cases studies

**UNIT V** **9 Hours**

**ECONOMICS OF PROCESS**

Economics of process selection. Techno economic feasibility of project report, case study on agricultural tines, case study of manufacturing of weeders, critical components and their selection. Feasibility study - Steps in feasibility analysis - cost analysis-market study

**FOR FURTHER READING**

Case study on manufacturing aspects of agricultural machinery and implements by visiting industries

**Total: 45 Hours**

**Reference(s)**

1. J.M. Shippen, C.R.Ellin and C.H. Clover, Basic farm machinery, Pergamon Press Ltd, 1987
2. C.J. Studman, Agricultural and horticultural engineering, Butterworths PVT Ltd, 1990.
3. R.N. Kaul, and C.O. Egbo, Introduction to Agricultural Mechanisation, Macmillan, London, 1985
4. C.P. Crossley, and J. Kilgour, Small Farm Mechanisation for Developing Countries, Wiley, London, 1983.
5. S. Nath, Manual of Practicals in Farm Mechanisation, Unitech Printery, 1988

## 18AG018 HUMAN ENGINEERING AND SAFETY 3 0 0 3

**Course Objectives**

- To know about the importance of ergonomics
- To design agricultural machinery, equipment, implements and tools that suits comfort for work
- To know about the safety in design and operation of agricultural machinery

**Programme Outcomes (POs)**

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

b. 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.

c. 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.

d. 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.

e. 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.

f. 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.

g. 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 knowledge on the importance of ergonomics and its application in agriculture
2. Outline the test procedures to take anthropometric data and measurement techniques
3. Design of controls and work space envelope
4. Execute the knowledge on physiological factors affecting operators
5. Apply the safety standards at work place during various farm operations

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **8 Hours**

**INTRODUCTION**

Importance of ergonomics and its application agriculture; Human: physiology, digestion and absorptionof foodstuff, liberation and transfer of energy. Concept of indirect, calorimetry, physiological responses and techniques of their measurements. Energetic efficiency of muscular work

**UNIT II** **9 Hours**

**ANTHROPOMETRY AND BIO-MECHANICS**

Structural and functional body dimensions, Instrumentation and their methods of measurement, Analysis and application of anthropometric data. Visual displays; Process of seeing, Horizontal and Vertical fields of hand, Colour discrimination, Quantitative and qualitative visual displays, signals and warning lights

**UNIT III** **12 Hours**

**DESIGN OF CONTROLS AND WORK SPACE ENVELOPE**

Types of CDM-topology -project activity -small scale CDM project categories- accesstation and cater station projects. PDO- project design document -General description of project activity-baseline methodology-monitoring methodology-auditing period-technical aspects-Monitoring and verification-verification process principles of verification-report preparation-pitfalls. Joint implementation (JI)-institutions and procedures-guidelines-JI or small scale projects-JI Land Use, Land Use Change and Forestry (LULUCF) projects

**UNIT IV** **7 Hours**

**CLIMATE CHANGE MODELING**

MISO,DSS-SAT, RCM and DCM

**UNIT V** **9 Hours**

**POSTURAL COMFORT AND OPERATOR SAFETY**

Problems of posture and comfort. Science of seating cushion functional requirements, static and dynamic compatibility of operator-seat machine. Engineering principles applied to industrial and agricultural safety. Road, accidents, road signs and accident prevention. Safety symbols and signs, hand signals, colour codes for agricultural equipment

**FOR FURTHER READING**

Analysis of case studies on ergonomic study of different farm implements andmachinery

**Total: 45 Hours**

**Reference(s)**

1. Sanders,M.S. and McComack,EJ. Human factors in Engineering and Design. Tata McGraw Hill, New York, 1992
2. Obome, David.J. Engieering Work. John Wiley and Sons Ltd., 1982
3. Astand, P.P. and Rodaid,K. Text book of Work Physiology, McGraw Hill Book Company, New York, 1970
4. Grandjean,E. Fitting the Track of the Man, Taylor and France Ltd., U.K.,1981

## 18AG019 DISATER MANAGEMENT 3 0 0 3

**Course Objectives**

- To provide students an exposure to disasters, their significance and types
- To ensure that students understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR) and to respond to potential disaster in their surroundings with due sensitivity

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. 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.
d. 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.
e. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel

**Course Outcomes (COs)**

1. Organize the types of disasters, causes and their impact on environment and society
2. Demonstrate the roles of various agencies in disaster management
3. Assess vulnerability and impact of disasters on development projects and climate
4. Compute hazard and Vulnerability profile of India for natural disasters and formulate disaster damage assessment and management.
5. Evaluate methods of risk reduction measures for landslide, flooding, forest fire

**Articulation Matrix**

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

**UNIT I** **9 Hours**

**INTRODUCTION TO DISASTERS**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks - Disasters: Types of Disasters -Earthquake, Landslide, Flood, Drought, Fire etc- Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc. - Differential impacts - in terms of caste, class, gender, age, location, disability- Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change - Dos and Don Its during various types of Disasters

**UNIT II** **9 Hours**

**APPROACHES TO DISASTER RISK REDUCTION (DRR**

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural - nonstructural measures, Roles and responsibilities of - community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders -Institutional Processess and Framework at State and Central Level - State Disaster Management Authority (SDMA) - Early Warning System - Advisories from Appropriate Agencies.

**UNIT III** **9 Hours**

**INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT**

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc. - Climate Change Adaptation-IPCC Scenario and Scenarios in the context of India- Relevance of indigenous knowledge, appropriate technology and local resources.

**UNIT IV** **9 Hours**

**DISASTER RISK MANAGEMENT IN INDIA H**

azard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation,Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation - Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster -Disaster Damage Assessment

**UNIT V** **9 Hours**

**DISASTER MANANGEMENT : APPLICATIONS AND CASE STUDIES AND FIELD WORKS**

Landslide Hazard Zonation : Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire : Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management

**FOR FURTHER READING**

Case study -Tsunami effect

**Total: 45 Hours**

**Reference(s)**

1. Govt. of India : Disaster Management Act, Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy, 2009

## 18AG020 CDM AND CARBON TRADING TECHNOLOGY

**3 0 0 3**

**Course Objectives**

- To know the basics, importance of clean development mechanism (CDM)
- To know the concept of carbon trading

**Programme Outcomes (POs)**

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

b. 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.

c. 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.

d. 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.

e. 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.

f. 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.

g. 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.

j. 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. Organize the effects of greenhouse gas emission and explain the responsibilities of countries in GHG emission
2. Outline the KYOTO PROTOCOL and develop clean development mechanism (CDM) projects
3. Execute the features of CDM and employ monitoring and auditing techniques on CDM projects
4. Execute guidelines for small scale and Land Use, Land Use Change and Forestry (LULUCF) CDM projects
5. Compare the alternate techniques for lowering carbon emission

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **9 Hours**

**GREEN HOUSE GASES AND ENVIRONMENTAL CHANGE**

Global Environmental changes-United nations framework convention on climate change-United (UNFCC)-ozone layer depletion -land degradation-air and water pollution-sea-level rise-loss of biodiversity-climatic change problem GHG emissions by different countries-developing countryresponsibilities - India"s Greenhouse gas emissions - The conference of parties

**UNIT II** **9 Hours**

**KYOTO PROTOCOL AND CDM PROJECTS**

Kyoto protocol and clean development mechanism-CDM and cooperative mechanism-CDM overview administration -participation-CDM institutions-procedures CDM project cycle-project design and formulation - eligibility-additionally. Approval of (DNA) Designated National Authority.Validation and registration-monitoring-validation and certification through the source of Certified Emission Reduction(CER)

**UNIT III** **9 Hours**

**TYPES AND FEATURES OF CDM**

Types of CDM-topology -project activity -small scale CDM project categories- accesstation and cater station projects. PDO- project design document -General description of project activity-baseline methodology-monitoring methodology-auditing period-technical aspects

**UNIT IV** **9 Hours**

**MONITORING OF CDM**

Monitoring and verification-verification process principles of verification-report preparation-pitfalls. Joint implementation (JI)-institutions and procedures-guidelines-JI or small scale projects-JI Land Use, Land Use Change and Forestry (LULUCF) projects

**UNIT V** **9 Hours**

**SUSTAINABLE ENERGY DEVELOPMENT**

Low carbon technologies-low carbon building-alternative approaches-energy efficiency projects-sustainable energy policy concepts-mitigating energy related GHG emissions through renewable energy-carbon trading

**FOR FURTHER READINGS**

Case studies on Clean development mechanisms and preparation of sample CDM projects

**Total: 45 Hours**

**Reference(s)**

1. CDM Manual for project developers and policy makers-UNFCCC Publication, 2007
2. MyungKyoon Lee, Baseline Methodologies for clean Development Mechanism Projects- AGuide Book-Vol.1, UNEP publication, 2005
3. Myungkyoon Lee, Information and Guide Book - the UNEP project CD4CDM-UNEP publication, June 2004.
4. Aukland L, Bass S, Hug S, Landell Mals N, Tipper R, Laying the Foundations forclean Development, Preparing the Land use sector London, 2002
5. Carbon sequestration in dryland soils, World Soil Resources report No.102, Food and Agriculture Organization, Rome,2004

## 18AG021 CLIMATE CHNAGE AND ADOPTION 3 0 0 3

**Course Objectives**

- To know the basics, importance of global warming
- To know the concept of mitigation measures against global warming
- To learn about the global warming and climate change

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
f. 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.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**Course Outcomes (COs)**

1. Outline of how the threats and opportunities of predicted climate changes will influence specific sectors at global and regional scale
2. Compare the relationship between atmosphere and its components
3. Analyze the impacts of climate change on environment parameters
4. Evaluate the scientific insights underlying the assessment reports of the IPCC, with a focus on impacts, adaptation and mitigation
5. E valuate the relative opportunities and needs for mitigation and adaptation (including vulnerability assessments) in a variety of sectoral contexts

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **9 Hours**

**EARTHS CLIMATE SYSTEM**

Role of ozone in environment ozone layer ozone depleting gases Green House Effect, Radiative effects of Greenhouses Gases Hydrological Cycle Green House Gases and Global Warming Carbon Cycle.

**UNIT II** **9 Hours**

**ATMOSPHERE AND ITS COMPONENTS**

Importance of Atmosphere - Physical Chemical Characteristics of Atmosphere - Vertical structure of the atmosphere- Composition of the atmosphere Atmospheric stability- Temperature profile of the atmosphere - Lapse rates - Temperature inversion - effects of inversion on pollution dispersion.

**UNIT III** **9 Hours**

**IMPACTS OF CLIMATE CHANGE**

Causes of Climate change : Change of Temperature in the environment Melting of ice Pole-sea level rise- Impacts of Climate Change on various sectors Agriculture, Forestry and Ecosystem Water Resources Human Health Industry, Settlement and Society Methods and Scenarious Projected Impacts for Different Regions Uncertainties in the Projected Impacts of Climate Change Risk of Irreversible Changes.

**UNIT IV** **9 Hours**

**OBSERVED CHANGES AND ITS CAUSES**

Climate change and Carbon credits - CDM - Initiatives in India-Kyoto Protocol Intergovernmental Panel on Climate change - Climate Sensitivity and Feedbacks - The Montreal Protocol - UNFCCCIPCC - Evidences of Changes in Climate and Environment - on a Global Scale and in India.

**UNIT V** **9 Hours**

**CLIMATE CHANGE AND MITIGATION MEASURES**

Clean Development Mechanism -Carbon Trading -examples of future Clean Technology - Biodiesel - Natural Compost - Eco-Friendly Plastic - Alternate Energy -Hydrogen - Bio-fuels - Solar Energy - Wind - Hydroelectric Power -Mitigation Efforts in India and Adaptation funding Key Mitigation Technologies and Practices-Energy Supply - Transport - Buildings- Industry-Agriculture - Forestry - Carbon sequestration- Carbon capture and storage (CCS) - Municipal solid Waste (MSW) & Bio waste, Biomedical, Industrial waste International and Regional cooperation.

**FOR FURTHER READINGS**

Sequestration of carbon through renewable energy technologies

**Total: 45 Hours**

**Reference(s)**

1. Adaptation and mitigation of climate Scientific Technical Analysis, Cambridge University Press, Cambridge, 2006
2. Atmospheric Science, J.M. Wallace and P.V. Hobbs, Elsevier / Academic Press 2006
3. Jan C. van Dam, Impacts of Climate Change and Climate Variability on Hydrological Regimes?, Cambridge University Press, 2003

## 18AG023 PLANT PROTECTION 3 0 0 3

### Course Objectives

- To impart basic knowledge of insect pest and diseases and their losses caused to crops.
- To study various methods of plant protection to get more yield in Agricultural and Horticultural crops
- To gain knowledge on pest & diseases management in horticultural crops

### Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
k. Project Management and Finance: 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.

l. 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. Implement the knowledge on various groups of insect pests and diseases of crops and their symptoms of damage
2. Execute the knowledge on different crops damaged by insects and diseases
3. Implement the knowledge on various methods of pest management to increase crop yield.
4. Assess the application of plant protection machineries.

5. Compare pesticide residues and health hazards; integrated pest and disease management in organic/inorganic farming.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **9 Hours**

**GROUPS OF INSECT AND DISEASE**

Sucking pests, borer pests, soil pests, Vectors, Rodent pests and their symptoms of damage. Fungal bacterial and viral pathogens causing crop diseases.

**UNIT II** **9 Hours**

**AGRICULTURE AND HORTICULTURE CROP PESTS**

Agricultural crops: Rice, pulses cotton, sugarcane. Horticultural crops: Coconut, fruits, vegetables and flower crops affected by various pests and diseases.

**UNIT III** **9 Hours**

**METHODS OF CROP PROTECTION**

Cultural, physical, mechanical, legal, biological, chemical and biotechnological methods of crop protection and IPM.

**UNIT IV** **9 Hours**

**PLANT PROTECTION APPLIANCES**

Different machineries available for spraying / soil application on annual and perennial crops and maintenance of machineries

**UNIT V** **9 Hours**

**PESTICIDE HAZARDS AND MANAGEMENT**

Pesticide residues in consumable crop parts by way of application of pesticides / fungicides, methods of decontamination of toxic chemicals, organic healthy way of crop protection

**FOR FURTHER READING**

Mode of spread of pest and diseases, prophylactic measures to manage pests mode of action of pesticides, complex problems in plant protection

**Total: 45 Hours**

**Reference(s)**

1. Dhandapani, N and S.Uthamasamy 2000. Integrated pest Management. Tnau Publications, Coimbatore.p.181.
2. Ragupathy. A and R. Ayyasamy 2003. A Guide on crop pests. Namrutha publications, Madananadapuram, Porur, Chennai-16.p.368
3. Justin. K.2004. Crop protection. TNAU, Petchipaarai, kanyakumari Dt.p.379.
4. K.Justin. Crop Protection. TNAU, Petchipaarai, Kanyakumari Dt.2004.

5. David, B.V. and T. kumaraswami 1975. Elements of Economic Entomology. Popular Book Depot, Chennai-600034.p.507. 16. 2003

## 18AG024 EMERGING TECHNOLOGIES IN FOOD PROCESS ENGINEERING 3 0 0 3

**Course Objectives**

- To understand the different emerging technologies in processing food
- To familiarize about the equipment's used for the processing of foods by emerging technologies
- To understand about alternate thermal and non-thermal processing techniques

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
f. 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.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
l. 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 the High-pressure processing and pulsed electric field processing
2. Predict the effect of application of pulsed electric field processing on food quality
3. Assess the importance of irradiation in food processing industry
4. Compare the efficacy of non-thermal processing techniques
5. Determine the changes in food quality during thermal processing techniques

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 4 | 2 | 2 | 3 | 2 | 1 | 1 | | | | | | 1 | | |
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**UNIT I** **9 Hours**

**HIGH PRESSURE PROCESSING**

Principles: Mechanism and applications of high pressure processing to food systems; High pressure processing of salads, meats and sea foods, fruits and fruit products; Effect of high pressure on microorganisms, enzymes, textural and nutritional quality of foods; Other applications of high pressure processing; High Pressure Freezing: principles and equipment, types of high pressure freezing process, microbiological and enzymatic inactivation after high pressure freezing.

**UNIT II** **8 Hours**

**PULSED ELECTRIC FIELDS PROCESSING**

Principles, Mechanism, PEF treatment systems, Main processing parameters; PEF technology: Equipments, Applications; Mechanisms of microbial and enzyme inactivation. PEF processing of solid foods, liquid foods and beverages. Food safety aspects of pulsed electric fields.

**UNIT III** **8 Hours**

**FOOD IRRADIATION**

Introduction: Fundamentals of food Irradiation, Type and sources of radiation, dosimetry, mode of action of ionizing radiation; Direct and indirect effect, radiation effect on food constituents, Dose requirement for different products and regulations

**UNIT IV** **14 Hours**

**ALTERNATIVE NON THERMAL PROCESSING TECHNIQUES**

High intensity pulsed light technology: principles of PLT technology, Technological aspects of PLT, Effects of PLT technology on microorganisms and food quality. Ultrasound Processing: Principle of ultrasound, Fundamentals, Ultrasound as a processing and food preservation tool, Effect of ultra sound on properties of foods, Applications of ultrasound in microbial inactivation, assisted drying, extraction, osmotic dehydration, detection of foreign bodies, filtration and freezing, challenges in ultrasound processing. Radio frequency electric fields: Introduction, radio frequency electric fields equipment, effect of radio frequency electrical field on inactivation of microorganisms.

**UNIT V** **6 Hours**

**ALTERNATIVE THERMAL PROCESSING TECHNIQUES**

Microwave heating and microwave drying: Microwaves, dielectric properties of foods, thermal properties of foods, Recent developments in microwave heating, combined microwave-vacuum drying, microwave freeze-drying, applications; Radio-frequency processing: Introduction, dielectric heating, Radio-Frequency applications for heating and drying.

**FOR FURTHER READINGS**

Preservation methods for food product to extend shelf life

**Total: 45 Hours**

**Reference(s)**

1. Emerging Technologies for Food Processing. Da-Wen Sun (Ed), Academic Press, 1st Edition, 2005.
2. Novel Food Processing Technologies. M. P. Cano, M. S. Tapia, and G. V. BarbosaCanovas, CRC Press, 1st Edition, 2004.
3. Maria Laura Passos, Claudio P. Ribeiro, Innovation in Food Engineering: New Techniques and Products, CRC press, 2010.
4. Howard Q. Zhang, Gustavo V. Barbosa-Canovas, V. M.Balasubramaniam, C. Patrick Dunne, Daniel F. Farkas, James T. C. Yuan, Nonthermal Processing Technologies for Food, 2000
5. Enrique Ortega-Rivas, Non-thermal Food Engineering Operations. Springer, 2012

## 18AG025 MUSHROOM PRODUCTION TECHNOLOGY

**3 0 0 3**

**Course Objectives**

- To provide hands on training for preparing the mother culture (Spawn production).
- To study the various methods of mushroom cultivation.
- To provide the training for using appropriate technology, utilization of resources and suitable market strategy for mushroom production

**Programme Outcomes (POs)**

b. 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.
c. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
k. Project Management and Finance: 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.

**Course Outcomes (COs)**

1. Execute the important of mushroom and how it can convert waste material into human food.
2. Analyze the different methods of mushroom spawn production within a relatively small space
3. Analyze various types cultivation practices of mushroom under different agro climatic zones of Tamil Nadu and India
4. Implement the post-harvest methods and value addition of mushroom for extend the shelf life
5. Predict the marketing linkages with centre to increase employment opportunities and generating income

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **8 Hours**

**INTRODUCTION OF MUSHROOM**

History of mushroom - Scope and Importance - Life cycle of mushroom - Area, Production, Productivity of mushroom in World, India and Tamil Nadu

**UNIT II** **9 Hours**

**MOTHER SPAWN PRODUCTION**

ushroom growing technologies - Preparation of mother spawn - Substrates used for spawn production - Growing conditions for mushrooms - Composting unit - Spawn unit- Cropping unit of mushroom

**UNIT III** **12 Hours**

**MUSHROOM CULTIVATION**

Types of mushroom - Oyster mushroom - Paddy straw mushroom - Button mushroom - Milky mushroom - Shiitake mushroom - Other mushrooms

**UNIT IV** **9 Hours**

**PEST MANGEMENT AND POST HARVEST METHODS**

Pest and diseases of mushroom - Harvesting, storing and using mushrooms - Post-harvest technology and value addition of mushroom

**UNIT V** **7 Hours**

**ECONOMICS OF MUSHROOM PRODUCTION**

Economics for mushroom cultivation -Environmental, Economic and Social impacts on mushroom cultivation – Exposure to Commercial mushroom cultivation Unit

**FOR FURTHER READINGS**

Government policies and programmes for promotion of mushroom

**Total: 45 Hours**

**Reference(s)**

1. V.N. Pathak, N. Yadav and M. Gaur. 2010. Mushroom production and processing technology. Published by Agrobios, Jodhpur
2. B.C. Suman and V.P.Sharma.2007. Mushroom cultivation in India. Daya Publishing House, New Delhi.179p
3. S.R. Mishra. Techniques of mushroom cultivation. Discovery Publishing, New Delhi. 180p

## 18AG026 AGRI BUSINESS MANAGEMENT AND ENTERPREUSHIP

**3 0 0 3**

**Course Objectives**

- To study about the concept and importance of agri business system
- To develop the management competencies required by student in the field of Agriculture to establish and support profitable agribusiness in a competitive global business environment
- The ability to use effectively business management techniques in an international environment

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
k. Project Management and Finance: 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.

**Course Outcomes (COs)**

1. Analyses agribusiness situations, formulate strategies, implement plans and manage strategic change
2. Execute how organizations adapt to an uncertain environment and identify techniques managers use to influence and control the internal environment
3. Analyze the process of management's four functions: planning, organizing, leading, and controlling
4. Analyze the various structure and technologies of the agribusiness sector to develop the business in the competitive marketing
5. Implement the systematic process to elect and ability to discern distinct entrepreneurial traits

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **9 Hours**

**AGRIBUSINESS MANAGEMENT**

Concept - components of agribusiness - forms of agribusiness firms. Management - concept - functions of management - managerial roles and skill (Mintzbergs) required at various levels of management.

**UNIT II** **9 Hours**

**MANAGEMENT FUNCTIONS**

Planning - steps and types of plans. Organizing - basis for Departmentation - Staffing - human resource planning process - Directing - techniques of direction. Coordination and control - types.

**UNIT III** **9 Hours**

**FUNCTIONAL AREA - I**

Operations management - planning and scheduling - supply chain management in agribusiness - Human resource management - job analysis, recruitment and selection process

**UNIT IV** **9 Hours**

**FUNCTIONAL AREA - II**

Marketing Management - market segmentation, consumer buying behaviour and marketing mix - Financial management - concept and financial planning for agribusinesses

**UNIT V** **9 Hours**

**ENTREPRENEURSHIP**

Entrepreneur - entrepreneurship - types, characteristics and process - Innovation, business incubation and financing entrepreneurs.

**FOR FURTHER READING**

Market survey for understanding client needs and satisfaction - Pricing methods for small agribusinesses

**Total: 45 Hours**

## 18AG027 AGRICULTURAL FINANCE, BANKING AND COOPERATION

**3 0 0 3**

**Course Objectives**

- To study the various methods of agriculture finance
- To reconstruct the policies and of co-operative so that it can bring about economic development of people

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
k. Project Management and Finance: 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.

**Course Outcomes (COs)**

1. Create a confidence in the preparation and use of business accounts
2. Compute an opportunity to prepare, as part of their final management project, a thorough analysis of a business situation
3. Implement the marketing linkages with centre to increase employment opportunities and generating income
4. Execute Co-operation Philosophy and Principles as part of revitalizing co-operative credit
5. Predict the financial inclusion and exclusion with assessment of crop losses.

**Articulation Matrix**

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

**UNIT I** **9 Hours**

**AGRICULTURAL FINANCE - NATURE AND SCOPE**

Agricultural Finance: Definition, Importance, Nature and Scope - Agricultural credit: Meaning, Definition, Need and Classification - Sources of credit - Role of institutional and non - institutional agencies - Rural indebtedness: Consequences of rural indebtedness Development of rural credit in India

**UNIT II** **9 Hours**

**FARM FINANCIAL ANALYSIS**

Principles of Credit - 5C"s, 3R"s and 7 P"s of Credit - Project Cycle and Management - Preparation of bankable projects / Farm credit proposals - Feasibility - Time value of money: Compounding and Discounting - Appraisal of farm credit proposals - Undiscounted and Discounted measures - Repayment plans - Farm Financial Statements: Balance Sheet, Income Statement and Cash Flow Statement -Financial Ratio Analysis

**UNIT III** **9 Hours**

**FINANCIAL INSTITUTIONS**

Institutional Lending Agencies - Commercial banks: Nationalization, Agricultural Development Branches - Regional Rural Banks, Lead bank, Scale of finance - Higher financial institutions: RBI, NABARD, AFC, ADB, World Bank and Deposit Insurance and Credit Guarantee Corporation of India - Microfinance and Its role in poverty alleviation - Self-Help Groups - Non-Governmental Organizations - Subsidized farm credit, Differential Interest Rate (DIR), Kisan Credit Card (KCC) Scheme - Relief Measures and Loan Waiver Scheme and Know Your Customer (KYC)

**UNIT IV** **9 Hours**

**CO-OPERATION**

Co-operation: Philosophy and Principles - History of Indian Co-operative credit movement: Pre and Post - Independence periods and Co-operation in different plan periods - Co-operative credit institutions: Two tier and three tier structure, Functions: provision of short term and long term credit, Strength and weakness of co-operative credit system, Policies for revitalizing co-operative credit - Successful co- operative credit systems in Gujarat, Maharashtra, Punjab, etc. - Special Co-operatives: LAMPS and FSS: Objectives, role and functions - National Cooperative Development Corporation (NCDC) and National Federation of State Cooperative Banks Ltd. (NAFSCOB): Objectives and functions

**UNIT V** **9 Hours**

**BANKING AND INSURANCE**

Meaning, Importance and Types - Central bank: RBI - functions - Credit control - Objectives and Methods: CRR, SLR and Repo rate - Credit rationing - Dear money and cheap money - Financial Inclusion and Exclusion: credit widening and credit deepening monetary policies. Credit gap: Factors influencing credit gap - Non- Banking Financial Institutions (NBFI) - Assessment of crop losses,Determination of compensation - Crop Insurance Schemes - Livestock Insurance Schemes - Agricultural Insurance Company of India Ltd (AIC)

**FOR FURTHER READING**

Role of technology in finance and banking sector in India

**Total: 45 Hours**

**Reference(s)**

1. Subba Reddy, S. and P. Raghu Ram. 2011. Agricultural Finance and Management. Oxford & IBH. New Delhi.
2. Muniraj, R. 1987. Farm Finance for Development. Oxford & IBH. New Delhi.

3. Lee, W.F., M.D. Boehlje, A.G. Nelson and W.G. Murray. 1998. Agricultural Finance.Kalyani Publishers. New Delhi
4. Patnaik, V.E. and A.K. Roy. 1988. Cooperation and Cooperative Management. Kalyani Publishers, Ludhiana.

## 18AG028 DESIGN OF AGRICULTURE MACHINERY 3 0 0 3

**Course Objectives**

- To learn design considerations and their applications in agricultural tractors and typical machines
- To understand the standards and procedures for designing of primary and secondary tillage implements
- To understand the standards and procedures for calibration of seed drill, planter and tractor safety measures

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
f. 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.

g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

**Course Outcomes (COs)**

1. Predict the knowledge on design considerations of farm machinery
2. Asses the knowledge on design and construction of primary tillage implements
3. Execute the design and construction of secondary tillage implements
4. Assess the working principles of seed drill and planters
5. Compute the knowledge on tractor safety measures.

**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 | | | | | | 1 | 1 |
| 2 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | | | | | | 1 | |
| 3 | 2 | 3 | 3 | 1 | 1 | 1 | 2 | | | | | | | 1 |
| 4 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | - | | | | | 2 | |
| 5 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | | - | - | | | | |

**UNIT I** **9 Hours**

**INTRODUCTION**

Modern trends, principles, procedures, fundamentals and economic considerations for design and development of farm power and machinery systems. Design considerations, procedure and their applications in agricultural tractors & typical machines. Reliability criteria in design and its application

**UNIT II** **9 Hours**

**CONSTRUCTION OF PRIMARY TILLAGE IMPLEMENTS**

Design of coulters, shares, mould boards. Construction of mould board working surface. Design of landside, frog, jointer. Forces acting on plough bottom and their effect on plough balance, trailed, semi mounted and mounted plough. Draft on ploughs, resistance during ploughing. Design disk ploughs, concave disk working tools, forces acting on disc ploughs.

**UNIT III** **9 Hours**

**CONSTRUCTION OF SECONDARY TILLAGE IMPLEMENTS**

Machines and implements for surface and inter row tillage, peg toothed harrow, disk harrows, rotary hoes, graders, rollers, cultivators, design of V shaped sweeps, rigidity of working tools. Rotary machines, trajectory of motion of rotary tiller tynes, forces acting, power requirement. Machines with working tools executing an oscillatory motion.

**UNIT IV** **9 Hours**

**CALIBRATION OF SEED DRILL/PLANTER**

Methods of sowing and planting, machines, agronomic specifications. Sowing inter-tilled crop. Grain hoppers, seed metering mechanism, furrow openers and seed tubes. Planting and transplanting, paddy transplanters, potato planters. Machines for fertilizer application, discs type broadcasters. Organic fertilizer application, properties of organic manure, spreading machines. Liquid fertilizer distributors

**UNIT V** **9 Hours**

**DESIGN OF PLANT PROTECTION AND HARVESTING MACHINERY**

Safety devices for tractors & farm implements. Cabs & HVAC designs- designs of ROPS & FOPS, seat belts and helmets. Safety locations of PTO, belt pulley and hitch linkages and shield -safe tractor operation- maintenance inspection for safety.

**FOR FURTHER READING**

Design of power screws, Lubrication theory, Static and Dynamic loadings.

**Total: 45 Hours**

**Reference(s)**

1. V. B. Bhandari, Design of Machine Elements, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2010
2. Faculty of Mechanical Engineering, PSG College of Technology, Design Data Book, M/s.Kalaikathir Achchagam, 2013
3. J. E. Shigley and C. R. Mischke, Mechanical Engineering Design, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2011
4. R. C. Juvinall and K. M. Marshek, Fundamentals of Machine Component Design, John Wiley & Sons, New Delhi, 2011
5. R. L. Norton, Design of Machinery, Tata McGraw-Hill Publishing Company Pvt Ltd., New Delhi, 2004

**ONE CREDIT**
**18AG0XA OPERATION AND MAINTAINANACE OF MICRO IRRIGATION SYSTEM** **1 0 0 1**

**Course Objectives**

- To understand the components of micro irrigation
- To assess the location of malfunctioning in micro irrigation
- To rectify the issues to ensure proper functioning of the system

**Programme Outcomes (POs)**

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

b. 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.

c. 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. Will be familiarized with different components of micro irrigation system
2. Can easily identify the problem and rectify it

**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 | | | | | | | | | | | |

**UNIT I** **3 Hours**

**INTRODUCTION TO MICRO IRRIGATION SYSTEM**

Drip Irrigation - Types and Advantages - Components-Sprinkler Irrigation System - Components - Automation in Micro Irrigation System - Components in Automation - Relay and Switches for Automation.

**UNIT II** **4 Hours**

**MAINTENANCE OF DRIP IRRIGATION SYSTEM**

Daily Maintenance - Fortnightly Maintenance - Monthly Maintenance - Half Yearly Maintenance - General Maintenance Tips -Precautions for Inline System

**UNIT III** **4 Hours**

**CHEMICAL TREATMENTS IN DRIP IRRIGATION SYSTEM**

Acid Treatment- Types of Acids-Procedure for Acid Treatment -Troubleshooting - Chlorine Treatment - Sources of Chlorine -Procedure for Chlorine Treatment - Safety Precautions during Chlorine Treatment.

**UNIT IV** **4 Hours**

**TROUBLE SHOOTING AND REMEDIES**

Leakages in Submain, Inline, Lateral Joints- Non Uniformity in Drippers - Drop in Pressure - Opening and Closure of Solenoid Valves - Connectivity in Electrical Communication for Automation.

**Total: 15 Hours**

## 18AG0XB TRAINING ON THE MANUFACTURE OF AGRICULTURAL IMPLEMNETS

**1 0 0 1**

**Course Objectives**

- To understand the manufacturing process of farm machinery.
- To learn the optimization techniques
- To study the design procedure of farm implements

**Programme Outcomes (POs)**

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

b. 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.

c. 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.

d. 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.

f. 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.

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

**Course Outcomes (COs)**

1. Illustrate the basics of farm implement design
2. Design of farm implements based on standards
3. Examine the designed implements using testing standards

**Articulation Matrix**

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

**UNIT I** **3 Hours**

**CURRENT TRENDS**

Effect of Soil, Crop & Grain properties in Farm machinery design-Farm machinery knowledge base - Some application & machinery available, mechanical, hydraulic & electrical influence in farm machinery design-Farm machinery demands for Reduce Human efforts, Increase Productivity, Time to market-Optimization of current

Farm machine design by increasing efficiency and ergonomically comfort to user & case studies

**UNIT II** **7 Hours**

**DESIGN PROCEDURE OF IMPLEMENTS**

Work flow of Farm machinery design life cycle-Sketching of concept design for farm machines -Review of current technology and market trends, hurdles in usage, market demands, customer requirements and future trends-Function, materials and geographical simulation modeling using CAD/CAE -Compliance with health and safety standards as per end user's country laws and regulations, Review for patents impregnation-Metallurgical properties selections for functional components-Simple test rigs for concept study and data to simulation powerful result using analyzer like Cosmos, Ansys, HyperMesh, etc,.

**UNIT III** **5 Hours**

**TEST PROCEDURE OF IMPLEMENTS**

Standard test code procedure for Machinery Performance evaluation-Prototype 3D part modeling using powerful tools like solid works, catia ,Pro-E -Designing of machine elements and factor of safety considerations-Component level analysis for mechanical elements design by using powerful tools like Kissoft, Gear tracks, Mitcalc ,etc-3D Part Modeling assembly for motion analysis and interference deduction and stack-up tolerance-Detailing / drawing of child and parent parts by using essential engineering annotations, geometrical tolerance & dimensioning (ASME14.5Y) , design data standards etc-Development of prototype farm machine by proper manufacturing process and technology , assembly fitment & special tools.-Design of Fixture, Tools ,Die, Patterns and Packaging study-Quality inspection - special instruments - NABL accreted lab certificate-Central & State testing center for performance evaluation of farm machinery

**Total: 15 Hours**

## 18AG0XB TRAINING ON THE MANUFACTURE OF AGRICULTURAL IMPLEMNETS

**1 0 0 1**

### Course Objectives

- To understand the operation of farm tractor, power tiller and combine harvester
- To learn the optimization techniques of farm machinery operation
- To learn the maintenance of farm tractor, power tiller and combine harvester

### Programme Outcomes (POs)

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

b. 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.

c. 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.

d. 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.

f. 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.

m. Model, design and analyze agricultural machineries and implement to increase productivity, improve land use and conserve resources like seed, water, fertilizer, pesticide and fuel

### Course Outcomes (COs)

- Operate the farm tractor, power tiller and combine harvester

- Perform the periodical maintenance of farm tractor, power tiller and combine harvester
- Calculate the annual maintenance cost of farm tractor, power tiller and combine harvester

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 3 | 2 | | | | | | | | | | | |
| 2 | | 3 | 1 | | 1 | 1 | | | | | | | 2 | |
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**UNIT I** **6 Hours**

**OPERATION AND MAINTENCE OF FARM TRACTOR**

Different controls of a farm tractor & safety instructions- constructional features, adjustments, preventive maintenance and operating techniques in tillage, puddling, seeding & planting, , material handling and transporting machinery / equipment- Field practice.

**UNIT II** **5 Hours**

**OPERATION AND MAINTENCE OF POWERTILLER**

Constructional features, adjustments, preventive maintenance and operating techniques of power tiller in tillage, puddling, seeding & planting, interculturing, plant protection, harvesting & post-harvesting, material handling and transporting machinery / equipment- Field practice with the above equipment and different seed bed preparation techniques with rotavator

**UNIT III** **4 Hours**

**MAINTENCE OF COMBINE HARVESTER**

Constructional features, adjustments, preventive maintenance and operating techniques of Combine harvester- Preventive maintenance and off season storage technique.

**Total: 15 Hours**

## 18AG0XD CUSTOM HIRING CENTRE 1 0 0 1

### Course Objectives

- To understand the importance of farm mechanization and labour shortage in agricultural operation.
- To learn the operationalization and establishment of CHCs
- To study the cost of operation of the farm implements and equipments.

### Programme Outcomes (POs)

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

b. 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.

c. 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.

d. 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.

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

**Course Outcomes (COs)**

1. Possess the knowledge on the importance of CHCs in the field of agricultural engineering
2. Know the cost of operation per unit area.
3. Explain why custom hiring centre is important for farmmechanization.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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**UNIT I** **4 Hours**

**INTRODUCTION**

Introduction to farm mechanization- establishment of CHC- operationalization- machinery selection- area wise-crop wise- storage of implements.

**UNIT II** **4 Hours**

**COST OF OPERATION**

Methods of cost of operation-cost fixing-hour basis-area basis- depreciation methods- straight line, declining balance, sum of- the- years- digit- fixed cost- variable cost- breakeven point

**UNIT III** **3 Hours**

**TILLAGE AND SOWING EQUIPMENTS**

Tillage-primary tillage-sub-soiler, chisel, MB plough, disc plough-secondary tillage-rotavator, cultivator, disc harrow- laser leveler- sowing equipments- broadcaster- sedd drill, seed sum fertilizer drill- planter- paddy transplanter- vegetable transplanter-nursery raising methods- cost of operation calculation.

**UNIT IV** **4 Hours**

**INTERCULTURAL IMPLEMENTS**

Weeder-wet land , dry land -cono weeder, power weeder- sprayer-manual, power -duster- manual,power- fertilizer applicator-manure spreader- cost of operation calculation

**UNIT V** **4 Hours**

**HARVESTING MACHINERY**

Harvester- paddy, sugarcane, ground nut- digger- potato, carrot, onion- thresher- maize, paddy- cost of operation calculation.

**Total: 15 Hours**

## 18AG0XE AGRO PROCESSING CENTRE 1 0 0 1

**Course Objectives**

- Understand different components of a Agro-Processing Centre and the various process involved in it.
- Understand the processing of various food products and value addition
- Apply knowledge of Agro-Processing Centre (APC) for entrepreneurship.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
e. 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. Understand different components of a Agro-Processing Centre and the various process involved in it
2. Understand the processing of various food products and value addition
3. Apply knowledge of Agro-Processing Centre (APC) for entrepreneurship.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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**UNIT I** **4 Hours**

**ESTABLISHMENT OF AGRO PROCESSING CENTRE**

Introduction- Agro processing centre - factors involved in Agro-Processing Centre - Survey- design - plant layout - Crop wise production -Population of villages- Machines identified for agro-processing centre- Location of the site of Agro Processing Centre- Existing farm level processing facilities in village - Processing facilities available in village- Details of equipments/machines in Agro Processing Centre- Economic analysis of Agro Processing Centre

**UNIT II** **6 Hours**

**PROCESSING AND VALUE-ADDITION TECHNOLOGY FOR CEREALS, PULSES AND OILSEEDS**

Introduction - cereals- rice - processing - equipments- by products and importance- value addition processed products- fermented products- extruded products- instant mixes- preparation of supplementary food mix- wheat, oats , barley pulses and oil seeds - processing - equipments- by products and importance- value addition.

**UNIT III** **6 Hours**

**PROCESSING AND VALUE-ADDITION TECHNOLOGY FOR RATOON CROPS, FRUITS AND VEGETABLES**

Introduction- ratoon crops- sugarcane, forage crops - fruits- amla, mango,papaya, guava, pianapple, tamarind and other fruits- processing - equipments- by products and importance- value addition- vegetables- onion, tomato, green leafy, roots, tubers and other vegetables- processing - equipments- by products and importance- value addition

**UNIT IV** **5 Hours**

**PROCESSING AND VALUE-ADDITION TECHNOLOGY FOR SPICES, PLANTATION CROPS AND MEDICINAL PLANTS**

Introduction- spices- Turmeric, chilly, ginger, pepper, cardamom and other spices - processing - equipments- value addition- plantation crop- coconut, tea, coffee, nuts and cocoa- processing - equipments-- by products and importance- value addition- medicinal plants- amla, bael and stevia- processing - equipments-- by products and importance- value addition

**UNIT V** **3 Hours**

**PROCESSING AND VALUE-ADDITION TECHNOLOGY FOR ANIMAL AND SEA FOODS**

Introduction- animal foods- milk, egg , chicken and meat processing - equipments- by products and importance-value addition- sea foods fish, crab and prawn processing - equipments-by products and importance- value addition

**Total: 24 Hours**

**Reference(s)**

1. Mangaraj Shukadev, Agro Processing and Value Addition for Entrepreneurship DevelopmentSatish, Serial Publishing House, 2014
2. Bakker-Arkema, CIGR Handbook of Agricultural Engineering, Volume IV Agro-Processing Engineering , Published by the American Society of Agricultural Engineers, USA.

## 18AG0XF LANDSCAPE DESIGNING AND ARCHITECTURE

**1 0 0 1**

**Course Objectives**

- To provide broad overview on various landscaping software
- To create perspective visualization on landscaping concepts
- To impart hands on training and skill in developing garden designs through software

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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. Understand broad overview on various landscaping software
2. Understand perspective visualization on landscaping concepts
3. Apply knowledge of landscaping designs through software

**Articulation Matrix**

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

**UNIT I** **4 Hours**

**INTRODUCTION**

Introduction to landscape horticulture - Overview of software for Computer Aided Design and Drafting (CADD) related landscape graphic oriented software (Real time landscape, 3D Max, Archi-CAD, etc.) Graphic communication

**UNIT II** **4 Hours**

**PERSPECTIVE**

Perspective sketching Plan drawing section object portions view points Elevation - Design forum Master planning residential and corporate landscape designs Landscape projects Architecture projects

**UNIT III** **4 Hours**

**AUTOCAD**

AUTOCAD plants and Design Coordinate system- Drawing tools- Modifying tools- Drawing properties- Dimensioning - Layer, Block, Group and attribute setting - Autocad design centre - Shortcut keys

**UNIT IV** **4 Hours**

**PHOTOSHOP**

Photoshop and Sketch up Basic drawing concepts of photoshop and its applications in CAD landscape designs Google sketch up to three-dimensional rendering 2 D drawing to presentation drawing Free sketch up download

**Total: 16 Hours**

**Reference(s)**

1. Christine Wein - Ping Yu. 1987. Computer aided design: Application to conceptual thinking in landscape architecture
2. http://www.cadforum.cz

## 18AG0XG MILLET PROCESSING AND COOKIES 1 0 0 1

**Course Objective**

- Learn the concept and the components involved millet processing.
- Impart knowledge of application of cookies.

**Course Outcomes (COs)**

1. Understand different components of a millet processing and the various processes involved in it.
2. Understand the processing of various millet based food products and value addition
3. Apply knowledge of millet processing and cookies for entrepreneurship.

**Programme Outcomes (POs)**

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

**Articulation Matrix**

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

**Unit 1- Millets chemistry and nutrition 3 hours**

Types of millets- Chemical components of millets- Nutritional quality of major and minor millets – Basics of millet production and processing

**Unit 2- Major Millets processing 5 hours**

Processing of sorghum- Processing of Pearl millet- Processing of Finger millet – Products from major millets

**Unit 3- Minor millets processing 5 hours**

Processing of Barnyard Millet, Kodo Millet, Little Millet, Proso Millet, Foxtail Millet – Minor millet products and their production techniques

**Unit 4- Millet cookies 4 hours**

Basics of cookie production technology –Millet cookie Recipes – Packaging and storage of cookies

**Unit 5- Commercialization of millet product 3 hours**

Start-up and small scale millet product industry-Government policies and Procedures- Basic requirements – Funding agencies- Procedure for financial support applications

**Total: 20 Hours**

## 18AG0XH COCONUT PROCESSING AND VALUE ADDITION 1 0 0 1

### Course Objective

- Learn the concept and the components involved coconutprocessing.
- Understand the processing of various food products and value addition

### Course Outcomes (COs)

1. Understand different components of a coconut processing
2. Understand the processing of various coconut based food products and value addition
3. Apply knowledge of coconut processing for entrepreneurship.

### Programme Outcomes (POs)

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

### Articulation Matrix

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **8 Hours**

**INTRODUCTION**

Coconut- production and importance - post harvest processing of coconut - harvesting and stages of harvest - drying, cleaning and grading-Coconut products-Copra- Coconut oil extraction process - Traditional method of oil extraction - Mechanical extraction of coconut oil from the fresh coconut meat - Coconut cake.

**UNIT II** **9 Hours**

**VALUE ADDED PRODUCTS FROM COCONUT**

Coconut honey-Coco sauce-Coconut lemonade-Nata-de-coco -COCONUT KERNEL OR WHITE MEAT-Desiccated coconut-Coconut Chips-Coconut Crisps-Roasted young coconut-Dehydrated sweet coconut-Coconut milk-Sweetened condensed coconut milk-Coconut milk powder-Coconut flour-Tender coconut water concentrate-Coconut jiggery-Coconut vinegar-Neera.

**Total: 17 Hours**

### Reference(s)

1. http://agritech.tnau.ac.in/horticulture/horti_tv_coconut_nutri_mgmt.html
2. http://www.coconutboard.nic.in/CoconutProducts.aspx

## 18GE0XA ETYMOLOGY 1 0 0 1

**Course Objectives**

- To increase vocabulary and enhance use, knowledge, and understanding of the English language.
- To stimulate an appreciation for the English language, including how it developed, how new wordsenter the language, and how it continues to be dynamic.
- To demonstrate the importance of a broad-based vocabulary for effective oral and written communication.

**Programme Outcomes (POs)**

j. 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. Examine prefixes, roots, and suffixes of Latin, Greek, Germanic, and Anglo-Saxon origin.
2. Explore the historical aspects of language, including the infusion of Indo-European languages, semantic changes, and the influence of world events.

**Articulation Matrix**

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**UNIT I** **7 Hours**

**CONVENTIONS**

Acronyms, Abbreviations, Initialises, Jargon Neologisms - Idiomatic Expressions, Euphemisms Spoonerisms Malapropisms ; Mondegreens - Words Derived from Latin - Words Derived from Greek - Words Derived from - Germanic/Anglo-Saxon - Abstract word Acronym - Affix Analogy - Antonym Apheresis - Blend word Assimilation - Colloquial language Clipped word

**UNIT II** **8 Hours**

**WORD ANALYSIS**

Concrete word Derivative - Dialect Diminutive suffix - Dissimilation Doublet - Etymology Euphemism - Figurative word Homonym - Hybrid word Inflection - Informal language Infusion - Jargon Linguistics - Loan words Metathesis ; Modify - Philology Onomatopoeia - Romance language Prefix - Semantics - Root-base word - Suffix Slang - Word component Synonym

**Total: 15 Hours**

**Reference(s)**

1. Norman, Lewis. Word Power Made Easy, Goyal Publisher. Edition 2. 2014.
2. C T Onions. The Oxford Dictionary of English Etymology, Volume 11, Issue 1.70, Wynford Drive, Don Mills, Ont, Oxford University Press.1965.
3. Nurnberg W, Maxwell and Rosenblum, Morris, How to build a better Vocabulary, Completely Revised and Updated, Popular Library. 1961.

## 18GE0XB GENERAL PSYCHOLOGY 1 0 0 1

**Course Objectives**

- To provide a basic understanding of psychology.
- Defining Psychology and the subject matter of psychology.
- To provide an awareness of various methods and branches of psychology.
- To explain social and work psychology of people and the need for mental health.

**Programme Outcomes (POs)**

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**Course Outcomes (COs)**

1. Understand the basics of human behavior in the workplace and society at large.
2. Understand the different fields of psychology and its uses.
3. Deal people effectively in their personal and social life.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **7 Hours**

**INTRODUCTION TO PSYCHOLOGY**

Psychology - Definition - Methods and Scope of Psychology Stress: Stressors - Coping Skills - Adjustment Disorders - Acute Stress Disorders - PTSD Anxiety Disorders: Generalized Anxiety disorder - Panic attack- Phobias - Obsessive Compulsive disorder (OCD).

**UNIT II** **8 Hours**

**PSYCHOLOGICAL DISORDERS**

Clinical Picture Childhood and Adolescent Disorders: Mental retardation - Autism-Learning disorders - Eating disorders -Clinical Picture Schizophrenia: Types - Clinical Pictures - Causes - Treatment;Suicide: Risk factors - Suicide prevention.

**Total: 15 Hours**

**Reference(s)**

1. Jeffrey E.Hecker,2005):Introduction to Clinical Psychology, New Delhi:Pearson Education.
2. Robert C Carson,James N Butcher & Susan Mineka,(2004): Abnormal Psychology and Modern Life,(11th Edition),New York: Pearson Education.
3. Morgan, C.T., King, R.A., Weisz, J.R., & Schopler, J.(1993). Introduction to Psychology,7th Ed. New Dehi:Tata McGraw Hill

## 18GE0XC NEURO BEHAVIORAL SCIENCE 1 0 0 1

**Course Objectives**

- To provide an introduction to the Cognitive Neuro Science of languages.
- To provide an understanding of the Cognitive processes.

**Programme Outcomes (POs)**

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

**Course Outcomes (COs)**

1. Identify the psychological problems that will impact mental health.
2. Value ethical conduct in professional and personal life.
3. Recognize the need for rationale and evidence in decision-making.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **8 Hours**

**INTRODUCTION TO PHYSIOLOGY**

Introduction to physiology - Anatomy - Neuro Biology - Psycho Neuro Science.

**UNIT II** **7 Hours**

**PSYCHOLOGICAL BEHAVIOR**

Behaviour and Hormones - Behaviour Modifications - Relaxation Therapy - Psycho Education for minds.

**Total: 15 Hours**

**Reference(s)**

1. Beck, Robert. Handbook of Physiology. Vol I. Oxford University Press March 15,1996
2. Horon C Philip. Sexology and Mind. Academic Press. 1993
3. Blatteis M.Clark and Melvin J. Fregly. Handbook of Physiology Sect 4, Oxford University Press. March 15, 1996

## 18GE0XD VISUAL MEDIA AND FILM MAKING 1 0 0 1

**Course Objectives**

- To acquire fundamental knowledge on development of filmmaking as an art
- To provide students a basic understanding of the techniques and nuances of visual medium
- To inculcate an ability to plan and produce a short film

**Programme Outcomes (POs)**

f. 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.
g. 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. Understand the significance and techniques of visual medium
2. Analyse and produce visual clippings

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **7 Hours**

**INTRODUCTION**

History of Cinema (Origin and Narrative). Cinema as a visual medium - Significance of Editing. Styles of Editing - Editing as a methodology (Hollywood"s Invisible Editing)-Technical Aspects of Editing (Final Cut Pro (FCP), AVID and Premire Pro) - Basics of video production (pre-production to post-production)

**UNIT II** **8 Hours**

**FUNDEMENTALS OF FILMMAKING**

Different types of shots and angles-Film style and Narrative-(Italian Neo-realism, Avant Garde, Russain Formalism, Alternative Cinema etc.,)- Regional Cinema to National Cinema - Basics of Script Writing (Double and Single Column)- Basics of Video Production (script to screen)- Final submission of a script for five minutes short film.

**Total: 15 Hours**

**Reference(s)**

1. Monaco, James, How to Read a Film: Movies, Media, and Beyond. Auckland: OUP, 2009.
2. Belavadi, Vasuki, Video Production. India: OUP, 2013.

## 18GE0XE YOGA FOR HUMAN EXCELLENCE 1 0 0 1

**Course Objectives**

- To know about the history and schools of yoga
- To know the difference between supreme consciousness and individual consciousness
- To apply the knowledge by the way of practice and introspection

**Programme Outcomes (POs)**

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**Course Outcomes (COs)**

1. Understand the historical aspects and schools of yoga
2. Ensure their physical & mental wellness through yoga practice
3. Develop the power to concentrate and have stress free mind

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **15 Hours**

**INTRODUCTION**

What is Yoga? - History of Yoga- Yoga in todays scenario - Schools of Yoga - Eight Limbs of Yoga - Sathvic, Rajasic, Tamasic Foods and Thoughts - Science of Yoga -Loosening Exercises - Yogasanas & Benefits - Super Brain Yoga - Surya Namaskar - Standing Asanas - Sitting Asanas - Prone Asanas - Supine Asanas - Mudras-Relaxation - Pranayama? Meditation.

**Total: 15 Hours**

**Reference(s)**

1. Vethathiri Publications, Yoga Practices-2, Erode, 2012.
2. Iyengar B.K.S. Yoga: Wisdom & Practice, B.K.S. Iyengar, 2009.
3. Ramesh Partani, The Complete Secret, Ru Education, 2013.

## 18GE0XF VEDIC MATHEMATICS 1 0 0 1

**Course Objectives**

- To improve their calculation speed, analytical thinking and numerical skills

**Programme Outcomes (POs)**

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**Course Outcomes (COs)**

1. Solve problems creatively in mathematics and its applications

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **15 Hours**

**VEDIC MATHEMATICS**

Addition- Subtraction- System of Multiplication- Squaring numbers- Cube roots- Square roots- Solution of simultaneous equations- Solutions of Quadratic equations

**Total: 15 Hours**

**Reference(s)**

1. Dhaval Bathia, Vedic Mathematics, JAICO Publishing House, 29th Edition, Mumbai, 2014
2. Jagadguru Swami Sri Bharathi Krsna Tirthaji Maharaja, Vedic Mathematics, Motilal Banarsidass Publishers Private Limited, New Delhi, 1997

## 18GE0XG HEALTH AND FITNESS 1 0 0 1

**Course Objectives**

- To understand the fundamental concepts about physical fitness & its types, training and assessment of physical fitness

**Programme Outcomes (POs)**

d. 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.
f. 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.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**Course Outcomes (COs)**

1. Acquire the knowledge and training of the individual physical, mental and social concepts
2. Understand the fundamental concepts of yogic practice and physical fitness
3. To acquire the knowledge about nutrition and health consciousness.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **5 Hours**

**FITNESS**

Meaning & Definition Need & importance of Physical fitness -Types Physical fitness - Exercise, Training and Conditioning and it is important

**UNIT II** **5 Hours**

**YOGA AND MEDITATION**

Meaning and definition -Principles of practicing - Basic Asana and it important - Pranayama and Meditation
- Relaxation Techniques

**UNIT III** **5 Hours**

**NUTRITION AND BALANCE DIET**

Nutrition and Balance Diet: Needs and Important - Significant of Nutritional Food - Tips for balance diet. Common Diseases for IT professionals: Common diseases - cause prevention - First aid for common sports injuries.

**Total: 15 Hours**

**Reference(s)**

1. Anderson, Bob., Pearl, Bill.,&Burke, Edmund R., (2001). Getting in Shape Workout Programs for Men&Women. Mumbai: Jaico Publishing House
2. Baechle, Thomas. R, & Earle, Roger. W., (2000). Essentials of Strength Training and Conditioning. Champaign: Human Kinetics
3. Iyengar, BKS., (2003). The Art of Yoga. New Delhi: Harper Collins Publishers
4. Singh, Hardayal, (1995). Science of Sports training. New Delhi: D.V.S. Publications
5. Begum, Raheena. M., (2002). A Textbook of Foods, Nutrition and Dietetics. New Delhi: Sterling Publishers Private Limited

## 18GE0XH CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMICOMPOSTING

**1 0 0 1**

**Course Objectives**

- To understand the importance of safe methods of treating solid wastes generated through various human activities
- To appreciate the skills / devices / practices associated with the compact proceedures of biodegradation of unwanted solid residues

**Programme Outcomes (POs)**

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

### Course Outcomes (COs)

1. Understand the role of recycling of garbage leading to the sustenance of our healthand environment.
2. Recognize the organic farming practices and production of healthy food products.
3. Prepare and maintain tips for small scale compost units and thereby becoming more environmentally conscious

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **15 Hours**

**VERMICOMPOSTING TECHNOLOGY**

Ecological roles and economic importance of earthworms - need for earthworm culture, scope and importance of vermiculture , limiting factors - types of worm culturing and the relative benefits Small scale and commercial methods: process & advantages , Vermicomposting equipments, devices, Design and maintenance of vermi bed - Products from vermiculture (matter & humus cycle), vermicastings in organic farming/horticulture - Marketing the products of vermiculture quality control, market research, marketing techniques , Applied vermiculture: use of urban solids & farm/ industrial residues for vermicomposting - Constraints of vermiculture and its future perspectives Artificial Earthworm as a standalone biodegradation assembly.

**Total: 15 Hours**

**Reference(s)**

1. Sultan Ahmed Ismail, 2005. The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.4
2. Vermiculture Technology; Earthworms, Organic Wastes and Environmental Management, 2011, Edited by Clive A Edwards, Norman Q Arancon & Rhonda Sherman, CRC Press
3. www.organicgrowingwithworms.com.au
4. New York Times , Scientists Hope to Cultivate and Immune System for Crops

## 18GE0XI BLOG WRITING 1 0 0 1

**Course Objectives:**

- To sharpen and improve writing skills, including draft writing, voice, and format.
- To develop general and global knowledge.
- To experiment with non-written forms of online communications, including images, audio and video.
- To be able to add content to your website without the assistance of a webdesigner.

**Programme Outcomes (POs)**

f. 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.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**Course Outcomes (COs)**

1. Understand the flow of language in natural manner.
2. Understand the elements of a blog and be able to use them effectively.
3. Find a niche for a long-term blog.
4. Gain insight into the strategies, methods and writing of successful bloggers.
5. Develop their creative thinking.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **7 Hours**

**UNIT I**

Concept: What is blog writing? Types of blog posts -personal experience, opinion, reviews, advice, news/updates. Focusing your blog - concept, audience, uniqueness, posts. Company blogs. Structure: Types of structure - inverted pyramid, feature article, list, story, other options. Creating effective openings. Planning a post.

**UNIT II** **8 Hours**

**UNIT II**

Voice: Defining and achieving voice. Exploring various voices. Stylistic tipsÃƒÂ¢??rhythm, verbs, interesting words, senses, emphasis. Smartness and sarcasm. Reliability - accuracy, provability, specificity. Transparency about payments. Sample Blogs and Activities

**Total: 15 Hours**

**Reference(s)**

1. The Elements of Blogging: Expanding the Conversation of Journalism, by Mark Leccese and Jerry Lanson. (Taylor & Francis, 2015) ISBN: 978-1-13-802154-9. $29.95 paperback.
2. Blogging Heroes, by Michael Banks. Choose 15 of the 30 interviews/profile segments to read, be sure to include the segments on Chris Anderson and Brian Lam.
3. Complete Guide to Blogging, Huffinghton Post

## 16GE0XJ INTERPERSONAL SKILLS 1 0 0 1

**Course Objectives:**

- To communicate and work effectively, both individually and ingroups
- To be able to understand and manage one's own and other's emotions
- To define and solve problems by making decisions about the best course of action

**Programme Outcomes (POs)**

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

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**Course Outcomes (COs)**

1. Express themselves clearly and confidently
2. Listen to others completely and with empathy
3. Assert an opinion without diminishing others opinion
4. Be responsible and timely with a willingness to collaborate
5. Develop innate personality traits to handle certain social situations

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **7 Hours**

**INTRODUCTION**

Conversational Skills - Active Listening - Team working Empathy - Emotional Intelligence

**UNIT II** **8 Hours**

**SKILLS**

Conflict Resolution and Mediation skills - Decision making and Problem Solving - Negotiation and Persuasion skills

**Total: 15 Hours**

**Reference(s)**

1. Stephen P. Robbins, Phillip L. Hunsaker, Training in Interpersonal Skills, Pearson, 2015
2. Robert B. Cialdini, Influence: The Psychology of Persuasion, Harper Business; Revised Edition, 2006
3. Suzanne C De Janasz, Karen O Dowo & Beth Z Schneder, Interpersonal Skills in Organisations, McGraw-Hill Education; 5th Edition, 2014

## 18GE0XK COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT

**1 0 0 1**

**Course Objectives**

- Understand the role of National Service Scheme in community
- Identify the needs and problems of the community and involve in problem solving
- Develop competence required for group living and acquire leadership qualities

**Programme Outcomes (POs)**

**Course Outcomes (COs)**

1. understand the community in which they work and render their service
2. develop among themselves a sense of social and civic responsibility

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **15 Hours**

**COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT**

Introduction and Basic Concepts of NSS: History-philosophy-aims & objectives of NSS- Emblem, flag, motto, song, badge- Organizational structure - roles and responsibilities functionaries. NSS Programmes and Activities: Concept of regular activities, special camping, DayCamps-Basisofadoption of village/slums-Methodology of conducting Survey -Financial pattern ofthescheme -Coordination withdifferent agencies-Maintenance oftheDiary. Community Mobilization: Mapping of community stakeholders-Designing the message in the context of the problem and the culture of the community-Identifying methods of mobilization-Youth-adult partnership. Health, Hygiene & Sanitation: Definition, needs and scope of health education- Food and Nutrition - Safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan). Entrepreneurship Development: Definition & Meaning - Qualities of good entrepreneur - Steps/ways in opening an enterprise -Role of financial and support service Institutions.

**Total: 15 Hours**

**Reference(s)**

1. A Hand book on National Service Scheme, Anna University, Chennai, 2012
2. http://nss.nic.in/intro.asp

3. Delgado-Gaitn and Concha, The Power of Community: Mobilizing for Family and SchoolingNew York: Rowman & Littlefield Publishing, Inc. 2001
4. James Bailey,Guide to Hygiene and Sanitation in Aviation, World health organization, 2nd edition. 1980
5. AnuradhaBasu, Mark Casson, Nigel wadeson and Bernard Yeung, The oxford hand book of entrepreneurship, Oxford Press. 2009.

## 18GE0XL NATIONAL CADET CORPS 1 0 0 1

**Course Objectives**

- To understand the importance of NCC and its organization.
- To realize the skills in the applications of drill and weapon training.
- To analyze the factors in National unity
- To identify the utility of smart materials in engineering applications.

**Programme Outcomes (POs)**

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**Course Outcomes (COs)**

1. Recall the motto and aim of NCC.
2. Implement synergy in disaster management.
3. Execute an example patriotic leader to serve nation

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **12 Hours**

**NCC STRUCTURE AND TRAINING**

NCC ORGANIZATION National Cadet Corps: Aim and Objectives - Administrative and Organizational pattern - NCC flag and NCC song - Duties, Responsibilities and Conduct by NCC Cadets - Badges of ranks in NCC and Armed forces- Types of NCC camps - Eligibility conditions for writing B and C certificate examinations. Cadet welfare society and Career opportunities for NCC cadets. DRILL AND WEAPON TRAINING Drill: Aims of drill - Types of drill - Foot drill, Arms drill and Ceremonial drill. Word of commands, Guard of honour. Weapon training - Rifles used in NCC: Parts and Characteristics of 0.22 and INSAS - Stripping, Assembling and Cleaning of weapons.NATIONAL INTEGRATION AND SOCIAL AWARENESS National Integration: Introduction - Constitution of India- Importance and Necessity - Factors affecting National integration - Role of NCC in National integration. Social service and its need - Rural development programs - NGOs role and Contribution - Social Security schemes.

**UNIT II** **8 Hours**

**PERSONALITY DEVELOPMENT AND LEADERSHIP**

PERSONALITY DEVELOPMENT AND LEADERSHIP : Personality Development: Introduction - Factor influences in personality development. Leadership: Leadership traits and Skills - Indicator of good leader - Honour code concept - Type of leaders - Case studies of effective leader. DISASTER MANAGEMENT AND FIRST AID Disaster types - Natural and Manmade disasters. Role of NCC cadets in disaster management. Civil defence: Civil defence measures - Civil defence services. First aid: First aid kits and Equipments - First aid for snake bite, Sun stroke and Drowning - Respiration -Types of respiration.

**Total: 20 Hours**

**Reference(s)**

1. Cadets Hand book Common subject, DG NCC, New Delhi.
2. Cadets Hand book Special subject, DG NCC, New Delhi
3. Misra R.C and Sanjaykumar Mishra, A HAND BOOK OF NCC(English), Kanti Prakashan, 2016
4. Gupta R. K, NCC: Handbook of NCC Cadets for A, B and C Certificate Examinations (English) RPH Editorial Board, 2018.

## 18GE0XM NEW AGE INNOVATION AND ENTREPRENEURSHIP

**1 0 0 1**

**Course Objectives**

- To make the participants understand as to how to get along with the task of setting independent business units and on the various facets of running a business
- To get the budding young entrepreneurs to appreciate the structured knowledge of the dynamics of operationalizing a business opportunity

**Programme Outcomes (POs)**

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

c. 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.

f. 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.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**Course Outcomes (COs)**

1. Understanding entrepreneurship as an important career option
2. Concept and methodology of idea translation to viable start-ups
3. Events to occur in the building of a technology based venture for students or working professionals or women
4. Overview of Indian trends in the start-up scene

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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**UNIT I** **15 Hours**

**NEW AGE INNOVATION AND ENTREPRENEURSHIP**

Introduction to Entrepreneurship - Opportunity Identification ideation -MVPPositioning as an Entrepreneur Starting own Business - Developing Effective Business Model - Industry and Competitor Analysis - Building Business PlanMentoring Session with Investors- Legal and Ethical Foundation for Startup. Types of startups and licensing systems - MSME -Evaluating the Financial Strength of a New Venture/Project - Getting Funding - Types of Sources VCs, Angel funding, PE etc. -Marketing Strategies for New Ventures - IT Systems - IPR - Strategies for New Venture Growth - Talent Acquisition and Management for New Ventures - Valuation Challenge in Entrepreneurship - Intrapreneurship Sustainability - Exit strategiesand Start-up trends in India.

**Total: 15 Hours**

**Reference(s)**

1. Kathleen R. Allen, Launching New Ventures, South-WesternCengage Learning, 6th Edition, 2012
2. Alex Osterwalder and Yves Pigneur, Business Model Generation, publishedby the authors, 2010
3. Branson. R. Business stripped bare, New York, Penguin books, 2011
4. Moris MH, Kuratko DF and Covin JG, Corporate entrepreneurship and innovation, 3 edition, Mason, Oh; CENGAGE/SOUTH WESTERN publisher, 2011

## 18GE0XN DISRUPTIVE INNOVATION BASED STARTUP ACTIVITIES

**1 0 0 1**

**Course Objectives**

- To make the participants understand as to how to get along with the task disruption led innovations.
- To get the budding young entrepreneurs to appreciate the structured knowledge of the dynamics of operationalizing creativity based disruption strategy

**Programme Outcomes (POs)**

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**Course Outcomes (COs)**

1. Understanding contemporary entrepreneurship as an important career option
2. Concept and methodology of creative disruption to viable start-ups
3. Events to occur in the building of a technology based venture for students or working professionals or women with disruptive technology option
4. Overview of Indian trends with reference to disruptive innovation based start-ups.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **15 Hours**

**DISRUPTIVE INNOVATION**

Creativity linked innovation - Differences between Disruptive & incremental Innovations - Historical, theoretical, and practical evolution of disruptive innovation (DI). - Idea generation & communication of creativity leading to DI. Innovation management concepts in DI based entrepreneur generation - How do firms bring in new business models and get new products and services to the market? - Investor preferences in core versus new or disruptive business models - disruptors and the disrupted frameworks for assessing company''s capabilities and rethinking product, market and strategy - Right customers for DI: strategy in a world that is changing so rapidly - Application of disruptive theories to complex problems and opportunities.

**Total: 15 Hours**

**Reference(s)**

1. https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1540-5885.2005.00177.x
2. http://www.brinq.com/workshop/archives/2005/01/08/what-is-disruptive-innovation
3. https://hbr.org/2006/12/disruptive-innovation-for-social-change

## 18GE0XO SOCIAL PSYCHOLOGY 1 0 0 1

**Course Objectives**

- To provide a basic understanding of social psychology.
- Defining psychological & physical changes during puberty age.
- To provide an awareness of various psychological problems and social problems.
- To explain social and work psychology of people and the need for mental health.

**Programme Outcomes (POs)**

f. 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.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**Course Outcomes (COs)**

1. Understand the basics of human behavior in the workplace and society at large
2. Understand the various psychological, physical, social problems and management skills.
3. Deal people effectively in their personal and social life.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **7 Hours**

**INTRODUCTION**

Introduction - Ice breaker - Time Line - Tasks and Challenges of the age( Erik Erikson)Physical changes - Introduction to Reproductive Health - Reproductive Organs - Menstruation - Changes during Puberty - Abortions - Contraception - Difference between Sex and Gender - Introduction to the origins of Patriarchy - Gender.

**UNIT II** **8 Hours**

**PSYCHOLOGY**

Developmental changes - Attraction - Friendship - Differences and Similarities - Images of Beauty and Body Image -Introduction to Media-Feedback - Sexuality - Boundaries Relationships - Marriage - Love - Emotional Health - Sexual Abuse and Safety - Role of Media - Abortions, Contraception, Wrapping up the Course.

**Total: 15 Hours**

**Reference(s)**

1. Baron, R. A.,Branscombe.N.R.(2016).Social Psychology,14th Ed. New Delhi;Pearson Education
2. Morgan,C.T., King,R.A.,Weisz,J.R.,&Schopler,J.(1993). Introduction to Psychology,7th Ed.New Dehi:Tata McGraw Hill.

## 18GE0XP FM RADIO BROADCASTING TECHNOLOGY

**1 0 0 1**

**Course Objectives**

- The course focuses on community radio technology and various program productions techniques for FM Radio Broadcasting.

**Programme Outcomes (POs)**

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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. Understand the hardware required for field recording and setting up a studio and carry out studio and field recording.
2. Examine the available options for telephony interfaces for radio.
3. Demonstrate proper techniques of wiring, fixing of connectors, soldering and use of tools and equipment for studio work.

**Articulation Matrix**

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

**UNIT I** **3 Hours**

**INTRODUCTION TO AM/ FM RADIO**

History of Radio-Types of Radio and its Reach- Entertainment Radio- Community Radio- Internet Radio-Satellite Radio. Evolution of Community Radio (CR) in India- principles behind setting up of FM/CR-policy guidelines and their impact on technology and content of a CR station- fundamental principles behind deciding the technology for a CR station.

**UNIT II** **3 Hours**

**STUDIO TECHNOLOGY**

Use of Microphones-Console handling-OB Recordings & Live Shows-Properties and components of sound-difference between analogue and digital audio-hardware required for field recording and setting up a studio-fundamental principles for setting up an audio studio.

**UNIT III** **3 Hours**

**AUDIO PRODUCTION**

Concept of recording and storing audio-hardware related to audio recording-open source software solutions for audio production-telephony interfaces for radio- audio Post Production. Voice Culture Exercise- Radio Production Techniques & Tools.

**UNIT IV** **3 Hours**

**STUDIO OPERATIONS**

Wiring, fixing of connectors, soldering and use of tools and equipment- preventive and corrective maintenance of studio and equipment.

**UNIT V** **3 Hours**

**RADIO TRANSMISSION TECHNOLOGY**

Components of the FM transmission chain- FM transmitter-different types of FM antenna - coaxial cable-propagation and coverage of RF signals-FM transmitter setup- Radio audience -measurements systems.

**Total: 15 Hours**

**Reference(s)**


1. UNESCO (2001). Community Radio Handbook.
2. Vinod Pavarala, Kanchan K Malik, Other Voices: The Struggle for Community Radio in India, SAGE Publications India, 2007.
3. Steve Buckley, Mark Raboy, Toby Mendel, Kreszentia Duer, Monroe E. Price, Sean O Siochru, Broadcasting, Voice, and Accountability: A Public Interest Approach to Policy, Law, and Regulation, University of Michigan Press, 2008.
4. www.floridasound.com
5. www.mediacollege.com
6. www.mediacollege.com