

ANNA UNIVERSITY, CHENNAI - 600 025

AFFILIATED INSTITUTIONS

REGULATIONS 2017

CHOICE BASED CREDIT SYSTEM

Common to all B.E. / B.Tech. Full-Time Programmes

(For the students admitted to B.E. / B.Tech. Programme at various Affiliated Institutions)

DEGREE OF BACHELOR OF ENGINEERING / BACHELOR OF TECHNOLOGY

This Regulations is applicable to the students admitted to B.E/B.Tech. Programmes at all Engineering Colleges affiliated to Anna University, Chennai (other than Autonomous Colleges) and to all the University Colleges of Engineering of Anna University, Chennai from the academic year 2017-2018 onwards.

1 PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires:

- I. **“Programme”** means Degree Programme, that is B.E./B.Tech. Degree Programme.
- II. **“Discipline”** means specialization or branch of B.E./B.Tech. Degree Programme, like Civil Engineering, Textile Technology, etc.
- III. **“Course”** means a theory or practical subject that is normally studied in a semester, like Mathematics, Physics, etc.
- IV. **“Director, Academic Courses”** means the authority of the University who is responsible for all academic activities of the Academic Programmes for implementation of relevant rules of this Regulations pertaining to the Academic Programmes.
- V. **“Chairman”** means the Head of the Faculty.
- VI. **“Head of the Institution”** means the Principal of the College.
- VII. **“Head of the Department”** means head of the Department concerned.
- VIII. **“Controller of Examinations”** means the authority of the University who is responsible for all activities of the University Examinations.
- IX. **“University”** means ANNA UNIVERSITY, CHENNAI.

2 ADMISSION

- 2.1** Candidates seeking admission to the first semester of the eight semester B.E. / B.Tech. Degree Programme:

Should have passed the Higher Secondary Examinations of (10+2) Curriculum (Academic Stream) prescribed by the Government of Tamil Nadu with Mathematics, Physics and Chemistry as three of the four subjects of study under Part-III or any examination of any other University or authority accepted by the Syndicate of Anna University as equivalent thereto.

(OR)

Should have passed the Higher Secondary Examination of Vocational stream (Vocational groups in Engineering / Technology) as prescribed by the Government of Tamil Nadu.

2.2 Lateral entry admission

- (i) The candidates who possess the Diploma in Engineering / Technology awarded by the State Board of Technical Education, Tamilnadu or its equivalent are eligible to apply for Lateral entry admission to the third semester of B.E. / B.Tech. in the branch corresponding to the branch of study.

(OR)

- (ii) The candidates who possess the Degree in Science (B.Sc.,) (10+2+3 stream) with Mathematics as a subject at the B.Sc. Level are eligible to apply for Lateral entry admission to the third semester of B.E. / B.Tech.

Such candidates shall undergo two additional Engineering subject(s) in the **third and fourth semesters** as prescribed by the University.

3. PROGRAMMES OFFERED

B.E. / B.Tech. Programmes under the Faculty of Civil Engineering, Faculty of Mechanical Engineering, Faculty of Electrical Engineering, Faculty of Information and Communication Engineering and Faculty of Technology.

4. STRUCTURE OF PROGRAMMES

4.1 Categorization of Courses

Every B.E. / B. Tech. Programme will have a curriculum with syllabi consisting of theory and practical courses that shall be categorized as follows:

- i. **Humanities and Social Sciences (HS)** courses include Technical English, Engineering Ethics and Human Values, Communication skills, Environmental Science and Engineering.

- ii. **Basic Sciences (BS)** courses include Mathematics, Physics, Chemistry, Biology, etc.
- iii. **Engineering Sciences (ES)** courses include Engineering practices, Engineering Graphics, Basics of Electrical / Electronics / Mechanical / Computer Engineering, Instrumentation etc.
- iv. **Professional Core (PC)** courses include the core courses relevant to the chosen specialization/branch.
- v. **Professional Elective (PE)** courses include the elective courses relevant to the chosen specialization/ branch.
- vi. **Open Elective (OE)** courses include the courses from other branches which a student can choose from the list specified in the curriculum of the students B.E. / B. Tech. / B.Arch. Programmes.
- vii. **Employability Enhancement Courses (EEC)** include Project Work and/or Internship, Seminar, Professional Practices, Case Study and Industrial/Practical Training.
- viii. **Employability Enhancement Skill Based Courses** include Skill based experiential learning courses will be offered in two categories as purely Laboratory Based Courses and Theory Integrated Laboratory Courses.

**Insertion
of New
Clause
4.1.viii**

4.2 Personality and Character Development

All students shall enroll, on admission, in any one of the personality and character development programmes (NCC/NSS/NSO/YRC) and undergo training for about 80 hours and attend a camp of about seven days. The training shall include classes on hygiene and health awareness and also training in first-aid.

National Cadet Corps (NCC) will have about 20 parades.

National Service Scheme (NSS) will have social service activities in and around the College / Institution.

National Sports Organization (NSO) will have sports, Games, Drills and Physical exercises.

Youth Red Cross (YRC) will have activities related to social services in and around College/Institutions.

While the training activities will normally be during weekends, the camp will normally be during vacation period.

4.3 Number of courses per semester

Each semester curriculum shall normally have a blend of lecture courses not exceeding 7 and Laboratory courses and Employability Enhancement Course(s) not exceeding 4. Each Employability Enhancement Course may have credits assigned as per clause 4.4. However, the total number of courses per semester shall not exceed 10.

4.4 Credit Assignment

Each course is assigned certain number of credits based on the following:

Contact period per week	CREDITS
1 Lecture Period	1
2 Tutorial Periods	1
2 Laboratory Periods (also for EEC courses like / Seminar / Project Work / Case study / etc.)	1

The Contact Periods per week for Tutorials and Practical can only be in multiples of 2.

4.5 Industrial Training / Internship

The students may undergo Industrial training for a period as specified in the Curriculum during summer / winter vacation. In this case the training has to be undergone continuously for the entire period.

The students may undergo Internship at Research organization / University (after due approval from the Department Consultative Committee) for the period prescribed in the curriculum during summer / winter vacation, in lieu of Industrial training.

4.6 Industrial Visit

Every student is required to go for at least one Industrial Visit every year starting from the second year of the Programme. The Heads of Departments shall ensure that necessary arrangements are made in this regard.

4.7 Value Added Courses

The Students may optionally undergo Value Added Courses and the credits earned through the Value Added Courses shall be over and above the total credit requirement prescribed in the curriculum for the award of the degree. One / Two credit courses shall be offered by a Department **of an institution with the prior approval from the Head of the Institution**. The details of the syllabus, time table and faculty may be sent to the Centre for Academic Courses and the Controller of Examinations after approval from the **Head of the Institution** concerned atleast one month before the

course is offered. **Students can take a maximum of two one credit courses / one two credit course** during the entire duration of the Programme.

4.8 Online Courses

- 4.8.1 Students may be permitted to credit only one online course of 3 credits with the approval of **Head of the Institution** and Centre for Academic Courses.
- 4.8.2 Students may be permitted to credit one online course (which are provided with certificate) subject to a maximum of three credits. The approved list of online courses will be provided by the Centre for Academic courses from time to time. The student needs to obtain certification or credit to become eligible for writing the End Semester Examination to be conducted by Controller of Examinations, Anna University. The details regarding online courses taken up by students should be sent to the Controller of Examinations, Anna University and Centre for Academic Courses one month before the commencement of End Semester Examination.

- 4.9** The students satisfying the following conditions shall be permitted to carry out their final semester Project work for six months in industry/research organizations.

The student should not have current arrears and shall have CGPA of 7.50 and above.

The student shall undergo the eighth semester courses in the sixth and seventh semesters. The Head of Department, in consultation with the faculty handling the said courses shall forward the proposal recommended by the Head of Institution to the Controller of Examinations through the Director, Centre for Academic courses for approval at least 4 weeks before the commencement of the sixth semester of the programme for approval.

4.10 Medium of Instruction

The medium of instruction is English for all courses, examinations, seminar presentations and project / thesis / dissertation reports except for the programmes offered in Tamil Medium.

4.11 Employability Enhancement Skill Based Courses

Skill based experiential learning courses will be offered in two categories as purely Laboratory Based Courses and Theory Integrated Laboratory Courses with the following credits. One such course will be offered in every semester from V to VII.

**Insertion of
New
Clause 4.11**

Category	L	T	P	C
Laboratory Courses	0	0	4	2
	0	0	2	1
Theory integrated Laboratory Course	1	0	2	2

A student may accumulate upto 6 credits through such courses, and such credits will be considered in lieu of the Professional Elective and/or Open Elective courses.

These courses may be offered with the support of the identified firms/companies and with one course coordinator per course and a mentor from the firm.

Evaluation Procedure:

The evaluation of the above mentioned courses are fully internal and shall be jointly done by the course coordinator from the institution and the mentor from the firm.

- (a) If the course involves certification from an identified firm/company, then 20% of the total marks will be included in the internal assessment marks, 30% will be included from the marks provided by the firm and 50% shall be evaluated by the respective Course Coordinators of the college by conducting appropriate theory and / or laboratory tests.
- (b) If there is no certification from the firm/company, then 50% will be included from the marks provided by the firm and 50% shall be evaluated by the respective Course Coordinators of the college by conducting appropriate theory and / or laboratory tests.

Procedure to drop Professional Elective / Open Elective course(s) and computation of Grade point

A student may accumulate up to 6 credits through such courses, and such credits will be considered in lieu of the Professional Elective and/or Open Elective courses.

In this regard, a student is permitted to drop either 1 or 2 Professional Elective / Open Elective course(s) as per the procedure given below.

Table: Procedure to drop Professional Elective / Open Elective course(s)

No. of courses	Total No. of credits earned	Courses to be printed in the grade sheet	No. of Professional elective/ open elective can be dropped	No. of credits considered for GPA/CGPA calculation
1	2	1	-	-
2	4	2	1	3
3	6	3	2	6

- The credits earned by the student of the successfully completed Skill Based Courses shall be recorded in the grade sheet.
- If a student has not successfully completed the skill based courses during the semesters V, VI and VII, then the same shall not be recorded in the grade sheet.
- If a student earns 2 credits in Semester V and then enrolls for another 2 credits in Semester VI, then he / she is permitted to drop one Professional elective/ open elective course in Semester VI. Further, if the student earns 4 credits upto Semester VI and enrolls for another 2 credits in Semester VII, then he/she is permitted to drop an additional professional elective/open elective course in the VII semester.

If the student has enrolled for skill based courses but has not successfully earned 4 or 6 credits and also dropped 1 or 2 PE/OE courses in anticipation of pass, then he/she has to enrol the PE/OE (as the case may be) to meet the total credit requirements to earn the degree.

Method for computation of Grade point of dropped PE / OE courses

The method of Computation of Grade point for the dropped PE/OE courses is given below:

1. If a student has successfully completed two Skill Based Courses, then the computation of Grade point for one PE/OE course dropped in lieu of those two skill based courses is as follows.

Grade point = $(2 \text{ credits} * \text{higher grade point obtained} + 1 \text{ credit} * \text{lower grade point obtained}) / 3 \text{ credits}$.

For example, for two courses of two credit each, if the grades obtained are,

Course 1– C grade – 5 points

Course 2– O grade – 10 points

Then, the grade point of the dropped course for the calculation of CGPA is obtained as: $(1 \times 5 + 2 \times 10) / 3 = 8.33$.

One PE/OE course shall be dropped for 3 credits with grade point computed as above.

2. If a student has successfully completed three Skill Based Courses, then the computation of Grade point for dropping two PE/OE in lieu of those three skill based courses is as follows.

For three courses of two credit each

Computation of Grade point of each of the two dropped PE/OE courses for the calculation of CGPA = Average grade point of three skill based courses.

Two PE/OE courses shall be dropped of 3 credits each, with grade point computed as above.

5. DURATION OF THE PROGRAMME

- 5.1 A student is ordinarily expected to complete the B.E. / B.Tech. Programme in 8 semesters (four academic years) but in any case not more than 14 Semesters for HSC (or equivalent) candidates and not more than 12 semesters for Lateral Entry Candidates.
- 5.1.1 A student is ordinarily expected to complete the B.E. Mechanical Engineering (Sandwich) Programme in 10 semesters (five academic years) but in any case not more than 18 Semesters for HSC (or equivalent) candidates.
- 5.2 Each semester shall normally consist of 75 working days or 540 periods of 50 minutes each. The Head of the Institution shall ensure that every teacher imparts instruction as per the number of periods specified in the syllabus and that the teacher teaches the full content of the specified syllabus for the course being taught.
- 5.3 The Head of the Institution may conduct additional classes for improvement, special coaching, conduct of model test etc., over and above the specified periods. But for the purpose of calculation of attendance requirement for writing the end semester examinations (as per clause 6) by the students, following method shall be used.

$$\text{Attendance} = \frac{\text{Percentage of } \frac{\text{Total no. of periods attended in all the courses per semester}}{\text{(No.of periods / week as prescribed in the curriculum) } \times 15} \times 100}{\text{taken together for all courses of the semester}}$$

The University Examination will ordinarily follow immediately after the last working day of the semester commencing from I semester as per the academic schedule prescribed from time to time.

- 5.4 The total period for completion of the programme reckoned from the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in clause 5.1 irrespective of the period of break of study (vide clause 18) in order that he/she may be eligible for the award of the degree (vide clause 16).

6. COURSE REGISTRATION

6.1 The Institution is responsible for registering the courses that each student is proposing to undergo in the ensuing semester. Each student has to register for all courses to be undergone in the curriculum of a particular semester (with the facility to drop courses to a maximum of 6 credits (vide clause 6.5). The student can also register for courses for which the student has failed in the earlier semesters. In such cases the student shall do **reappearance registration** for those courses for which the attendance requirement is not compulsory. However, the student have the option to take up some other professional elective or open elective that he has failed to pass. **But, the total number of credits that a student is allowed to register per semester cannot exceed 36.** The registration details of the candidates may be approved by the Head of the Institution and forwarded to the Controller of Examinations. This registration is for undergoing the course as well as for writing the End Semester Examinations. No course shall be offered by any department of any institution unless a minimum 10 students register for the course.

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

- i. Courses of the current semester.
- ii. The core (Theory/Lab /EEC) courses that the student has not cleared in the previous semesters.
- iii. Elective courses which the student failed (either the same elective or a different elective instead)

6.2 Flexibility to Drop courses

6.2.1 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.

6.2.2 From the III to final semesters, the student has the option of dropping existing courses in a semester during registration. Total number of credits of such courses cannot exceed 6.

6.2.3 The student shall register for the project work in the final semester only.

7. ATTENDANCE REQUIREMENTS FOR COMPLETION OF THE SEMESTER

7.1 A Candidate who has fulfilled the following conditions shall be deemed to have satisfied the requirements for completion of a semester.

Ideally every student is expected to attend all classes of all the courses and secure 100% attendance. However, in order to give provision for certain unavoidable reasons

such as Medical / participation in sports, the student is expected to attend atleast 75% of the classes.

Therefore, he/she shall **secure not less than 75%** (after rounding off to the nearest integer) of overall attendance as calculated as per clause 5.3.

- 7.2 However, a candidate who secures overall attendance between 65% and 74% in the current semester due to medical reasons (prolonged hospitalization / accident / specific illness) / Participation in Sports events may be permitted to appear for the current semester examinations subject to the condition that the candidate shall submit the medical certificate / sports participation certificate attested by the Head of the Institution. The same shall be forwarded to the Controller of Examinations for record purposes.
- 7.3 Candidates who secure less than 65% overall attendance and candidates who do not satisfy the clause 7.1 and 7.2 shall not be permitted to write the University examination at the end of the semester and not permitted to move to the next semester. They are required to repeat the incomplete semester in the next academic year, as per the norms prescribed.

8. CLASS ADVISOR

There shall be a class advisor for each class. The class advisor will be one among the (course-instructors) of the class. He / She will be appointed by the HoD of the department concerned. The class advisor is the ex-officio member and the Convener of the class committee. The responsibilities for the class advisor shall be:

- To act as the channel of communication between the HoD and the students of the respective class.
- To collect and maintain various statistical details of students.
- To help the chairperson of the class committee in planning and conduct of the class committee meetings.
- To monitor the academic performance of the students including attendance and to inform the class committee.
- To attend to the students' welfare activities like awards, medals, scholarships and industrial visits.

9. CLASS COMMITTEE

- 9.1 Every class shall have a class committee consisting of teachers of the class concerned, student representatives and a chairperson who is not teaching the class. It is like the 'Quality Circle' (more commonly used in industries) with the overall goal

of improving the teaching-learning process. The functions of the class committee include

- Solving problems experienced by students in the class room and in the laboratories.
- **Clarifying the regulations of the degree programme and the details of rules therein particularly (clause 5 and 7) which should be displayed on college Notice-Board.**
- Informing the student representatives, the academic schedule including the dates of assessments and the syllabus coverage for each assessment.
- Informing the student representatives the details of Regulations regarding weightage used for each assessment. In the case of practical courses (laboratory / drawing / project work / seminar etc.) the breakup of marks for each experiment / exercise / module of work, should be clearly discussed in the class committee meeting and informed to the students.
- Analyzing the performance of the students of the class after each test and finding the ways and means of solving problems, if any.
- Identifying the weak students, if any, and requesting the teachers concerned to provide some additional help or guidance or coaching to such weak students.

- 9.2 The class committee for a class under a particular branch is normally constituted by the Head of the Department. However, if the students of different branches are mixed in a class (like the first semester which is generally common to all branches), the class committee is to be constituted by the Head of the Institution.
- 9.3 The class committee shall be constituted within the first week of each semester.
- 9.4 At least 4 student representatives (usually 2 boys and 2 girls) shall be included in the class committee.
- 9.5 The Chairperson of the class committee may invite the Class adviser(s) and the Head of the Department to the class committee meeting.
- 9.6 The Head of the Institution may participate in any class committee of the institution.
- 9.7 The chairperson is required to prepare the minutes of every meeting, submit the same to Head of the Institution within two days of the meeting and arrange to circulate it among the students and teachers concerned. If there are some points in the minutes requiring action by the management, the same shall be brought to the notice of the Management by the Head of the Institution.

- 9.8 The first meeting of the class committee shall be held within one week from the date of commencement of the semester, in order to inform the students about the nature and weightage of assessments within the framework of the Regulations. Two or three subsequent meetings may be held in a semester at suitable intervals. **The Class Committee Chairman shall put on the Notice Board the cumulative attendance particulars of each student at the end of every such meeting to enable the students to know their attendance details to satisfy the clause 6 of this Regulation.** During these meetings the student members representing the entire class, shall meaningfully interact and express the opinions and suggestions of the other students of the class in order to improve the effectiveness of the teaching-learning process.

10. COURSE COMMITTEE FOR COMMON COURSES

Each common theory course offered to more than one discipline or group, shall have a "Course Committee" comprising all the teachers teaching the common course with one of them nominated as Course Coordinator. The nomination of the Course Coordinator shall be made by the Head of the Department / Head of the Institution depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The 'Course committee' shall meet in order to arrive at a common scheme of evaluation for the test and shall ensure a uniform evaluation of the tests. Wherever feasible, the course committee may also prepare a common question paper for the internal assessment test(s).

11. SYSTEM OF EXAMINATION

- 11.1 Performance in each course of study shall be evaluated based on (i) continuous internal assessment throughout the semester and (ii) University examination at the end of the semester.
- 11.2 Each course, both theory and practical (including project work & viva voce Examinations) shall be evaluated for a maximum of 100 marks.

For all theory and practical courses including project work, the continuous internal assessment will carry **20 marks** while the End - Semester University examination will carry **80 marks**.

- 11.3 Industrial training and seminar shall carry 100 marks and shall be evaluated through internal assessment only.

- 11.4 The University examination (theory and practical) of 3 hours duration shall ordinarily be conducted between October and December during the odd semesters and between April and June during the even semesters.
- 11.5 The University examination for project work shall consist of evaluation of the final report submitted by the student or students of the project group (of not exceeding 4 students) by an external examiner and an internal examiner, followed by a viva-voce examination conducted separately for each student by a committee consisting of the external examiner, the supervisor of the project group and an internal examiner.
- 11.6 For the University examination in both theory and practical courses including project work the internal and external examiners shall be appointed by the Controller of Examinations.

12. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

For all theory and practical courses (including project work) the continuous assessment shall be for a maximum of 20 marks. The above continuous assessment shall be awarded as per the procedure given below:

12.1 THEORY COURSES

Three tests each carrying 100 marks shall be conducted during the semester by the Department / College concerned. The total marks obtained in all tests put together out of 300, shall be proportionately reduced for 20 marks and rounded to the nearest integer (This also implies equal weightage to all the three tests).

12.2 LABORATORY COURSES

The maximum marks for Internal Assessment shall be 20 in case of practical courses. Every practical exercise / experiment shall be evaluated based on conduct of experiment / exercise and records maintained. There shall be at least one test. The criteria for arriving at the Internal Assessment marks of 20 is as follows: 75 marks shall be awarded for successful completion of all the prescribed experiments done in the Laboratory and 25 marks for the test. The total mark shall be reduced to 20 and rounded to the nearest integer.

12.3 THEORY COURSES WITH LABORATORY COMPONENT

If there is a theory course with Laboratory component, there shall be three tests: the first two tests (each 100 marks) will be from theory portions and the third test (maximum mark 100) will be for laboratory component. The sum of marks of first two tests shall be reduced to 60 marks and the third test mark shall be reduced to 40 marks. The sum of these 100 marks may then be arrived at for 20 and rounded to the nearest integer.

12.4 PROJECT WORK

Project work may be allotted to a single student or to a group of students not exceeding 4 per group.

The Head of the Institutions shall constitute a review committee for project work for each branch of study. There shall be three reviews during the semester by the review committee.

The student shall make presentation on the progress made by him / her before the committee. The total marks obtained in the three reviews shall be reduced for 20 marks and rounded to the nearest integer (as per the scheme given in 12.4.1).

- 12.4.1** The project report shall carry a maximum 30 marks. The project report shall be submitted as per the approved guidelines as given by Director, Academic Courses. Same mark shall be awarded to every student within the project group for the project report. The viva-voce examination shall carry 50 marks. Marks are awarded to each student of the project group based on the individual performance in the viva-voce examination.

Review I	Review II	Review III	End semester Examinations				
			Thesis Submission (30)		Viva-Voce (50)		
5	7.5	7.5	Internal	External	Internal	External	Supervisor
			15	15	15	20	15

- 12.4.2** If a candidate fails to submit the project report on or before the specified deadline, he/she is deemed to have failed in the Project Work and shall re-register for the same in a subsequent semester.

12.5 OTHER EMPLOYABILITY ENHANCEMENT COURSES

- (a) The seminar / Case study is to be considered as purely INTERNAL (with 100% internal marks only). Every student is expected to present a minimum of 2 seminars per semester before the evaluation committee and for each seminar, marks can be equally apportioned. The three member committee appointed by Head of the Institution will evaluate the seminar and at the end of the semester the marks can be consolidated and taken as the final mark. The evaluation shall be based on the seminar paper (40%), presentation (40%) and response to the questions asked during presentation (20%).

- (b) The Industrial / Practical Training, Summer Project, Internship, shall carry 100 marks and shall be evaluated through internal assessment only. At the end of Industrial / Practical training / internship / Summer Project, the candidate shall

submit a certificate from the organization where he / she has undergone training and a brief report. The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally by a three member Departmental Committee constituted by the Head of the Institution. The certificates (issued by the organization) submitted by the students shall be attached to the mark list sent by the Head of the Institution to the Controller of Examinations.

12.6 ASSESSMENT FOR VALUE ADDED COURSE

The one / two credit course shall carry 100 marks and shall be evaluated through **continuous assessments only**. Two Assessments shall be conducted during the semester by the Department concerned. The total marks obtained in the tests shall be reduced to 100 marks and rounded to the nearest integer. A committee consisting of the Head of the Department, staff handling the course and a senior Faculty member nominated by the Head of the Institution shall monitor the evaluation process. The list of students along with the marks and the grades earned may be forwarded to the Controller of Examinations for appropriate action at least one month before the commencement of End Semester Examinations.

12.7 ASSESSMENT FOR ONLINE COURSES

Students may be permitted to credit one online course (which are provided with certificate) subject to a maximum of three credits. The approved list of online courses will be provided by the Centre for Academic courses from time to time. **This online course of 3 credits can be considered instead of one elective course**. The student needs to obtain certification or credit to become eligible for writing the End Semester Examination to be conducted by Anna University. **The course shall be evaluated through the End Semester Examination only conducted by Controller of Examinations, Anna University.**

12.8 Internal marks approved by the Head of the Institution shall be displayed by the respective HODs within 5 days from the last working day.

12.9 Attendance Record

Every teacher is required to maintain an 'ATTENDANCE AND ASSESSMENT RECORD' which consists of attendance marked in each lecture or practical or project work class, the test marks and the record of class work (topic covered), separately for each course. This should be submitted to the Head of the department periodically (at least three times in a semester) for checking the syllabus coverage and the records of test marks and attendance. The Head of the department will put his signature and date after due verification. At the end of the semester, the record should be verified by the

Head of the Institution who will keep this document in safe custody (for five years). The University or any inspection team appointed by the University may verify the records of attendance and assessment of both current and previous semesters.

13. REQUIREMENTS FOR APPEARING FOR UNIVERSITY EXAMINATIONS

A candidate shall normally be permitted to appear for the University Examinations for all the courses registered in the current semester (vide clause 6) if he/she has satisfied the semester completion requirements (subject to Clause 7).

A candidate who has already appeared for any subject in a semester and passed the examination is not entitled to reappear in the same subject for improvement of grades.

14. PASSING REQUIREMENTS

14.1 A candidate who secures not less than 50% of total marks prescribed for the course [Internal Assessment + End semester University Examinations] with a minimum of 45% of the marks prescribed for the end-semester University Examination, shall be declared to have passed the course and acquired the relevant number of credits. This is applicable for both theory and practical courses (including project work).

14.2 If a student fails to secure a pass in a theory course / laboratory course (except electives), the student shall register and appear only for the end semester examination in the subsequent semester. In such case, the internal assessment marks obtained by the candidate in the first appearance shall be retained and considered valid for all subsequent attempts till the candidate secure a pass. However, from the third attempt onwards if a candidate fails to obtain pass marks (IA + End Semester Examination) as per clause 14.1, then the candidate shall be declared to have passed the examination if he/she secure a minimum of 50% marks prescribed for the university end semester examinations alone.

**Amendment
of
Clause 14.2**

14.3 Omitted

14.4 If a student fails to secure a pass in project work, the student shall register for the course again, when offered next.

14.5 The passing requirement for the courses which are assessed only through purely internal assessments (EEC courses except project work), is 50% of the internal assessment (continuous assessment) marks only.

14.6 A student can apply for revaluation of the student's semester examination answer paper in a theory course, within 2 weeks from the declaration of results, on payment of a prescribed fee along with prescribed application to the COE through the Head

of the Institution. The COE will arrange for the revaluation and the results will be intimated to the student concerned through the Head of the Institution. Revaluation is not permitted for laboratory course and project work.

15. AWARD OF LETTER GRADES

- 15.1 All assessments of a course will be evaluated on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain number of points, will be awarded as per the range of total marks (out of 100) obtained by the candidate in each subject as detailed below:

Letter Grade	Grade Points	Marks Range
O (Outstanding)	10	91 - 100
A + (Excellent)	9	81 - 90
A (Very Good)	8	71 – 80
B + (Good)	7	61 – 70
B (Average)	6	50 - 60
RA	0	
SA (Shortage of Attendance)	0	
W	0	

A student is deemed to have passed and acquired the corresponding credits in a particular course if he/she obtains any one of the following grades: "O", "A+", "A", "B+", "B".

'SA' denotes shortage of attendance (as per clause 7.3) and hence prevention from writing the end semester examinations. 'SA' will appear only in the result sheet.

"RA" denotes that the student has failed to pass in that course. "W" denotes **withdrawal** from the exam for the particular course. The grades RA and W will figure both in Marks Sheet as well as in Result Sheet). In both cases the student has to earn Continuous Assessment marks and appear for the End Semester Examinations.

If the grade W is given to course, the attendance requirement need not be satisfied. If the grade RA is given to a core **theory course**, the attendance requirement need not be satisfied, but if the grade RA is given to a **Laboratory Course/ Project work / Seminar and any other EEC course**, the attendance requirements (vide clause 7) should be satisfied.

- 15.2 For the Co-curricular activities such as National Cadet Corps (NCC)/ National Service Scheme (NSS) / NSO / YRC, every student shall put in a minimum of 75% attendance in the training and attend the camp. The training and camp shall be completed during

**Amendment
of
Clause 15.2**

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.

This co-curricular activity is not compulsory for the award of degree.

- 15.3 The grades O, A+, A, B+, B obtained for the one credit course shall figure in the Mark sheet under the title '**Value Added Courses**'. The Courses for which the grades are RA, SA will not figure in the mark sheet.

Grade sheet

After results are declared, Grade Sheets will be issued to each student which will contain the following details:

- The college in which the candidate has studied
- The list of courses enrolled during the semester and the grade scored.
- The Grade Point Average (GPA) for the semester and
- The Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards.

GPA for a semester is the ratio of the sum of the products of the number of credits for courses acquired and the corresponding points to the sum of the number of credits for the courses acquired in the semester.

CGPA will be calculated in a similar manner, considering all the courses registered from first semester. RA grades will be excluded for calculating GPA and CGPA.

$$\text{GPA / CGPA} = \frac{\sum_{i=1}^n C_i G P_i}{\sum_{i=1}^n C_i}$$

where C_i is the number of Credits assigned to the course

$G P_i$ is the point corresponding to the grade obtained for each course

n is number of all courses successfully cleared during the particular semester in the case of GPA and during all the semesters in the case of CGPA.

16 ELIGIBILITY FOR THE AWARD OF THE DEGREE

- 16.1 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 subjects prescribed in all the 8 semesters / (10 Semesters for B.E. Mechanical Engineering (Sandwich)) within a maximum period of 7 years (9 years in case of B.E. Mechanical Engineering (Sandwich) and 6 years in the case of Lateral Entry) reckoned from the commencement of the first (third in the case of Lateral Entry) semester to which the candidate was admitted.
- iii. Successfully passed any additional courses prescribed by the Director, Academic Courses whenever readmitted under regulations R-2017 (vide clause 18.3)
- iv. Successfully completed the NCC / NSS / NSO / YRC requirements.
- v. No disciplinary action pending against the student.
- vi. The award of Degree must have been approved by the Syndicate of the University.

16.2 CLASSIFICATION OF THE DEGREE AWARDED

16.2.1 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 (10 Semesters in case of Mechanical (Sandwich) and 6 semesters in the case of Lateral Entry) in the student's First Appearance within **five** years (Six years in the case of Mechanical (Sandwich) and Four years in the case of Lateral Entry). Withdrawal from examination (vide Clause 17) will not be considered as an appearance.
- Should have secured a CGPA of not less than 8.50
- One year authorized break of study (if availed of) is included in the five years (Six years in the case of Mechanical (Sandwich) and four years in the case of lateral entry) for award of First class with Distinction.
- Should NOT have been prevented from writing end semester examination due to lack of attendance in any semester.

16.2.2 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 (10 Semesters in case of Mechanical (Sandwich) and 6 semesters in the case of Lateral Entry) **within Six years**. (Seven years in case of Mechanical (Sandwich) and Five years in the case of Lateral Entry).

- One year authorized break of study (if availed of) or prevention from writing the End Semester examination due to lack of attendance (if applicable) is included in the duration of six years (Seven years in case of Mechanical (Sandwich) and five years in the case of lateral entry) for award of First class
- Should have secured a CGPA of not less than **7.00**.

16.2.3 SECOND CLASS:

All other students (not covered in clauses 16.2.1 and 16.2.2) who qualify for the award of the degree (vide Clause 16.1) shall be declared to have passed the examination in **Second Class**.

16.3 A candidate who is absent in end semester examination in a course / project work after having registered for the same shall be considered to have appeared in that examination for the purpose of classification. (subject to clause 17 and 18).

16.4 Photocopy / Revaluation

A candidate can apply for photocopy of his/her semester examination answer paper in a theory course, within 2 weeks from the declaration of results, on payment of a prescribed fee through proper application to the Controller of Examinations through the Head of Institutions. The answer script is to be valued and justified by a faculty member, who handled the subject and recommend for revaluation with breakup of marks for each question. Based on the recommendation, the candidate can register for the revaluation through proper application to the Controller of Examinations. The Controller of Examinations will arrange for the revaluation and the results will be intimated to the candidate concerned through the Head of the Institutions. Revaluation is not permitted for practical courses and for project work.

A candidate can apply for revaluation of answer scripts for not exceeding 5 subjects at a time.

16.5 Review

Candidates not satisfied with Revaluation can apply for Review of his/ her examination answer paper in a theory course, within the prescribed date on payment of a prescribed fee through proper application to Controller of Examination through the Head of the Institution.

Candidates applying for Revaluation only are eligible to apply for Review.

17. PROVISION FOR WITHDRAWAL FROM END-SEMESTER EXAMINATION

17.1 A student may, for valid reasons, (medically unfit / unexpected family situations / sports approved by Chairman, sports board and HOD) be granted permission to

withdraw from appearing for the end semester examination in any course or courses in **ANY ONE** of the semester examinations during the entire duration of the degree programme. The application shall be sent to Director, Student Affairs through the Head of the Institutions with required documents.

- 17.2 Withdrawal application is valid if the student is otherwise eligible to write the examination (Clause 7) and if it is made within TEN days prior to the commencement of the examination in that course or courses and recommended by the Head of the Institution and approved by the Controller of Examinations.
- 17.2.1 Notwithstanding the requirement of mandatory 10 days notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.
- 17.3 In case of withdrawal from a course / courses (Clause 13) the course will figure both in Marks Sheet as well as in Result Sheet. **Withdrawal essentially requires the student to register for the course/courses** The student has to register for the course, fulfill the attendance requirements (vide clause 7), earn continuous assessment marks and attend the end semester examination. However, withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction.
- 17.4 Withdrawal is permitted for the end semester examinations in the final semester only if the period of study the student concerned does not exceed 5 years as per clause 16.2.1.

18. PROVISION FOR AUTHORISED BREAK OF STUDY

- 18.1 A student is permitted to go on break of study for a maximum period of one year as a single spell.
- 18.2 Break of Study shall be granted only once for valid reasons for a maximum of one year during the entire period of study of the degree programme. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for break of study. If a candidate intends to temporarily discontinue the programme in the middle of the semester for valid reasons, and to rejoin the programme in a subsequent year, permission may be granted based on the merits of the case provided he / she applies to the Director, Student Affairs in advance, but not later than the last date for registering for the end semester examination of the semester in question, through the Head of the Institution stating the reasons therefore and the probable date of rejoining the programme.

- 18.3 The candidates permitted to rejoin the programme after break of study / 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 Director, Academic Courses in the prescribed format through Head of the Institution at the beginning of the readmitted semester itself for prescribing additional courses, if any, from any semester of the regulations in-force, so as to bridge the curriculum in-force and the old curriculum.
- 18.3.1 Total number of credits to be earned by the student shall be more than or equal to the total number of credits prescribed in the curriculum in force. If the credit assigned for L T P of the courses are not same in two Regulations under consideration, then equivalence shall be arrived as per the credit assignment followed in the Regulations in force.
- 18.4 The authorized break of study would not be counted towards the duration specified for passing all the courses for the purpose of classification (vide Clause 16.1).
- 18.5 The total period for completion of the Programme reckoned from, the commencement of the first semester to which the candidate was 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.
- 18.6 If any student is prevented for want of required attendance, the period of prevention shall not be considered as authorized 'Break of Study' (Clause 18.1)
- 19 DISCIPLINE**
- 19.1 Every student is required to observe disciplined and decorous behavior both inside and outside the college and not to indulge in any activity which will tend to bring down the prestige of the University / College. The Head of Institution shall constitute a disciplinary committee consisting of Head of Institution, Two Heads of Department of which one should be from the faculty of the student, to enquire into acts of indiscipline and notify the University about the disciplinary action recommended for approval. In case of any serious disciplinary action which leads to suspension or dismissal, then a committee shall be constituted including one representative from Anna University, Chennai. In this regard, the member will be nominated by the University on getting information from the Head of the Institution.
- 19.2 If a student indulges in malpractice in any of the University / internal examination he / she shall be liable for punitive action as prescribed by the University from time to time.

**Insertion
of New
Clause 18.3.1**

20. REVISION OF REGULATIONS, CURRICULUM AND SYLLABI

The University may from time to time revise, amend or change the Regulations, Curriculum, Syllabus and scheme of examinations through the Academic Council with the approval of Syndicate.

ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM

B. E. AGRICULTURE ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- i) To train and educate students with general knowledge and skills in agricultural water management, agricultural production process, farm machinery and farm management.
- ii) To provide a sound theoretical knowledge in engineering principles applied to agriculture
- iii) To prepare students for a successful agricultural engineering career integrating all aspects of engineering in agriculture.
- iv) To develop innovative capacity of students for increasing agricultural production with scarce water resources available.
- v) To impart positive and responsive out-reach attitudes, initiative and creative thinking in their mission as engineers.
- vi) To understand ethical issues and responsibility of serving the society and the environment at large.

PROGRAM OUTCOMES (POs)

Graduates of Agriculture Engineering will have

- a) Ability to apply the knowledge of mathematics, science and engineering in agriculture
- b) Ability to design and conduct experiments, analyze and interpret data to prepare farm specific report
- c) Ability to design an irrigation system to meet the desired needs within realistic Constraints such as economic, environmental, social, political, ethical, and sustainability
- d) Ability to think creatively, to formulate problem statements, to communicate effectively, to synthesize information, and to evaluate agricultural systems
- e) Ability to function in interdisciplinary teams within the Institute and also with other organizations at National/ International level while planning the research projects.
- f) Ability to use the techniques, skills and modern engineering tools necessary for Agricultural engineering practice.
- g) Will develop competencies in computer and automatic control systems, information systems, mechanical systems, natural resource systems to solve engineering problems
- h) Graduates will be able to express themselves clearly in oral and verbal communication needs.
- i) Ability to devise a strategy or action plan to utilize the acquired knowledge in increasing water- use efficiency, farm mechanization and Post harvest technology etc.
- j) Graduates will be capable of self-education in emerging problems and understand the value of lifelong learning in Food Technology, Farm Machinery and Food Processing.

PEOs and POs – Agriculture Engineering

PEOs	POs									
	a)	b)	c)	d)	e)	f)	g)	h)	i)	j)
i)	X	X							X	
ii)			X	X		X	X			
iii)	X	X	X							
iv)					X			X		
v)			X		X					X
vi)								X	X	X

			POa	POb	POc	POd	POe	POf	POg	POh	POi	POj
YEAR 1	SEM 1	Communicative English				✓				✓		
		Engineering Mathematics I	✓									
		Engineering Physics	✓	✓	✓	✓	✓	✓				
		Engineering Chemistry	✓	✓	✓		✓	✓	✓			
		Problem Solving and Python Programming	✓	✓	✓		✓	✓	✓			
		Engineering Graphics	✓	✓	✓		✓	✓	✓		✓	✓
		Problem Solving and Python Programming Laboratory	✓	✓			✓	✓	✓			
		Physics and Chemistry Laboratory	✓	✓	✓	✓	✓	✓				
YEAR 2	SEM 2	Technical English										
		Engineering Mathematics – II	✓	✓	✓	✓	✓	✓				
		Basic Electrical and Electronics Engineering	✓	✓	✓	✓						
		Engineering Mechanics	✓	✓	✓		✓	✓	✓		✓	✓
		Principles and Practices of Crop Production	✓	✓	✓		✓	✓				
		Crop Husbandry Laboratory	✓	✓	✓		✓	✓	✓			
		Engineering Practices Laboratory	✓	✓			✓	✓	✓			
			POa	POb	POc	POd	POe	POf	POg	POh	POi	POj
YEAR 2	SEM 3	Transforms and Partial Differential Equations	✓				✓				✓	
		Soil Science and Engineering	✓	✓		✓		✓				
		Thermodynamics		✓	✓	✓		✓	✓	✓		
		Fluid Mechanics and Hydraulics	✓	✓	✓	✓	✓		✓	✓		
		Surveying and Levelling					✓	✓				
		Theory of Machines					✓	✓	✓			
		Surveying and Levelling Laboratory	✓				✓	✓	✓			
		Fluid Mechanics Laboratory		✓	✓	✓	✓	✓	✓	✓	✓	✓
		Interpersonal Skills / Listening and Speaking	✓		✓		✓					
		Probability and Statistics	✓	✓	✓	✓						
		Unit Operations in Agricultural	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

	SEM 4	Processing								
		Farm Tractors		✓	✓		✓	✓		
		Hydrology and Water Resources Engineering	✓	✓	✓	✓		✓	✓	
		Strength of Materials	✓	✓		✓	✓	✓		
		Environmental Science and Engineering	✓	✓	✓	✓		✓	✓	
		Soil Science Laboratory		✓	✓		✓			
		Strength of Materials Laboratory	✓	✓	✓		✓	✓		
		Advanced Reading and Writing	✓		✓	✓	✓			
			POa	POb	POc	POd	POe	POf	POg	POh
YEAR 3	SEM 5	Irrigation and Drainage Engineering			✓	✓	✓	✓		✓
		Farm Machinery and Equipment	✓	✓	✓		✓	✓	✓	
		Design of Basic Machine Elements	✓	✓	✓		✓	✓	✓	✓
		Post Harvest Technology	✓	✓	✓	✓		✓		✓
		Professional Elective - I								
		Open Elective - I*								
		Operation and Maintenance of Farm Machinery Lab	✓	✓	✓	✓			✓	✓
		Post Harvest Engineering Laboratory	✓	✓	✓		✓			✓
		Irrigation Field Laboratory	✓	✓	✓	✓		✓	✓	✓
	SEM 6	Professional Communication								
		Groundwater and Well Engineering	✓	✓	✓	✓			✓	✓
		Food and Dairy Engineering	✓	✓		✓	✓			✓
		Protected Cultivation	✓	✓	✓	✓		✓	✓	
		Solar and Wind Energy Engineering	✓	✓	✓	✓		✓	✓	
		Professional Elective – II								
		Professional Elective – III								
		CAD for Agricultural Engineering	✓	✓	✓			✓	✓	✓
		Drawing of Farm Structures								
		Study Tour (1 Week)			✓	✓	✓			
		Food Process Engineering Laboratory	✓	✓		✓	✓		✓	✓

			POa	POb	POc	POd	POe	POf	POg	POh	POi	POj
YEAR 4	SEM 7	Soil and Water Conservation Engineering	✓			✓	✓			✓	✓	
		Remote Sensing and Geographical Information System		✓	✓	✓	✓	✓			✓	✓
		Bio-Energy Resource Technology	✓	✓		✓	✓		✓		✓	
		Professional Elective – IV										
		Open Elective - II*										
		GIS Laboratory for Agricultural Engineers	✓	✓		✓	✓		✓	✓		
		Renewable Energy Laboratory	✓	✓		✓	✓	✓	✓	✓		
		ICT in Agricultural Engineering Lab Exercises	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Industrial Training (4 weeks During VI Semester –Summer)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	SEM 8	Professional Elective – V										
		Professional Elective – VI										
		Project work	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

PROFESSIONAL ELECTIVES

	POa	POb	POc	POd	POe	POf	POg	POh	POi	POj
Systems Analysis and Soft Computing in Agricultural Engineering	✓	✓		✓	✓	✓	✓	✓		
IT in Agricultural Systems	✓	✓				✓	✓	✓	✓	
Climate Change and Adaptation	✓	✓	✓		✓	✓			✓	✓
Disaster Management	✓	✓	✓	✓				✓	✓	
Human Rights										
Agricultural Business Management	✓	✓	✓		✓	✓	✓			
Agricultural Economics and Farm Management	✓	✓	✓	✓	✓		✓	✓	✓	
Agricultural Extension	✓	✓	✓	✓	✓			✓	✓	
Numerical Methods	✓	✓	✓			✓	✓			
Intellectual Property Rights										
Sustainable Agriculture and Food Security	✓	✓			✓	✓	✓	✓		
Agricultural Waste Management	✓		✓		✓		✓		✓	
Refrigeration and Air Conditioning for Agricultural Engineers	✓		✓		✓		✓		✓	
Storage and Packaging Technology	✓	✓	✓	✓	✓	✓	✓		✓	✓
Seed Processing Technology	✓	✓	✓	✓		✓	✓			
Heat and Mass Transfer for Agricultural Engineers	✓	✓	✓		✓	✓	✓		✓	✓
Total Quality Management										
Process Engineering of Fruits and Vegetables										
Watershed Management			✓	✓	✓	✓	✓		✓	✓
Micro Irrigation	✓	✓	✓		✓	✓	✓			
On Farm Water Management	✓	✓	✓	✓			✓	✓		
Automation in Irrigation	✓	✓	✓		✓	✓	✓			
Professional Ethics in Engineering										
Farm Power and Machinery Management	✓	✓		✓	✓			✓	✓	✓
Mechanics of Tillage and Traction	✓	✓	✓	✓	✓			✓	✓	✓
Special Farm Equipment	✓	✓		✓	✓			✓	✓	✓
Energy Auditing and Management	✓		✓	✓	✓	✓		✓		
Ergonomics and Safety in Agricultural Engineering	✓	✓	✓	✓	✓			✓	✓	✓
Fundamentals of Nanoscience										
Foundation Skills In Integrated Product Development										

ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
B. E. AGRICULTURE ENGINEERING
REGULATIONS– 2017
CHOICE BASED CREDIT SYSTEM
I TO VIII SEMESTERS CURRICULA & SYLLABI

SEMESTER I

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS8151	Communicative English	HS	4	4	0	0	4
2.	MA8151	Engineering Mathematics – I	BS	4	4	0	0	4
3.	PH8151	Engineering Physics	BS	3	3	0	0	3
4.	CY8151	Engineering Chemistry	BS	3	3	0	0	3
5.	GE8151	Problem Solving and Python Programming	ES	3	3	0	0	3
6.	GE8152	Engineering Graphics	ES	6	2	0	4	4
PRACTICAL								
7.	GE8161	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
8.	BS8161	Physics and Chemistry Laboratory	BS	4	0	0	4	2
TOTAL				31	19	0	12	25

SEMESTER II

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS8251	Technical English	HS	4	4	0	0	4
2.	MA8251	Engineering Mathematics – II	BS	4	4	0	0	4
3.	BE8251	Basic Electrical and Electronics Engineering	ES	3	3	0	0	3
4.	GE8292	Engineering Mechanics	ES	5	3	2	0	4
5.	AI8201	Principles and Practices of Crop Production	PC	3	3	0	0	3
PRACTICAL								
6.	GE8261	Engineering Practices Laboratory	ES	4	0	0	4	2
7.	AI8211	Crop Husbandry Laboratory	PC	4	0	0	4	2
TOTAL				27	17	2	8	22

SEMESTER III

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA8353	Transforms and Partial Differential Equations	BS	4	4	0	0	4
2.	AI8301	Soil Science and Engineering	PC	3	3	0	0	3
3.	AI8302	Fluid Mechanics and Hydraulics	PC	4	4	0	0	4
4.	AI8303	Theory of Machines	PC	3	3	0	0	3
5.	CE8304	Surveying and Levelling	ES	3	3	0	0	3
6.	MF8491	Thermodynamics	ES	5	3	2	0	4
PRACTICAL								
7.	CE8312	Surveying and Levelling Laboratory	ES	4	0	0	4	2
8.	AI8311	Fluid Mechanics Laboratory	PC	2	0	0	2	1
9.	HS8381	Interpersonal Skills / Listening and Speaking	EEC	2	0	0	2	1
TOTAL				30	20	2	8	25

SEMESTER IV

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA8391	Probability and Statistics	BS	4	4	0	0	4
2.	AI8401	Unit Operations in Agricultural Processing	PC	3	3	0	0	3
3.	AI8402	Farm Tractors	PC	3	3	0	0	3
4.	CE8091	Hydrology and Water Resources Engineering	PC	3	3	0	0	3
5.	CE8393	Strength of Materials	ES	4	4	0	0	4
6.	GE8291	Environmental Science and Engineering	HS	3	3	0	0	3
PRACTICAL								
7.	AI8411	Soil Science Laboratory	PC	2	0	0	2	1
8.	CE8481	Strength of Materials Laboratory	ES	4	0	0	4	2
9.	HS8461	Advanced Reading and Writing	EEC	2	0	0	2	1
TOTAL				28	20	0	8	24

SEMESTER V

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	AI8501	Irrigation and Drainage Engineering	PC	3	3	0	0	3
2.	AI8502	Farm Machinery and Equipment	PC	3	3	0	0	3
3.	AI8503	Design of Basic Machine Elements	PC	4	4	0	0	4
4.	AI8504	Post Harvest Technology	PC	3	3	0	0	3
5.		Professional Elective - I	PE	3	3	0	0	3
6.		Open Elective - I*	OE	3	3	0	0	3
PRACTICAL								
7.	AI8511	Operation and Maintenance of Farm Machinery Lab	PC	4	0	0	4	2
8.	AI8512	Post Harvest Engineering Laboratory	PC	4	0	0	4	2
9.	AI8513	Irrigation Field Laboratory	PC	4	0	0	4	2
10.	HS8581	Professional Communication	EEC	2	0	0	2	1
TOTAL					33	19	0	14
								26

SEMESTER VI

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	AI8601	Groundwater and Well Engineering	PC	3	3	0	0	3
2.	AI8602	Food and Dairy Engineering	PC	3	3	0	0	3
3.	AI8603	Protected Cultivation	PC	3	3	0	0	3
4.	AI8604	Solar and Wind Energy Engineering	PC	3	3	0	0	3
5.		Professional Elective – II	PE	3	3	0	0	3
6.		Professional Elective – III	PE	3	3	0	0	3
PRACTICAL								
7.	AI8611	CAD for Agricultural Engineering	PC	4	0	0	4	2
8.	AI8612	Drawing of Farm Structures	PC	4	0	0	4	2
9.	AI8613	Study Tour(1 Week)	EEC	0	0	0	0	1
10.	AI8614	Food Process Engineering Laboratory	PC	4	0	0	4	2
TOTAL					30	18	0	12
								25

SEMESTER VII

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	AI8701	Soil and Water Conservation Engineering	PC	3	3	0	0	3
2.	AI8702	Remote Sensing and Geographical Information System	PC	3	3	0	0	3
3.	AI8703	Bio-Energy Resource Technology	PC	3	3	0	0	3
4.		Professional Elective – IV	PE	3	3	0	0	3
5.		Open Elective - II*	OE	3	3	0	0	3
PRACTICAL								
6.	AI8711	GIS Laboratory for Agricultural Engineers	PC	4	0	0	4	2
7.	AI8712	Renewable Energy Laboratory	PC	4	0	0	4	2
8.	AI8713	ICT in Agricultural Engineering Lab Excercises	PC	2	0	0	2	1
9.	AI8714	Industrial Training (4 weeks During VI Semester –Summer)	EEC	0	0	0	0	2
TOTAL				25	15	0	10	22

SEMESTER VIII

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective – V	PE	3	3	0	0	3
2.		Professional Elective – VI	PE	3	3	0	0	3
PRACTICAL								
3.	AI8811	Project work	EEC	20	0	0	20	10
TOTAL				26	6	0	20	16

TOTAL NO. OF CREDITS: 185

HUMANITIES AND SOCIAL SCIENCES (HS)

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS8151	Communicative English	HS	4	4	0	0	4
2.	HS8251	Technical English	HS	4	4	0	0	4
3.	GE8291	Environmental Science and Engineering	HS	3	3	0	0	3

BASIC SCIENCES (BS)

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA8151	Engineering Mathematics – I	BS	4	4	0	0	4
2.	PH8151	Engineering Physics	BS	3	3	0	0	3
3.	BS8161	Physics and Chemistry Laboratory	BS	4	0	0	4	2
4.	MA8251	Engineering Mathematics – II	BS	4	4	0	0	4
5.	CY8151	Engineering Chemistry	BS	3	3	0	0	3
6.	MA8353	Transforms and Partial Differential Equations	BS	4	4	0	0	4
7.	MA8391	Probability and Statistics	BS	4	4	0	0	4

ENGINEERING SCIENCES (ES)

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE8151	Problem Solving and Python Programming	ES	3	3	0	0	3
2.	GE8152	Engineering Graphics	ES	6	2	0	4	4
3.	GE8161	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
4.	BE8251	Basic Electrical and Electronics Engineering	ES	3	3	0	0	3
5.	GE8292	Engineering Mechanics	ES	5	3	2	0	4
6.	GE8261	Engineering Practices Laboratory	ES	4	0	0	4	2
7.	MF8491	Thermodynamics	ES	5	3	2	0	4
8.	CE8304	Surveying and Levelling	ES	3	3	0	0	3
9.	CE8312	Surveying and Levelling Laboratory	ES	4	0	0	4	2
10.	CE8481	Strength of Materials Laboratory	ES	4	0	0	4	2
11	CE8393	Strength of Materials	ES	4	4	0	0	4

PROFESSIONAL CORE (PC)

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AI8201	Principles and Practices of Crop Production	PC	3	3	0	0	3
2.	AI8211	Crop Husbandry Laboratory	PC	4	0	0	4	2
3.	AI8301	Soil Science and Engineering	PC	3	3	0	0	3
4.	AI8302	Fluid Mechanics and Hydraulics	PC	4	4	0	0	4
5.	AI8303	Theory of Machines	PC	3	3	0	0	3
6.	AI8311	Fluid Mechanics Laboratory	PC	2	0	0	2	1
7.	AI8401	Unit Operations in Agricultural Processing	PC	3	3	0	0	3
8.	AI8402	Farm Tractors	PC	3	3	0	0	3
9.	AI8411	Soil Science Laboratory	PC	2	0	0	2	1
10.	CE8091	Hydrology and Water Resources Engineering	PC	3	3	0	0	3
11.	AI8501	Irrigation and Drainage Engineering	PC	3	3	0	0	3
12.	AI8502	Farm Machinery and Equipment	PC	3	3	0	0	3
13.	AI8503	Design of Basic Machine Elements	PC	4	4	0	0	4
14.	AI8504	Post Harvest Technology	PC	3	3	0	0	3
15.	AI8511	Operation and Maintenance of Farm Machinery Lab	PC	4	0	0	4	2
16.	AI8512	Post Harvest Engineering Laboratory	PC	4	0	0	4	2
17.	AI8513	Irrigation Field Laboratory	PC	4	0	0	4	2
18.	AI8601	Groundwater and Well Engineering	PC	3	3	0	0	3
19.	AI8602	Food and Dairy Engineering	PC	3	3	0	0	3
20.	AI8603	Protected Cultivation	PC	3	3	0	0	3
21.	AI8604	Solar and Wind Energy Engineering	PC	3	3	0	0	3
22.	AI8611	CAD for Agricultural Engineering	PC	4	0	0	4	2
23.	AI8612	Drawing of Farm Structures	PC	4	0	0	4	2
24.	AI8614	Food Process Engineering Laboratory	PC	4	0	0	4	2
25.	AI8701	Soil and Water Conservation Engineering	PC	3	3	0	0	3

26.	AI8702	Remote Sensing and Geographical Information System	PC	3	3	0	0	3
27.	AI8703	Bio-Energy Resource Technology	PC	3	3	0	0	3
28.	AI8711	GIS Laboratory for Agricultural Engineers	PC	4	0	0	4	2
29.	AI8712	Renewable Energy Laboratory	PC	4	0	0	4	2
30.	AI8713	ICT in Agricultural Engineering Lab Exercises	PC	2	0	0	2	1

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS8381	Interpersonal Skills / Listening and Speaking	EEC	2	0	0	2	1
2.	HS8461	Advanced reading and Writing	EEC	2	0	0	2	1
3.	AI8613	Study tour (1 week)	EEC	0	0	0	0	1
4.	HS8581	Professional Communication	EEC	2	0	0	2	1
5.	AI8714	Industrial Training (4 weeks During VI Semester –Summer)	EEC	0	0	0	0	2
6.	AI8811	Project work	EEC	20	0	0	20	10

PROFESSIONAL ELECTIVE

SEMESTER V ELECTIVE - I

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AI8001	Systems Analysis and Soft Computing in Agricultural Engineering	PE	3	3	0	0	3
2.	AI8002	IT in Agricultural Systems	PE	3	3	0	0	3
3.	AI8003	Climate change and adaptation	PE	3	3	0	0	3
4.	GE8071	Disaster Management	PE	3	3	0	0	3
5.	GE8074	Human Rights	PE	3	3	0	0	3

SEMESTER VI ELECTIVE - II

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AI8004	Agricultural Business Management	PE	3	3	0	0	3
2.	AI8005	Agricultural Economics and Farm Management	PE	3	3	0	0	3
3.	AI8006	Agricultural Extension	PE	3	3	0	0	3
4.	MA8491	Numerical Methods	PE	4	4	0	0	4
5.	GE8075	Intellectual Property Rights	PE	3	3	0	0	3

**SEMESTER VI
ELECTIVE - III**

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AI8007	Agricultural Waste Management	PE	3	3	0	0	3
2.	AI8008	Sustainable Agriculture and Food Security	PE	3	3	0	0	3

**SEMESTER VII
ELECTIVE – IV**

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AI8009	Refrigeration and Air Conditioning for Agricultural Engineers	PE	3	3	0	0	3
2.	AI8010	Storage and Packaging Technology	PE	3	3	0	0	3
3.	AI8011	Seed Processing Technology	PE	3	3	0	0	3
4.	AI8012	Heat and Mass Transfer for Agricultural Engineers	PE	3	3	0	0	3
5.	AI8013	Process Engineering of Fruits and Vegetables	PE	3	3	0	0	3
6.	GE8077	Total Quality Management	PE	3	3	0	0	3
7.	GE8072	Foundation Skills In Integrated Product Development	PE	3	3	0	0	3

**SEMESTER VIII
ELECTIVE - V**

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AI8014	Watershed Management	PE	3	3	0	0	3
2.	AI8015	Micro Irrigation	PE	3	3	0	0	3
3.	AI8016	On Farm Water Management	PE	3	3	0	0	3
4.	AI8017	Automation in Irrigation	PE	3	3	0	0	3
5.	GE8076	Professional Ethics in Engineering	PE	3	3	0	0	3

**SEMESTER VIII
ELECTIVE - VI**

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AI8018	Farm Power and Machinery Management	PE	3	3	0	0	3
2.	AI8019	Mechanics of Tillage and Traction	PE	3	3	0	0	3
3.	AI8020	Special Farm Equipment	PE	3	3	0	0	3
4.	AI8021	Energy Auditing and Management	PE	3	3	0	0	3
5.	AI8022	Ergonomics and Safety in Agricultural Engineering	PE	3	3	0	0	3
6.	GE8073	Fundamentals of Nanoscience	PE	3	3	0	0	3

SUMMARY

S.NO	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL
		I	II	III	IV	V	VI	VII	VIII	
1.	HS	4	4	0	3	0	0	0	0	11
2.	BS	12	4	4	4	0	0	0	0	24
3.	ES	9	9	9	6	0	0	0	0	33
4.	PC	0	5	11	10	19	18	14	0	77
5.	PE	0	0	0	0	3	6	3	6	18
6.	OE	0	0	0	0	3	0	3	0	6
7.	EEC	0	0	1	1	1	1	2	10	16
	Total	25	22	25	24	26	25	22	16	185
8.	Non Credit/Mandatory									

OBJECTIVES:

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

UNIT I SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS 12

Reading- short comprehension passages, practice in skimming-scanning and predicting-

Writing- completing sentences- - developing hints. **Listening-** short texts- short formal and informal conversations.

Speaking- introducing oneself - exchanging personal information-

Language development- Wh- Questions- asking and answering-yes or no questions- parts of speech. **Vocabulary development--** prefixes- suffixes- articles.- count/ uncount nouns.

UNIT II GENERAL READING AND FREE WRITING 12

Reading - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and /or short questions/ open-ended questions)-inductive reading- short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register- **Writing** – paragraph writing- topic sentence- main ideas- free writing,

short narrative descriptions using some suggested vocabulary and structures –**Listening-** telephonic conversations. **Speaking** – sharing information of a personal kind—greeting – taking leave- **Language development** – prepositions, conjunctions **Vocabulary development-**

guessing meanings of words in context.

UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 12

Reading- short texts and longer passages (close reading) **Writing-** understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences

Listening – listening to longer texts and filling up the table- product description- narratives from different sources. **Speaking-** asking about routine actions and expressing opinions. **Language development-** degrees of comparison- pronouns- direct vs indirect questions- **Vocabulary development** – single word substitutes- adverbs.

UNIT IV READING AND LANGUAGE DEVELOPMENT 12

Reading- comprehension-reading longer texts- reading different types of texts- magazines

Writing- letter writing, informal or personal letters-e-mails-conventions of personal email-

Listening- listening to dialogues or conversations and completing exercises based on them.

Speaking- speaking about oneself- speaking about one's friend- **Language development-**

Tenses- simple present-simple past- present continuous and past continuous- **Vocabulary development-** synonyms-antonyms- phrasal verbs.

UNIT V EXTENDED WRITING 12

Reading- longer texts- close reading –**Writing-** brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing-**Listening** –

listening to talks- conversations- **Speaking** – participating in conversations- short group conversations-**Language development**-modal verbs- present/ past perfect tense - **Vocabulary development**-collocations- fixed and semi-fixed expressions.

OUTCOMES: At the end of the course, learners will be able to:

- Read articles of a general kind in magazines and newspapers.
- Participate effectively in informal conversations; introduce themselves and their friends and express opinions in English.
- Comprehend conversations and short talks delivered in English
- Write short essays of a general kind and personal letters and emails in English.

TEXT BOOKS:

1. Board of Editors. **Using English** A Coursebook for Undergraduate Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015
2. Richards, C. Jack. **Interchange Students' Book-2** New Delhi: CUP, 2015.

REFERENCES

1. Bailey, Stephen. **Academic Writing: A practical guide for students**. New York: Rutledge, 2011.
2. Comfort, Jeremy, et al. **Speaking Effectively : Developing Speaking Skills for Business English**. Cambridge University Press, Cambridge: Reprint 2011
3. Dutt P. Kiranmai and Rajeevan Geeta. **Basic Communication Skills**, Foundation Books: 2013
4. Means, L. Thomas and Elaine Langlois. **English & Communication For Colleges**. CengageLearning, USA: 2007
5. Redston, Chris & Gillies Cunningham **Face2Face** (Pre-intermediate Student's Book & Workbook) Cambridge University Press, New Delhi: 2005

MA8151**ENGINEERING MATHEMATICS – I**L T P C
4 0 0 4**OBJECTIVES :**

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus. The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT I DIFFERENTIAL CALCULUS**12**

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

UNIT II FUNCTIONS OF SEVERAL VARIABLES**12**

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT III INTEGRAL CALCULUS**12**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT IV MULTIPLE INTEGRALS**12**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

UNIT V DIFFERENTIAL EQUATIONS**12**

Higher order linear differential equations with constant coefficients - Method of variation of parameters – Homogeneous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients - Method of undetermined coefficients.

TOTAL : 60 PERIODS**OUTCOMES :**

After completing this course, students should demonstrate competency in the following skills:

- Use both the limit definition and rules of differentiation to differentiate functions.
- Apply differentiation to solve maxima and minima problems.
- Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of Calculus.

- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.
- Evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts.
- Determine convergence/divergence of improper integrals and evaluate convergent improper integrals.
- Apply various techniques in solving differential equations.

TEXT BOOKS :

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015. [For Units I & III - Sections 1.1, 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1(Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

REFERENCES :

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. Weir, M.D and Joel Hass, "Thomas Calculus", 12th Edition, Pearson India, 2016.

PH8151	ENGINEERING PHYSICS	L T P C
		3 0 0 3

OBJECTIVES:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT I	PROPERTIES OF MATTER	9
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Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.

UNIT II	WAVES AND FIBER OPTICS	9
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Oscillatory motion – forced and damped oscillations: differential equation and its solution – plane progressive waves – wave equation. Lasers : population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers - fibre optic sensors: pressure and displacement.

UNIT III	THERMAL PHYSICS	9
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Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductances in solids – thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT IV QUANTUM PHYSICS 9

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – tunnelling (qualitative) - scanning tunnelling microscope.

UNIT V CRYSTAL PHYSICS 9

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

TOTAL :45 PERIODS**OUTCOMES:**

Upon completion of this course,

- the students will gain knowledge on the basics of properties of matter and its applications,
- the students will acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics,
- the students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers,
- the students will get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
- the students will understand the basics of crystals, their structures and different crystal growth techniques.

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.

REFERENCES:

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics". W.H.Freeman, 2007.

CY8151**ENGINEERING CHEMISTRY****L T P C
3 0 0 3****OBJECTIVES:**

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- Preparation, properties and applications of engineering materials.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.

UNIT I	WATER AND ITS TREATMENT	9
Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA – numerical problems – boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) external treatment – Ion exchange process, zeolite process – desalination of brackish water - Reverse Osmosis.		
UNIT II	SURFACE CHEMISTRY AND CATALYSIS	9
Adsorption: Types of adsorption – adsorption of gases on solids – adsorption of solute from solutions – adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – contact theory – kinetics of surface reactions, unimolecular reactions, Langmuir - applications of adsorption on pollution abatement.		
Catalysis: Catalyst – types of catalysis – criteria – autocatalysis – catalytic poisoning and catalytic promoters - acid base catalysis – applications (catalytic convertor) – enzyme catalysis– Michaelis – Menten equation.		
UNIT III	ALLOYS AND PHASE RULE	9
Alloys: Introduction- Definition- properties of alloys- significance of alloying, functions and effect of alloying elements- Nichrome and stainless steel (18/8) – heat treatment of steel. Phase rule: Introduction, definition of terms with examples, one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component systems - lead-silver system - Pattinson process.		
UNIT IV	FUELS AND COMBUSTION	9
Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - power alcohol and biodiesel. Combustion of fuels: Introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).		

TOTAL : 45 PERIODS

OUTCOMES:

- The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

TEXT BOOKS:

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015
 2. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
 3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.

REFERENCES:

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
 2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
 3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

OBJECTIVES:

- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures -- lists, tuples, dictionaries.
- To do input/output with files in Python.

UNIT I ALGORITHMIC PROBLEM SOLVING

9

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA, EXPRESSIONS, STATEMENTS

9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS

9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES

9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT V FILES, MODULES, PACKAGES

9

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

TOTAL : 45 PERIODS**OUTCOMES:****Upon completion of the course, students will be able to**

- Develop algorithmic solutions to simple computational problems
- Read, write, execute by hand simple Python programs.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python Programs.

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (<http://greenteapress.com/wp/think-python/>)
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES:

1. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
2. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013
3. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
4. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3", Second edition, Pragmatic Programmers,LLC,2013.
5. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
6. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.

GE8152**ENGINEERING GRAPHICS****L T P C
2 0 4 4****OBJECTIVES:**

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)**1**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREEHAND SKETCHING**7+12**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE**6+12**

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS**5+12**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES**5+12**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS**6+12**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

TOTAL: 90 PERIODS**OUTCOMES:**

On successful completion of this course, the student will be able to

- familiarize with the fundamentals and standards of Engineering graphics
- perform freehand sketching of basic geometrical constructions and multiple views of objects.
- project orthographic projections of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- visualize and to project isometric and perspective sections of simple solids.

TEXT BOOK:

1. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.

REFERENCES:

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
2. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy And Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

GE8161	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L T P C
		0 0 4 2

OBJECTIVES:

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data **from/to files in Python.**

LIST OF PROGRAMS

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux

TOTAL : 60 PERIODS

OUTCOMES:

Upon completion of the course, students will be able to

- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

BS8161	PHYSICS AND CHEMISTRY LABORATORY	L T P C
	(Common to all branches of B.E. / B.Tech Programmes)	0 0 4 2

OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)

1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young's modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser
(b) Determination of acceptance angle in an optical fiber.
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of band gap of a semiconductor
8. Determination of thickness of a thin wire – Air wedge method

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- apply principles of elasticity, optics and thermal properties for engineering applications.

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)**OBJECTIVES:**

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
 - To acquaint the students with the determination of molecular weight of a polymer by viscometry.
1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
 2. Determination of total, temporary & permanent hardness of water by EDTA method.
 3. Determination of DO content of water sample by Winkler's method.
 4. Determination of chloride content of water sample by argentometric method.
 5. Estimation of copper content of the given solution by Iodometry.
 6. Determination of strength of given hydrochloric acid using pH meter.
 7. Determination of strength of acids in a mixture of acids using conductivity meter.
 8. Estimation of iron content of the given solution using potentiometer.
 9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
 10. Estimation of sodium and potassium present in water using flame photometer.
 11. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer
 12. Pseudo first order kinetics-ester hydrolysis.
 13. Corrosion experiment-weight loss method.
 14. Determination of CMC.
 15. Phase change in a solid.
 16. Conductometric titration of strong acid vs strong base.

TOTAL: 30 PERIODS**OUTCOMES:**

- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

TEXTBOOKS:

1. Vogel's Textbook of Quantitative Chemical Analysis (8TH edition, 2014)

HS8251**TECHNICAL ENGLISH****L T P C
4 0 0 4****OBJECTIVES:**

The Course prepares second semester engineering and Technology students to:

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialisation.

UNIT I	INTRODUCTION TECHNICAL ENGLISH	12
Listening - Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- Speaking – Asking for and giving directions- Reading – reading short technical texts from journals- newspapers- Writing - purpose statements – extended definitions – issue- writing instructions – checklists-recommendations- Vocabulary Development - technical vocabulary Language Development –subject verb agreement - compound words.		
UNIT II	READING AND STUDY SKILLS	12
Listening - Listening to longer technical talks and completing exercises based on them- Speaking – describing a process- Reading – reading longer technical texts- identifying the various transitions in a text- paragraphing- Writing - interpreting charts, graphs- Vocabulary Development -vocabulary used in formal letters/emails and reports Language Development - impersonal passive voice, numerical adjectives.		
UNIT III	TECHNICAL WRITING AND GRAMMAR	12
Listening - Listening to classroom lectures/ talks on engineering/technology - Speaking – introduction to technical presentations- Reading – longer texts both general and technical, practice in speed reading; Writing -Describing a process, use of sequence words- Vocabulary Development - sequence words- Misspelled words. Language Development - embedded sentences		
UNIT IV	REPORT WRITING	12
Listening - Listening to documentaries and making notes. Speaking – mechanics of presentations- Reading – reading for detailed comprehension- Writing - email etiquette- job application – cover letter –Résumé preparation(via email and hard copy)- analytical essays and issue based essays-- Vocabulary Development - finding suitable synonyms-paraphrasing-. Language Development - clauses- if conditionals.		
UNIT V	GROUP DISCUSSION AND JOB APPLICATIONS	12
Listening - TED/Ink talks; Speaking –participating in a group discussion - Reading – reading and understanding technical articles Writing – Writing reports- minutes of a meeting- accident and survey- Vocabulary Development - verbal analogies Language Development - reported speech		
TOTAL :60 PERIODS		

OUTCOMES:

At the end of the course learners will be able to:

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialisation successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.

TEXT BOOKS:

1. Board of editors. **Fluency in English A Course book for Engineering and Technology.** Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. **English for Technical Communication.** Cambridge University Press: New Delhi, 2016.

REFERENCES:

1. Booth-L. Diana, **Project Work**, Oxford University Press, Oxford: 2014.
2. Grussendorf, Marion, **English for Presentations**, Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. **Engineering English.** Orient Blackswan: Hyderabad,2015
4. Means, L. Thomas and Elaine Langlois, **English & Communication For Colleges.** Cengage Learning, USA: 2007
5. Raman, Meenakshi and Sharma, Sangeetha- **Technical Communication Principles and Practice.**Oxford University Press: New Delhi,2014.

Students can be asked to read Tagore, Chetan Bhagat and for supplementary reading.

MA8251**ENGINEERING MATHEMATICS – II****L T P C****4 0 0 4****OBJECTIVES :**

- This course is designed to cover topics such as Matrix Algebra, Vector Calculus, Complex Analysis and Laplace Transform. Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering. Vector calculus can be widely used for modelling the various laws of physics. The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

UNIT I MATRICES**12**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II VECTOR CALCULUS**12**

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III ANALYTIC FUNCTIONS**12**

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $w = z + c, cz, \frac{1}{z}, z^2$ - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION**12**

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour.

UNIT V LAPLACE TRANSFORMS**12**

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

TOTAL: 60 PERIODS**OUTCOMES :**

After successfully completing the course, the student will have a good understanding of the following topics and their applications:

- Eigenvalues and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices.
- Gradient, divergence and curl of a vector point function and related identities.
- Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
- Analytic functions, conformal mapping and complex integration.
- Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.

TEXT BOOKS :

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.

REFERENCES :

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7th Edition, 2009.
 2. Jain R.K. and Iyengar S.R.K., " Advanced Engineering Mathematics", Narosa Publications, New Delhi , 3rd Edition, 2007.
 3. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.
 4. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
 5. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

BE8251

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

L T P C
3 00 3

OBJECTIVES:

- To explain the basic theorems used in Electrical circuits and the different components and function of electrical machines.
 - To explain the fundamentals of semiconductor and applications.
 - To explain the principles of digital electronics
 - To impart knowledge of communication.

UNIT I ELECTRICAL CIRCUITS & MEASUREMENTS

9

Fundamental laws of electric circuits— Steady State Solution of DC Circuits – Introduction to AC Circuits –Sinusoidal steady state analysis— Power and Power factor – Single Phase and Three Phase Balanced Circuits. Classification of instruments – Operating Principles of indicating Instruments

UNIT II ELECTRICAL MACHINES

9

Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single Phase Transformer, single phase induction Motor.

UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS

9

Introduction - Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation

Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier.

UNIT IV DIGITAL ELECTRONICS

9

Binary Number System – Boolean Algebra theorems– Digital circuits - Introduction to sequential Circuits– Flip-Flops – Registers and Counters – A/D and D/A Conversion –digital processing architecture

UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING

9

UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING

TOTAL : 45 PERIODS

OUTCOMES:

- ability to identify the electrical components and explain the characteristics of electrical machines.
- ability to identify electronics components and understand the characteristics

TEXT BOOKS:

1. D P Kothari and I.J Nagarath, "Electrical Machines "Basic Electrical and Electronics Engineering", McGraw Hill Education(India) Private Limited, Third Reprint ,2016
2. S.K.Bhattacharya "Basic Electrical and Electronics Engineering", Pearson India, 2011
3. Sedha R.S., "Applied Electronics", S. Chand & Co., 2006

REFERENCES:

1. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, "Basic Electrical Engineering", McGraw Hill Education(India) Private Limited, 2009
2. Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2007
3. Leonard S Bobrow, " Foundations of Electrical Engineering", Oxford University Press, 2013
4. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, 2002.
5. Mehta V K, "Principles of Electronics", S.Chand & Company Ltd, 1994.
6. Nagsarkar T K and Sukhija M S, "Basics of Electrical Engineering", Oxford press 2005.

GE8292**ENGINEERING MECHANICS****L T P C
3 2 0 4****OBJECTIVES:**

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.

UNIT I STATICS OF PARTICLES**9+6**

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces – Vectorial representation of forces – Vector operations of forces - additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility .

UNIT II EQUILIBRIUM OF RIGID BODIES**9+6**

Free body diagram – Types of supports –Action and reaction forces –stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

UNIT III PROPERTIES OF SURFACES AND SOLIDS**9+6**

Centroids and centre of mass – Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula –Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

UNIT IV DYNAMICS OF PARTICLES**9+6**

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

UNIT V FRICTION AND RIGID BODY DYNAMICS**9+6**

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction –wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

TOTAL : (45+30)=75 PERIODS**OUTCOMES:**

On successful completion of this course, the student will be able to

- illustrate the vectorial and scalar representation of forces and moments
- analyse the rigid body in equilibrium
- evaluate the properties of surfaces and solids
- calculate dynamic forces exerted in rigid body
- determine the friction and the effects by the laws of friction

TEXT BOOKS:

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

REFERENCES:

1. Bhavikatti, S.S and Rajashekharappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
2. Hibbeler, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
3. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education 2006.
4. Meriam J.L. and Kraige L.G., " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons,1993.
5. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.

AI8201**PRINCIPLES AND PRACTICES OF CROP PRODUCTION****L T P C****3 0 0 3****OBJECTIVES:**

- To introduce the students to principles of agricultural and horticultural crop production and to introduce the production practices of crops.
- To delineate the role of agricultural and irrigation engineers in relation to various crop production practices.

UNIT I AGRICULTURE AND CROP PRODUCTION**9**

Introduction to agriculture and its crop production sub-sectors - field crop production and horticulture; Factors affecting crop growth and production: genetic (internal) and environmental (external) factors; Crop management through environmental modification and adaptation of crops to the existing environment through crop cultural practices

UNIT II CROP SELECTION AND ESTABLISHMENT**9**

Regional and seasonal selection of crops; Systems of crop production; Competition among crop plants; Spacing and arrangement of crop plants; Field preparation for crops including systems of tillage; Establishment of an adequate crop stand and ground cover, including selection and treatment of seed, and nursery growing.

UNIT III CROP MANAGEMENT 9

Crop water Management; Crop nutrition management - need for supplementation to soil supplied nutrients, sources, generalized recommendations, methods and timing of application of supplemental nutrients including fertigation scheduling; Crop protection including management of weeds, pests and pathogens; Integrated methods of managing water, nutrients and plant protection; Types and methods of harvest.

UNIT IV PRODUCTION PRACTICES OF AGRICULTURAL CROPS 9

Generalized management and cultivation practices for important groups of field crops in Tamil Nadu: cereal crops, grain legumes, oil seed crops, sugarcane, and fiber crops, and special purpose crops such as those grown for green manure and fodder.

UNIT V PRODUCTION PRACTICES OF HORTICULTURAL CROPS 9

Important groups of horticultural crops in Tamil Nadu such as vegetable crops, fruit crops, flower crops; Cultivation practices of representatives of each group; Special features of production of horticultural crops - green house cultivation.

TOTAL: 45 PERIODS

OUTCOMES:

- Students completing this course would have acquired knowledge on crop selection, crop production crop management.
- The students will have the required knowledge in the area of production of agricultural and horticultural crops.

TEXTBOOKS:

1. Rajendra Prasad, Text Book of Field Crop Production. Directorate of Information and Publication, Krishi Anusandhan Bhavan, Pusa, New Delhi, 2015.
2. Reddy T. Sankara G.H. Yellamanda Reddi, Principles of Agronomy, Kalyani Publishers, New Delhi, 2005.
3. Handbook of Agriculture. ICAR Publications, New Delhi, 2011.

REFERENCES:

1. Bose T. K. and L.P.Yadav. Commercial Flowers, Naya Prakash, Calcutta.1989.
2. Crop Production Guide, Tamil Nadu Agricultural University Publication, Coimbatore. 2005
3. Kumar, N., Abdul Khader, M. Rangaswami, P. and Irulappan, I. Introduction to spices, plantation crops, medicinal and aromatic plants. Rajalakshmi Publications, Nagercoil. 1993.
4. Kumar, N., "Introduction to Horticulture", Rajalakshmi Publications. Nagercoil, 7th edition, 2015.
5. Shanmugavel, K.G. Production Technology of Vegetable Crops. Oxford India Publications, New Delhi. 1989.

GE8261	ENGINEERING PRACTICES LABORATORY	L T P C
		0 0 4 2

OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE 13**Buildings:**

- (a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

- (a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
- (b) Study of pipe connections requirements for pumps and turbines.

- (c) Preparation of plumbing line sketches for water supply and sewage works.
 - (d) Hands-on-exercise:
Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
 - (e) Demonstration of plumbing requirements of high-rise buildings.
- Carpentry using Power Tools only:**
- (a) Study of the joints in roofs, doors, windows and furniture.
 - (b) Hands-on-exercise:
Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE

18

Welding:

- (a) Preparation of butt joints, lap joints and T-joints by Shielded metal arc welding.
- (b) Gas welding practice

Basic Machining:

- (a) Simple Turning and Taper turning
- (b) Drilling Practice

Sheet Metal Work:

- (a) Forming & Bending:
- (b) Model making – Trays and funnels.
- (c) Different type of joints.

Machine assembly practice:

- (a) Study of centrifugal pump
- (b) Study of air conditioner

Demonstration on:

- (a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
- (b) Foundry operations like mould preparation for gear and step cone pulley.
- (c) Fitting – Exercises – Preparation of square fitting and V-fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE

13

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE

16

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of this course, the student will be able to

- fabricate carpentry components and pipe connections including plumbing works.
- use welding equipments to join the structures.
- Carry out the basic machining operations

- Make the models using sheet metal works
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundry and fittings
- Carry out basic home electrical works and appliances
- Measure the electrical quantities
- Elaborate on the components, gates, soldering practices.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets.
2. Carpentry vice (fitted to work bench)	15 Nos.
3. Standard woodworking tools	15 Sets.
4. Models of industrial trusses, door joints, furniture joints	5 each
5. Power Tools: (a) Rotary Hammer	2 Nos
(b) Demolition Hammer	2 Nos
(c) Circular Saw	2 Nos
(d) Planer	2 Nos
(e) Hand Drilling Machine	2 Nos
(f) Jigsaw	2 Nos

MECHANICAL

1. Arc welding transformer with cables and holders	5 Nos.
2. Welding booth with exhaust facility	5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos.
5. Centre lathe	2 Nos.
6. Hearth furnace, anvil and smithy tools	2 Sets.
7. Moulding table, foundry tools	2 Sets.
8. Power Tool: Angle Grinder	2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner	One each.

ELECTRICAL

1. Assorted electrical components for house wiring	15 Sets
2. Electrical measuring instruments	10 Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp	1 each
4. Megger (250V/500V)	1 No.
5. Power Tools: (a) Range Finder	2 Nos
(b) Digital Live-wire detector	2 Nos

ELECTRONICS

1. Soldering guns	10 Nos.
2. Assorted electronic components for making circuits	50 Nos.
3. Small PCBs	10 Nos.
4. Multimeters	10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply	

AI8211

CROP HUSBANDRY LABORATORY

**L T P C
0 0 4 2**

OBJECTIVE:

- To introduce the different crop production practices in wet land, dry land and garden land through hands on experience and demonstrations.

List of Experiments:

- Field preparation studies
- Seed selection and seed treatment procedures
- Seed bed and nursery preparation
- Sowing / Transplanting
- Biometric observation for crops
- Nutrient management studies
- Water management and irrigation scheduling
- Weed management studies
- Integrated Pest Management studies
- Harvesting
- Post harvesting

TOTAL: 60 PERIODS**LIST OF EQUIPMENTS REQUIRED**

- A wet land / garden land for a minimum of 5 cents area for each / group of students.
- An open / borewell as water source to support cultivation

MA8353	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L T P C
		4 0 0 4

OBJECTIVES :

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I	PARTIAL DIFFERENTIAL EQUATIONS	12
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Formation of partial differential equations – Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II	FOURIER SERIES	12
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Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT III	APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS	12
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Classification of PDE – Method of separation of variables - Fourier Series Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

UNIT IV	FOURIER TRANSFORMS	12
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Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS**12**

Z-transforms - Elementary properties – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems - Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

TOTAL : 60 PERIODS**OUTCOMES :**

Upon successful completion of the course, students should be able to:

- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXTBOOKS :

1. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

REFERENCES :

1. Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
3. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
4. James, G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

AI8301**SOIL SCIENCE AND ENGINEERING****L T P C
3 0 0 3****OBJECTIVE:**

- To expose the students to the fundamental knowledge on Soil physical parameters, Permeability – Compaction, Bearing Capacity and types and methods of soil survey and interpretative groupings

UNIT I**INTRODUCTION AND SOIL PHYSICS****9**

Soil - definition - major components –Soil forming minerals and processes- soil profile -Physical properties - texture –density-porosity-consistence-colour- -specific gravity - capillary and non-capillary -plasticity. Soil air - soil temperature - soil water - classification of soil water- Movement soil water. Soil colloids – organic and inorganic matter-Ion exchange- pH – Plant nutrient availability

UNIT II	SOIL CLASSIFICATION AND SURVEY	9
Soil taxonomy – Soils of Tamil Nadu and India. Soil survey - types and methods of soil survey – Field mapping- mapping units - base maps -preparation of survey reports - concepts and uses - land capability classes and subclasses - soil suitability -Problem soils – Reclamation.		
UNIT III	PHASE RELATIONSHIP AND SOIL COMPACTION	9
Phase relations- Gradation analysis- Atterberg Limits and Indices- Engineering Classification of soil – Soil compaction- factors affecting compaction- field and laboratory methods.		
UNIT IV	ENGINEERING PROPERTIES OF SOIL	9
Shear strength of cohesive and cohesionless - Mohr-Coulomb failure theory- Measurement of shear strength, direct shear, Triaxial and vane shear test- -Permeability- Coefficient of Permeability-Darcy's law-field and lab methods - Assessment of seepage - Compressibility.		
UNIT V	BEARING CAPACITY AND SLOPE STABILITY	9
Bearing capacity of soils - Factors affecting Bearing Capacity- Shallow foundations-Terzaghi's formula- BIS standards - Slope stability-Analysis of infinite and finite slopes- friction circle method- slope protection measures		

OUTCOMES-

OUTCOMES: At the end of the course the student will be able to understand

- Fundamental knowledge of soil physical parameters.
 - The procedures involved in soil survey, soil classification.
 - The phase relationship and soil compaction.
 - Concepts of bearing capacity and slope stability.

TEXTBOOKS-

- BOOKS:**

 1. Nyle C. Brady, "The Nature and Properties of Soil", Macmillan Publishing Company, 10th Edition, New York, 2008.
 2. Punnia, B.C., "Soil Mechanics and Foundation "Laxmi Publishers, New Delhi, 2007.

REFERENCES:

1. Edward J. Plaster., "Soil Science", Cengage Learning India Ltd, New Delhi, 2009.
 2. Arora, K.R. "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 2007.
 3. Murthy, V.N.S. "Soil Mechanics and Foundation Engineering", UBS Publishers and Distributors, New Delhi, 2007.
 4. Sehgal, S.B., "Text Book of Soil Mechanics", CBS Publishers and Distributors New Delhi, 2007.

AI8302 **FLUID MECHANICS AND HYDRAULICS** **L T P C**
 4 0 0 4

OBJECTIVES:

- To introduce the students to the mechanics of fluids through a thorough understanding of the properties of the fluids, behaviour of fluids under static conditions. The dynamics of fluids is introduced through the control volume approach which gives an integrated understanding of the transport of mass, momentum and energy.
 - To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on vanes.
 - To introduce the students to various hydraulic engineering problems like open channel flows and hydraulic pumps. At the completion of the course, the student should be able to relate the theory and practice of problems in hydraulic engineering.

UNIT I	PROPERTIES OF FLUIDS	12
Properties of fluids – definition – units of measurement - Mass density – specific weight, specific volume – specific gravity - equation of state – perfect gas - Viscosity – vapour pressure – compressibility and elasticity - surface tension – capillarity. Fluid pressure and measurement – simple, differential and micro manometers - Mechanical gauges – calibration. Hydrostatic forces on surfaces – total pressure and centre of pressure - Horizontal- vertical and inclined plane surface - Pressure diagram – total pressure on curved surface. Archimedes principles – buoyancy – meta centre – metacentric height.		
UNIT II	FLUID FLOW ANALYSIS	12
Types of fluid flow – velocity and acceleration of a fluid particle - Rotational – irrotational circulation and vorticity - Flow pattern – stream line – equipotential line – stream tube path line – streak line – flow net – velocity potential – stream function. Principles of conservation of mass – energy – momentum – continuity equation in Cartesian co-ordinates - Euler's equation of motion.		
UNIT III	FLOW MEASUREMENT	12
Bernoulli's equation – applications - Venturimeter – orifice meter – nozzle meter - rotameter – elbow meter - pitot tube – Orifice – sharp edged orifice discharging free – submerged orifice – mouth piece - Flow through orifice under variable head – time of emptying a tank with and without inflow. Flow through pipes – laminar and turbulent flow in pipes - Reynold's experiment - Darcy – Weisbach equation for friction head loss – Chezy's formula – Manning's formula – Hazen-William's formula - Major and minor losses in pipes – hydraulic gradient line – energy gradient line. Siphon – water hammer in pipes – gradual and sudden closure of valves		
UNIT IV	OPEN CHANNEL FLOW	12
Types of flow in channel – uniform flow – most economical section of channel – rectangular – trapezoidal. Specific energy and critical depth - momentum in open channel flow – specific force – critical flow – computation. Flow measurement in channels – notches – rectangular, Cipolletti and triangular – float method - Flow measurement in rivers/ streams/ canals – weirs – free and submerged flow – current meter – Parshall flume.		
UNIT V	DIMENSIONAL ANALYSIS & PUMPS	12
Dimensional analysis – Fundamental dimensions – dimensional homogeneity – Rayleigh's method and Buckingham Pi-Theorem - concept of geometric, kinematic and dynamic similarity. Important non dimensional numbers – Reynolds, Froude, Euler, Mach and Weber - Pump terminology – suction lift, suction head, delivery head, discharge, water horse power – selection of pump capacity. Centrifugal pumps – components – working – types of pumps and impellers - Priming – cavitation – specific speed – characteristic curves. Turbine and submersible pumps - Jet pump – jet assembly - Other pumps – Air lift pump - reciprocating pump - sludge pump and vacuum pump-Hydraulic ram.		

TOTAL: 60 PERIODS

OUTCOMES:

- The students will be able to get a basic knowledge of fluids in static, kinematic and dynamic equilibrium.
 - They will also gain the knowledge of the applicability of physical laws in addressing problems in hydraulics.

TEXTBOOKS:

1. Modi, P.N. and Seth S.M.,*Hydraulics and Fluid Mechanics*. Standard Publishers Distributors, New Delhi, 2010.
 2. Bansal, R.K., *A text book of Fluid Mechanics and Hydraulic Machinery*, Laxmi Publications (P) Ltd., New Delhi, 2002.
 3. Jagdish Lal., *Hydraulic Machines*. Metropolitan Book House, New Delhi, 2000.

REFERENCES:

1. Garde, R.J., Fluid Mechanics through problems. New Age International Publishers (P) Ltd., New Delhi, 2002.
2. Michael A.M. and S.D. Khepar, Water Well and Pump Engineering. Tata McGraw Hill Co. New Delhi, 2005.
3. Michael A.M. Irrigation Theory and Practice, Vikas Publishing House, New Delhi, 2008.

Web sites

1. www.onesmartclick.com/engineering/fluid-mechanics.html
2. www.it.iitb.ac.in/vweb/engr/civil/fluid_mech/course.html

AI8303**THEORY OF MACHINES****L T P C**
3 0 0 3**OBJECTIVE:**

- To introduce the students the theory of machines pertaining to agricultural engineering.

UNIT I TERMINOLOGY**9**

Definitions - Kinematic links - Pairs - Chain - Machines and mechanism - Types and uses – Kinematic inversion of four bar chain and slider crank mechanism. Velocity and acceleration in simple mechanisms - Vector polygon and instantaneous centre methods – Coriolis component of acceleration.

UNIT II FRICTION AND APPLICATIONS**9**

Sliding and rolling friction –friction in screw threads-Bearing and lubrication- Friction clutches- Belt drives- Friction aspects in brakes.

UNIT III MOTION OF CAM AND FOLLOWER**9**

Cam and follower - types - application – displacement diagrams - profile layout for uniform velocity - Uniform acceleration and retardation - simple harmonic and cycloidal motion.

UNIT IV GEARS AND GEAR TRAINS**9**

Gears - classification - terminology -law of gearing - tooth profile - interference between rack and pinion. Gear trains - simple - compound reverted. Simple epicyclic gear trains.

UNIT V FLYWHEEL AND BALANCING**9**

Inertia - turning moment - flywheel - fluctuation of speed and energy. Balancing of rotating masses and reciprocating masses.

TOTAL: 45 PERIODS**OUTCOMES:**

At the end of the course the student will be able to

- Basic knowledge on the friction applications, gear and gear trains.
- Learn the fundamentals related to motion of cam and follower and fly wheel balancing

TEXTBOOKS:

1. Rattan, S.S, Theory of Machines, 3rd Edition, Tata McGraw-Hill, 2009.
2. Khurmi, R.S. and Gupta, J.K, Theory of machines, Eurasia Publication House, 1994.

REFERENCES:

1. Thomas Beven, Theory of Machines, CBS Publishers and Distributors, New Delhi, 1984.
2. Ballaney, P.L, Theory of machines, Khanna Publishers, New Delhi, 1994
3. <http://www.softintegration.com/chhtml/toolkit/mechanism/>

CE8304

SURVEYING AND LEVELLING

L T P C

3 0 0 3

OBJECTIVE:

- To introduce the principle of surveying, various methods and applications to Agricultural & Irrigation Engineering projects.

UNIT I FUNDAMENTALS AND CHAIN SURVEYING

9

Definition- Classifications - Basic principles – Equipment and accessories for ranging and chaining – Methods of ranging - well conditioned triangles – Errors in linear measurement and their corrections - Obstacles - Traversing – Plotting – applications- enlarging and reducing figures- Areas enclosed by straight lines - Irregular figures- digital Planimeter.

UNIT II COMPASS AND PLANE TABLE SURVEYING

9

Compass – Basic principles - Types - Bearing – Systems and conversions – Sources of Errors - Local attraction - Magnetic declination-Dip-Traversing - Plotting - Adjustment of closing error – applications - Plane table and its accessories - Merits and demerits - Radiation - Intersection - Resection – Traversing- sources of errors – applications.

UNIT III THEODOLITE AND MODERN SURVEYING

9

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 - Gale's table - Total Station- Global Positioning System (GPS).

UNIT IV LEVELLING

9

Level line - Horizontal line - Datum - Bench marks -Levels and staves - temporary and permanent adjustments – Methods of leveling - Fly levelling - Check levelling - Procedure in levelling - Booking -Reduction - Curvature and refraction - Reciprocal levelling - sources of errors in leveling- Precise levelling - Types of instruments - Adjustments - Field procedure.

UNIT V LEVELLING APPLICATIONS

9

Longitudinal and Cross-section-Plotting - Contouring - Methods – Characteristics and uses of contours- Plotting – Methods of interpolating contours – computation of cross sectional area and volumes - Earthwork calculations - Capacity of reservoirs - Mass haul diagrams

TOTAL: 45 PERIODS

OUTCOMES:

- Students are expected to use all surveying equipments, prepare LS & CS, contour maps and carryout surveying works related to land and civil engineering projects.

TEXTBOOKS:

1. James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, Seventh Edition, Mc Graw Hill 2001.
2. Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004.

REFERENCES:

1. S.K. Roy, Fundamentals of Surveying, Second Edition, Prentice Hall of India 2004.
2. A.M. Chandra, Plane Surveying, New Age International Publishers 2002.
3. Alak De, Plane Surveying, S. Chand & Company Ltd., 2000.

MF8491

THERMODYNAMICS

L T P C
3 2 0 4

OBJECTIVES-

- To understand the basic laws of thermodynamics and heat transfer. 1
 - To understand the principle of operation of thermal equipments like IC engine, boilers, turbine and refrigerator etc. 1

UNIT I BASIC CONCEPTS OF THERMODYNAMICS

9+6

UNIT - BASIC CONCEPTS OF THERMODYNAMICS

Thermodynamics and Energy – Systems – Types and properties - State and Equilibrium - Processes and Cycles – Forms of Energy – Temperature and Zeroth law of Thermodynamics – Pure substances – Phase change processes of pure substances – Property diagrams – Internal energy – Enthalpy – Energy transfer by Heat, Work and Mass – Applications.

UNIT II FIRST AND SECOND LAW OF THERMODYNAMICS

9±6

UNIT II – FIRST AND SECOND LAW OF THERMODYNAMICS

Applications of First law of Thermodynamics – Energy balance for Unsteady flow processes
Second law of Thermodynamics – Entropy – Carnot principles – Change in Entropy – Entropy and irreversibility - Applications

UNIT III HEAT ENGINES

9+6

UNIT III HEAT ENGINES 940
Internal Combustion Engines – C.I and S.I Engines – Four Stroke and Two Stroke Engines – Gas Turbines - Boilers – Fire Tube Boiler & Water Tube Boilers , Boiler Accessories and Components. Turbines – Impulse Turbine and Reaction Turbine , Turbine Components - Refrigeration Cycle – Vapour Compression & Vapour Absorption System ,Gas Refrigeration System – Environmental friendly Refrigerants – Air Conditioning.

UNIT IV GASES AND VAPOUR MIXTURES

9+6

Ideal and Real gases – Vander waals equations – Reduced property – Compressibility chart - Properties of mixture of gases – Dalton's law and Gibbs – Dalton law – Internal energy, Enthalpy and specific heats of gas mixtures.

UNIT V HEAT TRANSFER

9±6

Conduction – Plane Wall, Cylinder system, Composite Walls – Critical insulation thickness – Simple, fins convection – Free convection and forced convection – Flow over Flat plates and Flow through Pipes – Radiation – Black Body, Grey Body Radiation.

TOTAL · 75 PERIODS

OUTCOME:

- Upon completion of this course, the students can able to understand different gas power cycles and use of them in IC and R&AC applications.

TEXT BOOKS:

1. Yunus A. Cengel and Michael A. Boles, "Thermodynamics: An Engineering Approach", Fourth Edition, Tata McGraw-hill, 2004.
 2. Michael J. Moran, Howard N. Shapiro, "Fundamentals of Engineering Thermodynamics", Fourth Editon, John wiley & Sons, 2000.

REFERENCES:

1. R.K.Rajput, "A Text book of Engineering Thermodynamics", Third Edition, Laxmi publication (P) Ltd., 2007.
 2. Nag.P.K., "Engineering Thermodynamics", Third Edition, Tata McGraw hill, 2005.
 3. Domkundwar.S., C.P.Kothandaraman "A course in Thermal engineering", Fifth Edition, Dhanpat rai & co (p) Ltd, 2000.

CE8312

SURVEYING AND LEVELLING LABORATORYL T P C
0 0 4 2**OBJECTIVE:**

- To train the student to acquire skill in operation various surveying and levelling instruments
- **CHAIN SURVEYING**
 - Ranging, Chaining and Pacing
 - Chain traversing
- **COMPASS SURVEYING**
 - Triangulation Problem
 - Compass traversing
- **PLANE TABLE SURVEYING**
 - Radiation
 - Intersection - Triangulation problem
 - Plane table traversing
- **THEODOLITE SURVEYING**
 - Measurement of horizontal & vertical angles
 - Tangential & Stadia Tacheometry
- **LEVELLING**
 - Fly levelling using Dumpy level
 - Fly levelling using Tilting level
 - Check levelling
 - Block Levelling
 - Radial Contouring
- **DEMONSTRATION OF TOTAL STATION AND GPS**

OUTCOME:

- Students completing this course would have acquired practical knowledge on handling basic survey instruments including leveling and development of contour map of given area.

TOTAL: 60 PERIODS**LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS**

SI.No.	Description of Equipment	Quantity
1.	Total Station	3 Nos
2.	Theodolites	Atleast 1 for every 5 students
3.	Dumpy level / Filling level	Atleast 1 for every 5 students
4.	Pocket stereoscope	1
5.	Ranging rods	
6.	Levelling staff	
7.	Cross staff	
8.	Chains	1 for a set of 5 students
9.	Tapes	
10.	Arrows	
11.	Prismatic Compass	10 nos
12.	Surveyor Compass	2 nos
13.	Survey grade or Hand held GPS	3 nos

OBJECTIVE:

- Students should be able to verify the principles studied in theory by performing the experiments in lab.

LIST OF EXPERIMENTS**1. Flow Measurement**

- Calibration of Rotameter
- Flow through Venturimeter
- Flow through a circular Orifice
- Determination of mean velocity by Pitot tube
- Flow through a Triangular Notch
- Flow through a Rectangular Notch

2. Losses in Pipes

- Determination of friction coefficient in pipes
- Determination of losses due to bends, fittings and elbows

3. Pumps

- Characteristics of Centrifugal pump
- Characteristics of Submersible pump
- Characteristics of Reciprocating pump

TOTAL: 30 PERIODS**OUTCOMES:**

- The students will be able to measure flow in pipes and determine frictional losses.
- The students will be able to develop characteristics of pumps and turbines.

REFERENCES:

1. Hydraulic Laboratory Manual, Centre for Water Resources, Anna University, 2004.
2. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics. Standard Book House, New Delhi, 2000.
3. Subramanya, K. Flow in Open Channels, Tata McGraw - Hill Pub. Co.1992.
4. Subramanya, K. Fluid Mechanics, Tata McGraw- Hill Pub. Co., New Delhi, 1992.

LIST OF EQUIPMENTS REQUIRED

- Rotameter – 1 no.
- Venturimeter – 1 no.
- Orificemeter – 1 no.
- Pitot tube – 1 no.
- Bernoulli's theorem apparatus – 1 no.
- Triangular notch and Rectangular notch – 1 each (with a lined open channel setup)
- Coefficient of friction apparatus
- Pipe setup with bends, fittings and elbows for estimating minor losses
- Centrifugal pump, Reciprocating pump, Submersible pump, Jet pump – 1 each
- Collecting tank, Stop watch – 1 no. for each experiment

HS8381

INTERPERSONAL SKILLS/LISTENING AND SPEAKING

L	T	P	C
0	0	2	1

OBJECTIVES:

The Course will enable learners to:

- Equip students with the English language skills required for the successful undertaking of academic studies with primary emphasis on academic speaking and listening skills.
- Provide guidance and practice in basic general and classroom conversation and to engage in specific academic speaking activities.
- improve general and academic listening skills
- Make effective presentations.

UNIT I

Listening as a key skill- its importance- speaking - give personal information - ask for personal information - express ability - enquire about ability - ask for clarification Improving pronunciation - pronunciation basics taking lecture notes - preparing to listen to a lecture - articulate a complete idea as opposed to producing fragmented utterances.

UNIT II

Listen to a process information- give information, as part of a simple explanation - conversation starters: small talk - stressing syllables and speaking clearly - intonation patterns - compare and contrast information and ideas from multiple sources- converse with reasonable accuracy over a wide range of everyday topics.

UNIT III

Lexical chunking for accuracy and fluency- factors influence fluency, deliver a five-minute informal talk - greet - respond to greetings - describe health and symptoms - invite and offer - accept - decline - take leave - listen for and follow the gist- listen for detail

UNIT IV

Being an active listener: giving verbal and non-verbal feedback - participating in a group discussion - summarizing academic readings and lectures conversational speech listening to and participating in conversations - persuade.

UNIT V

Formal and informal talk - listen to follow and respond to explanations, directions and instructions in academic and business contexts - strategies for presentations and interactive communication - group/pair presentations - negotiate disagreement in group work.

TOTAL :30 PERIODS

OUTCOMES:

At the end of the course Learners will be able to:

- Listen and respond appropriately.
- Participate in group discussions
- Make effective presentations
- Participate confidently and appropriately in conversations both formal and informal

TEXTBOOKS:

1. Brooks,Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford: 2011.
2. Richards,C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010

REFERENCES:

1. Bhatnagar, Nitin and MamtaBhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.
2. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.
3. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.
4. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.
5. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014

MA8391**PROBABILITY AND STATISTICS****L T P C
4 0 0 4****OBJECTIVES :**

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

UNIT I PROBABILITY AND RANDOM VARIABLES 12

Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTING OF HYPOTHESIS 12

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT IV DESIGN OF EXPERIMENTS 12

One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT V STATISTICAL QUALITY CONTROL 12

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

TOTAL : 60 PERIODS**OUTCOMES :**

Upon successful completion of the course, students will be able to:

- Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
- Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
- Apply the concept of testing of hypothesis for small and large samples in real life problems.

- Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.
- Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

TEXTBOOKS :

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.

REFERENCES :

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
2. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2010.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
4. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.

AI8401

UNIT OPERATIONS IN AGRICULTURAL PROCESSING

L T P C
3 0 0 3

OBJECTIVE:

- The students would be exposed to the fundamental knowledge in Evaporation, Filtration, Sedimentation, Processing, Sieve analysis, Crystallization and Distillation in processing of agricultural produce.

UNIT I EVAPORATION AND CONCENTRATION

9

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-performance of evaporators and boiling point elevation – capacity – economy and heat balance-types of evaporators – once through and circulation evaporators – short tube evaporators and long tube evaporators – agitated film evaporator

UNIT II MECHANICAL SEPARATION

9

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 SIZE REDUCTION

9

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 equipments – crushers – jaw crusher, gyratory crusher-crushing rolls – grinders – hammer mills – rolling compression mills - attrition, rod, ball and tube mills – construction and operation.

UNIT IV CONTACT EQUILIBRIUM SEPARATION 9

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 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 – equipments

UNIT V CRYSTALLISATION AND DISTILLATION 9

Crystallization-Equilibrium –Rate of crystal growth stage-Equilibrium crystallization-Crystallizers- Equipment-Classification- Construction and operation – Crystallizers-Tank-Agitated batch-Swenson-Walker and Vacuum crystallizers-Distillation-Binary mixtures-Flash and differential distillation-Steam distillation –Theory-Continuous distillation with rectification –Vacuum distillation - Batch distillation-Operation and process-Advantages and limitation-Distillation equipments- Construction and operation-Factors influencing the operation.

TOTAL : 45 PERIODS**OUTCOMES:**

At the end of the study the student will have knowledge on

- Fundamentals of various unit operations of Agricultural Processing.
- Material handling equipments

TEXTBOOKS:

1. Earle, R.L., "Unit operations in Food Processing", Pergamon Press, Oxford, U.K, 1985.
2. McCabe, W.L., and Smith, J.C., "Unit Operations of Chemical Engineering", Mc-Graw-Hill Inc., Kosaido Printing Ltd., Tokyo, 1990.
3. Geankoplis, C.J. "Transport Processes and Separation Process Principles", 4th Edition, Prentice Hall, 2003.

REFERENCES:

1. Coulson, J.M and J.F. Richardson. Chemical Engineering. Volume I to V. The Pergamon Press. New York, 1999.
2. Albert Ibarz and Gustavo V. Barbosa-Cánovas. Unit Operations in Food Engineering. CRC Press LLC, Florida, 2003..

AI8402**FARM TRACTORS****L T P C**
3 0 0 3**OBJECTIVE :**

- To introduce the students to the different systems and working principles of tractor, power tiller, makes of tractors and power tillers.

UNIT I TRACTORS 9

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 ENGINE SYSTEMS 9

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

UNIT III TRANSMISSION SYSTEMS

9

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.

UNIT IV HYDRAULIC SYSTEMS

9

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

UNIT V POWER TILLER, BULLDOZER AND TRACTOR TESTING

9

Power tiller - special features - clutch - gear box - steering and brake. Makes of tractors, power tillers and bulldozers. Bulldozer- salient features – turning mechanism, track mechanism, components – operations performed by bulldozers. Types of tests- test procedure - need for testing & evaluation of farm tractor -Test code for performance testing of tractors and power tillers.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will be able to understand the various equipments and mechanizations used in the farm.
 - The students will have the knowledge on earth moving machinaries, tractor classification and tillage implements.

TEXTBOOK:

1. Jain, S.C. and C.R. Rai. Farm tractor maintenance and repair. Standard publishers and distributors, New Delhi, 1999.

REFERENCES:

1. Barger, E.L., J.B. Liljedahl and E.C. McKibben, Tractors and their Power Units. Wiley Eastern Pvt. Ltd., New Delhi, 1997.
 2. Domkundwar A.V. A course in internal combustion engines. Dhanpat Rai & Co. (P) Ltd., Educational and Technical Publishers, Delhi, 1999.
 3. Black, P.O. Diesel engine manual. Taraporevala Sons & Co., Mumbai, 1996.
 4. Grouse, W.H. and Anglin, D.L. Automative mechanics. Macmillan McGraw- Hill, Singapore, Indian Standard Codes for Agricultural Implements Published by ISI, New Delhi, 1993.
 5. Jagadeeshwar Sahay, Elements of Agricultural Engineering, Standard Publishers Co., New Delhi, 2010.

CE8091

HYDROLOGY AND WATER RESOURCES ENGINEERING

L T P C

3 0 0 3

OBJECTIVE:

- To introduce the student to the concept of hydrological aspects of water availability and requirements and should be able to quantify, control and regulate the water resources.

UNIT I PRECIPITATION AND ABSTRACTIONS

10

Hydrological cycle- Meteorological measurements – Requirements, types and forms of precipitation - Rain gauges-Spatial analysis of rainfall data using Thiessen and Isohyetal methods-Interception - Evaporation. Horton's equation, pan evaporation measurements and evaporation suppression - Infiltration-Horton's equation - double ring infiltrometer, infiltration indices.

UNIT II	RUNOFF	8
Watershed, catchment and basin - Catchment characteristics - factors affecting runoff - Run off estimation using empirical - Strange's table and SCS methods – Stage discharge relationships-flow measurements- Hydrograph – Unit Hydrograph – IUH		
UNIT III	FLOOD AND DROUGHT	9
Natural Disasters-Flood Estimation- Frequency analysis- Flood control- Definitions of droughts-Meteorological, hydrological and agricultural droughts- IMD method-NDVI analysis- Drought Prone Area Programme (DPAP)		
UNIT IV	RESERVOIRS	8
Classification of reservoirs, General principles of design, site selection, spillways, elevation – area - capacity - storage estimation, sedimentation - life of reservoirs – rule curve		
UNIT V	GROUNDWATER AND MANAGEMENT	10
Origin- Classification and types - properties of aquifers- governing equations – steady and unsteady flow - artificial recharge - RWH in rural and urban areas		
TOTAL: 45 PERIODS		

OUTCOMES:

The students completing the course will have

- an understanding of the key drivers on water resources, hydrological processes and their integrated behaviour in catchments,
- ability to construct and apply a range of hydrological models to surface water and groundwater problems including Hydrograph, Flood/Drought management, artificial recharge
- ability to conduct Spatial analysis of rainfall data and design water storage reservoirs
- Understand the concept and methods of ground water management.

TEXTBOOKS:

1. Subramanya .K. "Engineering Hydrology"- Tata McGraw Hill, 2010
2. Jayarami Reddy .P. "Hydrology", Tata McGraw Hill, 2008.
3. Linsley, R.K. and Franzini, J.B. "Water Resources Engineering", McGraw Hill International Book Company, 1995.

REFERENCES:

1. David Keith Todd. "Groundwater Hydrology", John Wiley & Sons, Inc. 2007
2. Ven Te Chow, Maidment, D.R. and Mays, L.W. "Applied Hydrology", McGraw Hill International Book Company, 1998.
3. Raghunath .H.M., "Hydrology", Wiley Eastern Ltd., 1998.

CE8393	STRENGTH OF MATERIALS	L T P C
		4 0 0 4

OBJECTIVE:

- To understand the stresses developed in bars, compounds bars, beams, shafts, cylinders and spheres.

UNIT I	STRESS, STRAIN AND DEFORMATION OF SOLIDS	12
Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains - Thin shells - circumferential and longitudinal stresses in thin cylinders - deformation of thin cylinder – stresses in spherical shells – Deformation of spherical shells.		

UNIT II	ANALYSIS OF PLANE TRUSSES	12
Determinate and indeterminate plane trusses – determination of member forces by method of joints, method of sections and method of tension coefficient.		
UNIT III	TRANSVERSE LOADING AND STRESSES IN BEAM	12
Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over-hanging beams. Theory of simple bending– bending stress distribution – Shear stress distribution - Flitched beams – carriage springs.		
UNIT IV	TORSION	12
Torsion formula - stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs - carriage springs.		
UNIT V	DEFLECTION OF BEAMS	12
Computation of slopes and deflections in determinate beams - Double Integration method – Macaulay's method – Area moment method – Conjugate beam method.		
		TOTAL : 60 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to apply mathematical knowledge to calculate the deformation behaviour of simple structures.
 - Critically analyse problem and solve the problems related to structural elements and analyse the deformation behaviour for different types of loads.

TEXTBOOKS:

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2007
 2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2007

REFERENCES:

- Egor. P.Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2001
 - Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series,2007.
 - Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2007
 - Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing „co. Ltd., New Delhi, 2005.

GE8291

ENVIRONMENTAL SCIENCE AND ENGINEERING

L T P C
3 0 0 3

OBJECTIVES-

- To study the nature and facts about environment.
 - To finding and implementing scientific, technological, economic and political solutions to environmental problems.
 - To study the interrelationship between living organism and environment.
 - To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
 - To study the dynamic processes and understand the features of the earth's interior and surface.
 - To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL: 45 PERIODS

OUTCOMES:

- Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

TEXTBOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

REFERENCES :

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) Pvt, Ltd, Hyderabad, 2015.
3. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt, Ltd, Delhi, 2014.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.

AI8411

SOIL SCIENCE LABORATORY**L T P C**
0 0 2 1**OBJECTIVE:**

- Students should be able to verify various quality aspects of soil and water studied in theory by performing experiments in lab.
1. Identification of rocks and minerals
 2. Collection and processing of soil samples
 3. Determination of soil moisture, EC and pH
 4. Field density determination by Core Cutter and Sand Replacement method
 5. Specific gravity determination by Pycnometer
 6. Textural analysis of soil by International Pipette method
 7. Grain size analysis by using Mechanical shaker
 8. Determination of Organic carbon
 9. Estimation of Gypsum requirements

TOTAL : 30 PERIODS**OUTCOME:**

- Students know the techniques to determine various physical and chemical properties of soil that are applicable for agriculture and irrigation by conducting appropriate tests.

REFERENCES:

1. Punmia, B.C, "Soil Mechanics and Foundation Engineering", Laxmi Publishers, New Delhi. 2007.
2. Laboratory Manual, Centre for Water Resources, Anna University, Chennai. 2012.

CE8481**STRENGTH OF MATERIALS LABORATORY****L T P C
0 0 4 2****OBJECTIVE:**

- To expose the students to the testing of different materials under the action of various forces and determination of their characteristics experimentally.

LIST OF EXPERIMENTS

1. Tension test on steel rod
2. Compression test on wood
3. Double shear test on metal
4. Torsion test on mild steel rod
5. Impact test on metal specimen (Izod and Charpy)
6. Hardness test on metals (Rockwell and Brinell Hardness Tests)
7. Deflection test on metal beam
8. Compression test on helical spring
9. Deflection test on carriage spring

TOTAL: 60 PERIODS**OUTCOME:**

- The students will have the required knowledge in the area of testing of materials and components of structural elements experimentally.

REFERENCES:

1. Strength of Materials Laboratory Manual, Anna University, Chennai - 600 025.
2. IS1786-2008 (Fourth Revision, Reaffirmed 2013), 'High strength deformed bars and wires for concrete reinforcement – Specification', 2008.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

SI. No.	Description of Equipment	Quantity
1.	UTM of minimum 400 kN capacity	1
2.	Torsion testing machine	1
3.	Izod impact testing machine	1
4.	Hardness testing machine Rockwell Vicker's Brinnel } (any 2)	1 each
5.	Beam deflection test apparatus	1
6.	Extensometer	1
7.	Compressometer	1
8.	Dial gauges	Few
9.	Le Chatelier's apparatus	2
10.	Vicat's apparatus	2
11.	Mortar cube moulds	10

HS8461**ADVANCED READING AND WRITING****L T P C
0 0 2 1****OBJECTIVES:**

- Strengthen the reading skills of students of engineering.
- Enhance their writing skills with specific reference to technical writing.
- Develop students' critical thinking skills.
- Provide more opportunities to develop their project and proposal writing skills.

UNIT I

Reading - Strategies for effective reading-Use glosses and footnotes to aid reading comprehension- Read and recognize different text types-Predicting content using photos and title Writing-Plan before writing- Develop a paragraph: topic sentence, supporting sentences, concluding sentence –Write a descriptive paragraph

UNIT II

Reading-Read for details-Use of graphic organizers to review and aid comprehension Writing- State reasons and examples to support ideas in writing- Write a paragraph with reasons and examples- Write an opinion paragraph

UNIT III

Reading- Understanding pronoun reference and use of connectors in a passage- speed reading techniques-Writing- Elements of a good essay-Types of essays- descriptive-narrative- issue-based-argumentative-analytical.

UNIT IV

Reading- Genre and Organization of Ideas- Writing- Email writing- visumes – Job application-project writing-writing convincing proposals.

UNIT V

Reading- Critical reading and thinking- understanding how the text positions the reader- identify Writing- Statement of Purpose- letter of recommendation- Vision statement

TOTAL: 30 PERIODS

OUTCOMES:

At the end of the course Learners will be able to:

- Write different types of essays.
- Write winning job applications.
- Read and evaluate texts critically.
- Display critical thinking in various professional contexts.

TEXT BOOKS:

1. Gramer F. Margot and Colin S. Ward Reading and Writing (Level 3) Oxford University Press: Oxford, 2011
2. Debra Daise, CharlNorloff, and Paul Carne Reading and Writing (Level 4) Oxford University Press: Oxford, 2011

REFERENCES:

1. Davis, Jason and Rhonda Liiss. Effective Academic Writing (Level 3) Oxford University Press: Oxford, 2006
2. E. Suresh Kumar and et al. Enriching Speaking and Writing Skills. Second Edition. Orient Black swan: Hyderabad, 2012
3. Withrow, Jeans and et al. Inspired to Write. Readings and Tasks to develop writing skills. Cambridge University Press: Cambridge, 2004
4. Goatly, Andrew. Critical Reading and Writing. Routledge: United States of America, 2000
5. Petelin, Roslyn and Marsh Durham. The Professional Writing Guide: Knowing Well and Knowing Why. Business & Professional Publishing: Australia, 2004

AI8501

IRRIGATION AND DRAINAGE ENGINEERING

L T P C
3 0 0 3

OBJECTIVES:

- At the completion of the course the students should be able to understand the necessity of planning an irrigation system to provide water at the right time and right place.
- To understand the basic concepts for planning, design and management of land drainage works in cultivated areas

UNIT I WATER RESOURCES AND IRRIGATION REQUIREMENT 9

Water Resources- River basins-Development and Utilization in India and Tamil Nadu-Irrigation – duty and delta - Rooting characteristics - Moisture use of crop, Evapotranspiration - ET plot - Crop water requirement - Effective rainfall - Scheduling - Irrigation requirement - Irrigation frequency, Irrigation efficiencies.

UNIT II METHODS OF IRRIGATION 9

Methods of Irrigation – Surface and Subsurface methods – Drip and Sprinkler - Hydraulics and design - Erodible and non-erodible, Kennedy's and Lacey's theories, Materials for lining water courses and field channel, Water control and diversion structure - Underground pipeline irrigation system

UNIT III DIVERSION AND IMPOUNDING STRUCTURES 9

Head works –Weirs and Barrage –Types of impounding structures - Factors affecting, location of dams -Forces on a dam -Design of Gravity dams- Earth dams, Arch dams – Spillways -Energy dissipaters.

UNIT IV CANAL IRRIGATION AND COMMAND AREA DEVELOPMENT 9

Classification of canals- Alignment of canals – Design of irrigation canals– Regime theories - Canal Head works – Canal regulators - Canal drops – Cross drainage works – Canal Outlet, Escapes –Lining and maintenance of canals - Excess irrigation and waterlogging problem - Command area - Concept, Components of CADP - On Farm Development works, Farmer's committee - its role for water distribution and system operation - rotational irrigation system.

UNIT V AGRICULTURAL DRAINAGE 9

Agricultural drainage - Drainage coefficient; principles of flow through soils, Darcy's 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.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will have knowledge and skills on Planning, design, operation and management of reservoir system.
- The student will gain knowledge on different methods of irrigation including canal irrigation.

TEXTBOOKS:

1. Dilip Kumar Majumdar., "Irrigation Water Management", Prentice-Hall of India, New Delhi, 2008.
2. Michael, A.M., "Irrigation Engineering", Vikas Publishers, New Delhi, 2008.
3. Garg, S.K., "Irrigation Engineering," Laxmi Publications, New Delhi, 2008.
4. Ritzema, H.P., "Drainage Principles and Applications", Publication No. 16, International Institute of Land Reclamation and Improvement, Netherlands, 1994.

REFERENCES:

1. Basak, N.N., "Irrigation Engineering", Tata McGraw-Hill Publishing Co, New Delhi, 2008.
2. Murthy, V.V.N. Land and water management, Kalyani publishing, New Delhi, 1998.
3. Bhattacharya, A.K., and Michael, A.M., "Land Drainage – Principles, Methods and Applications", Konark Publishers Pvt. Ltd., New Delhi, 2003.

4. Irrigation water Management, Training Manual No 6, Drainage of Irrigated Lands, Food and Agriculture Organisation, Rome 1996
5. Kessler, J., "Drainage Principles and Applications", Vol. II and IV, International Institute of Land Reclamation and Improvement, Netherlands, 1979.

AI8502

FARM MACHINERY AND EQUIPMENT

L T P C
3 0 0 3

OBJECTIVES:

- To introduce the students to the working principles of farm equipments, tillage implements.
- To expose the students to farm mechanization benefits and constraints, identification of components of primary and secondary tillage implements

UNIT I FARM MECHANIZATION

9

Farm mechanisation – objectives. Tillage - objectives - methods – primary tillage implements - secondary tillage implements - animal drawn ploughs - construction. Types of farm implements – trailed, mounted . Field capacity - forces acting on tillage tool.

UNIT II PRIMARY AND SECONDARY TILLAGE IMPLEMENTS

9

Mould board plough- attachments – mould board shapes and types. Disc plough – force representation on disc – Types of disc ploughs – Subsoiler plough - Rotary plough. Cultivators - types - construction. Disc harrows - Bund former - ridger – leveller. Basin lister-Wetland preparation implements.

UNIT III SOWING AND FERTILIZING EQUIPMENT

9

Crop planting - methods - row crop planting systems - Devices for metering seeds – furrow openers – furrow closers- types – Types of seed drills and planters – calibration-fertilizer metering devices - seed cum fertilizer drills – paddy transplanters – nursery tray machines.

UNIT IV WEEDING AND PLANT PROTECTION EQUIPMENT

9

Weeding equipment – hand hoe – long handled weeding tools – dryland star weeder – wetland conoweede and rotary weeder – Engine operated and tractor weeders

Sprayers –types-classification – methods of atomization, spray application rate, droplet size determination – volume median diameter, numerical median diameter – drift control

UNIT V HARVESTING MACHINERY

9

Principles of cutting crop, types of harvesting machinery, vertical conveyor reaper and binder combine harvesters, balers, threshers, tractor on top combine harvester, combine losses

TOTAL: 45 PERIODS

OUTCOME:

- The students will be able to understand the mechanization and various equipment used in the farm for different field operations.

TEXTBOOKS :

1. Jagdishwar Sahay. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi 6.,2010.
2. Michael and Ohja. Principles of Agricultural Engineering. Jain brothers, New Delhi., 2005

REFERENCES:

1. Kepner, R.A., et al. Principles of farm machinery. CBS Publishers and Distributors, Delhi. 99, 1997.
2. Harris Pearson Smith et al. Farm machinery and equipment. Tata McGraw-Hill pub., New Delhi.,1996.
3. Srivastava, A.C. Elements of Farm Machinery. Oxford and IBH Pub. Co., New Delhi, 1990.

AI8503**DESIGN OF BASIC MACHINE ELEMENTS****L T P C
4 0 0 4****OBJECTIVES:**

- To introduce to the students to the basic concepts involved in the design of basic elements that are common to any agricultural machinery.
- To get through the detailed design & drawing of various components of agricultural machineries.

UNIT I STRESSES IN MACHINE MEMBERS**12**

Introduction to design process- factor influencing the machine design, selection of material based on mechanical properties- Direct, bending and torsional stress equations- calculation of Principal stresses for combined loading. Design of curved beams- factor of safety – theories of failure-stress concentration- design of variable loading- Soderberg and Goodman relations.

UNIT II DESIGN OF POWER TRANSMISSION SYSTEMS**12**

Selection of V-Belts and pulleys- selection of flat belts and pulleys- wire ropes and pulleys- selection of transmission chains and sprockets. Design of pulleys and sprockets.

UNIT III DESIGN OF SHAFTS AND COUPLINGS**12**

Design of solid and hollow shafts based on strength and rigidity- Design of keys, keyways and splines- Design of rigid and flexible couplings. Design of bolts and nuts - knuckle and cotter joints.

UNIT IV DESIGN OF ENERGY STORING ELEMENTS**12**

Design of helical, leaf, disc and torsional springs under constant loads and varying loads – Concentric torsion springs.

UNIT V DESIGN OF GEARS AND BEARINGS**12**

Gears - spur gear and helical gear - terminology - strength of gear teeth - Lewis equation - Buckingham equation. - Failure of gear teeth.- Applications of different types of Gears - Types of bearings – sliding contact and rolling contact types. – Bearing selection based on application - Lubrication in journal bearings – calculation of bearing dimensions.

TOTAL :60 PERIODS

(Note: Use of PSG Design Data book is permitted in the university examination)

OUTCOME:

- At the end of the course the student will have the knowledge on detailed design and drawing of basic machine components.

TEXTBOOKS:

1. Khurmi R.S and Gupta J.K, A Textbook of Machine Design, Euarsia publication house, 2005.
2. Bhandari V.B, "Design of Machine Elements", Tata McGraw-Hill Book Co, 2003.

REFERENCES:

1. Norton R.L, Machine Design – An Integrated Approach, Pearson Publications, 3rd Edition, 2006.
 2. Srivastava A.K., Goering.C.E. and Rohrbach R.P. Engineering Principles of Agricultural Machines. Revised Printing by American Society of Agricultural Engineers. 1993.
 3. Gary Krutz, Lester Thompson and Paul Clear., “Design of Agricultural Machinery”, John Wiley and Sons, New York, 1984.

A18504

POST HARVEST TECHNOLOGY

L T P C
3 003

OBJECTIVE:

- The students would be exposed to fundamental knowledge in engineering properties of agricultural materials, different Post Harvest operations and processing methods of harvested crops and storage of crops

UNIT I FUNDAMENTALS OF POST HARVESTING

9

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

UNIT II PSYCHROMETRY AND DRYING

9

Psychrometry – importance – Psychrometric charts and its uses – 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 CLEANING AND GRADING

9

Principles - air screen cleaners – adjustments - cylinder separator - spiral separator – magnetic separator - colour sorter - inclined belt separator – length separators - effectiveness of separation and performance index.

UNIT IV SHELLING AND HANDLING

9

Principles and operation – maize sheller, husker sheller for maize – groundnut decorticator – castor sheller – material handling – belt conveyor –screw conveyor – chain conveyor – bucket elevators – pneumatic conveying

UNIT V CROP PROCESSING

9

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 - wheat milling – pulse milling methods – oil seed processing – millets processing.

TOTAL: 45 PERIODS

OUTCOMES:

OUTCOMES: At the end of the study the student will have knowledge on

- Material handling equipments
 - Different Post Harvest operations and processing methods of harvested crops.
 - Fundamentals of various unit operations of Agricultural Processing.

TEXTBOOKS:

1. Chakraverty, A. Post harvest technology for Cereals, Pulses and oilseeds. Oxford & IBH publication Pvt Ltd, New Delhi, Third Edition, 2000.
2. Sahay, K.M., and Singh, K.K. Unit operations of Agricultural Processing. Vikas publishing house Pvt. Ltd., New Delhi, 1994.

REFERENCES:

1. Pande, P.H. Principles of Agriculture Processing. Kalyani Publishers, Ludhiana, 1994.
2. Henderson, S.M. and R.L. Perry. Agricultural Process Engineering. John Wiley and Sons, New York. 1955.

AI8511**OPERATION AND MAINTENANCE OF FARM MACHINERY LAB****L T P C
0 0 4 2****OBJECTIVE:**

- The students will be introduced to the practice of different farm machinery in the field on tillage, sowing, plant protection, harvesting and threshing; care and maintenance; lubrication; fits and tolerances and replacements; adjustments of farm machines; dismantling and reassembling of a disc harrow, seed-cum fertilizer drill and sprayer, engine pumps

LIST OF EXPERIMENTS

- Identification of major systems of a tractor and general guidelines on preliminary check measures before starting a tractor - procedure for starting, running and stopping the tractor.
- Identification of components of power tiller, their maintenance and study on preliminary check measures and safety aspects before starting a power tiller - procedure for starting, running and stopping the power tiller.
- Field operation and adjustments of ploughs
- Field operation and adjustments of harrows
- Field operation and adjustments of cultivators
- Field operation of sowing and planting equipment and their adjustments
- Field operation of plant protection equipment
- Field operation on mowers and reapers
- Field operation of combine and determination of field losses
- Field operation of threshers and their performance evaluation
- Studies on methods of repair, maintenance and off-season storage of farm equipment
- Opening and reassembly of disc harrows, determination and adjustment of tilt and disc angles
- Hitching of agricultural implements and trailers
- Study and operation of bulldozer
- Visit to agro-manufacturers

TOTAL : 60 PERIODS**TEXTBOOKS:**

1. Jain, S.C. and C.R. Rai. Farm Tractor Maintenance and Repair. Standard publishers and Distributors, New Delhi, 1999.
2. Herbert L.Nichols Sr., Moving the Earth, D. Van Nostrand company Inc. Princeton, 1959.

REFERENCES:

1. John A Havers and Frank W Stubbs, Hand book of Heavy Construction, McGraw – Hill book Company, New York, 1971.
2. Barger, E.L., J.B. Liljedahl and E.C. McKibben, Tractors and their Power Units. Wiley Eastern Pvt. Ltd., New Delhi, 1997.

LIST OF EQUIPMENT REQUIRED

- Tractor – 1 no.
- Power tiller – 1 no.
- Disc plough – 1 no.
- Disc harrow – 1 no.
- Multi tyne cultivator – 1 no.
- Paddy Transplanter – 1 no.
- Seed drill – 1 no.
- Sprayer – 1 no.
- Mower – 1 no.
- Weeder -1 no.
- Combine harvester -1 no. (optional) – can be had as demonstration

AI8512

POST HARVEST ENGINEERING LABORATORY

L T P C
0 0 4 2

OBJECTIVE:

- After the end of this lab, students will be able to determine various engineering properties of grains, test and evaluate different post harvesting machineries.

LIST OF EXPERIMENTS:

- Determination of moisture content of grains by oven method and moisture meter.
- Determination of porosity of grains.
- Determination of coefficient of friction and angle of repose of grains.
- Testing of paddy thresher & paddy winnower.
- Testing of groundnut decorticator & maize sheller
- Evaluation of thin layer drier
- Evaluation of L.S.U. drier.
- Determining the efficiency of bucket elevator and screw conveyor
- Evaluation of shelling efficiency of rubber roll sheller
- Determining the oil content of oil seeds.
- Visit to modern rice mill
- Visit to pulse milling industry

TOTAL: 60 PERIODS

TEXTBOOKS:

1. Chakraverty, A. Post harvest technology for Cereals, Pulses and Oilseeds. Oxford & IBH Publication Pvt Ltd, New Delhi, Third Edition, 2000.
2. Sahay, K.M., and Singh, K.K. Unit operations of Agricultural Processing, Vikas Publishing House Pvt. Ltd., New Delhi, 1994.

REFERENCES:

1. Pande, P.H. Principles of Agriculture Processing. Kalyani Publishers, Ludhiana, 1994.
2. Henderson, S.M. and R.L. Perry. Agricultural Process Engineering. John Wiley and Sons, New York. 1955.
3. Mohsenin, N.N. Physical Properties of Plant and Animal Materials Gordon and Breach Publishers, Ludhiana, 1970.

LIST OF EQUIPMENTS REQUIRED:

- Hot air oven, Grain moisturemeter – 1 no. each
- Porosity apparatus – 1 no.
- Coefficient of friction apparatus – 1 no.
- Angle of repose – round type and L type – 1 no.each.
- Paddy thresher – 1 no.

- Groundnut decorticator and maize sheller – 1 no. each
- Thin layer dryer – 1 no.
- LSU dryer – 1 no.
- Bucket elevator and screw conveyor – 1 no. each
- Rubber roll sheller – 1 no.
- Oil expeller – 1 no.

AI8513

IRRIGATION FIELD LABORATORY

L T P C

0 0 4 2

OBJECTIVE:

- Students should be able to verify the principles studied in theory by performing the experiments in lab.

LIST OF EXPERIMENTS

1. To study various instruments in the Meteorological Laboratory
2. Determination of infiltration rate using double ring and digital infiltrometer
3. Determination of soil moisture wetting pattern for irrigation scheduling
4. Design of Drip irrigation system
5. Design of sprinkler irrigation system
6. Measurement of flow properties in open irrigated channels (flumes, notches)
7. Evaluation of surface irrigation
8. Determination of uniformity coefficient for drip irrigation system
9. Determination of uniformity coefficient for sprinkler system (catch can method)
10. To conduct experiment on disc filter for micro irrigation systems

TOTAL: 60 PERIODS

LIST OF EQUIPMENTS REQUIRED

1. Meteorological lab with Cup counter anemometer, Sunshine recorder, Open pan vaporimeter, Stevenson's screen - Dry bulb, wet bulb thermometers, recording and non-recording type rain gauge etc. – each 1 no.
2. Double ring infiltrometer – 1 no.
3. Digital infiltrometer – 1 no.
4. Parshall flume, cut throat flume – 1 no. each
5. V notch, Rectangular notch and trapezoidal notch – 1 no. each
6. Drip irrigation system with all accessories
7. Sprinkler irrigation system with all accessories
8. Required number of stop watches
9. Weighing balance – 1 no.
10. Catch cans, measuring jars – required numbers

OUTCOME:

- On the completion of the course the student will have the knowledge on various meteorological instruments and understanding the concept of different irrigational systems in the laboratory tests.

REFERENCES:

1. Michael, A.M., "Irrigation Theory and Practice", Vikas Publishing House, New Delhi, 1999.
2. Asawa, G.L., "Irrigation Engineering", New Age International Private Limited, New Delhi, 1996.
3. Laboratory Manual, Centre for Water Resources, Anna University, Chennai.

HS8581	PROFESSIONAL COMMUNICATION	L T P C
		0 0 2 1

OBJECTIVES: The course aims to:

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

UNIT I

Introduction to Soft Skills-- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Time Management—General awareness of Current Affairs

UNIT II

Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice— presenting the visuals effectively – 5 minute presentations

UNIT III

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic -- questioning and clarifying —GD strategies- activities to improve GD skills

UNIT IV

Interview etiquette – dress code – body language – attending job interviews— telephone/skype interview -one to one interview & panel interview – FAQs related to job interviews

UNIT V

Recognizing differences between groups and teams- managing time-managing stress- networking professionally- respecting social protocols-understanding career management-developing a long-term career plan-making career changes

TOTAL :30 PERIODS

OUTCOMES: At the end of the course Learners will be able to:

- Make effective presentations
- Participate confidently in Group Discussions.
- Attend job interviews and be successful in them.
- Develop adequate Soft Skills required for the workplace

Recommended Software

1. Open Source Software
2. Win English

REFERENCES:

1. Butterfield, Jeff. Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. Interact English Lab Manual for Undergraduate Students,. OrientBalckSwan: Hyderabad, 2016.
3. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
4. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
5. S. Hariharanetal. Soft Skills. MJP Publishers: Chennai, 2010.

AI8601

GROUNDWATER AND WELL ENGINEERING

L T P C

3 0 0 3

OBJECTIVES:

- To introduce the concepts of groundwater, its availability, assessment and utilization
- To understand the theory behind well design, construction and management of wells.

UNIT I HYDROGEOLOGIC PARAMETERS

9

Water Balance – Distribution of subsurface water – Water bearing properties of Rocks – Types of Aquifers – Aquifer properties Estimation – Pumping test :- Permeability, Specific yield, transmissivity and Storage coefficient – Methods of Estimation – Ground water table fluctuation method – GEC Norms – Ground water development and potential in India - Groundwater prospectives - Geophysical techniques – Electrical resistivity survey

UNIT II WELL HYDRAULICS

9

Darcy's law – Groundwater Flow Equation – Steady state flow – Dupuit Forcheimer Assumption – Theim's Equation - unsteady flow – Theis method and Jacob method – Image well theory – Partial penetration of wells.

UNIT III WELL DESIGN

9

Design characteristics – Design of wells - Well diameter, depth and Well screen design – Materials for well screens – Well casing – Design of collector wells and Infiltration gallery – Dug wells versus tube wells

UNIT IV WELL CONSTRUCTION AND MAINTENANCE

9

Types of wells – Well drilling - Boring, Jetting – Rotary drilling, Hammer drilling - Construction – Installation of pipes and screens - Well development, Completion and disinfection – Well maintenance – Well performance test – Well effectiveness – Well loss – Pumping equipment – Rehabilitation of wells and borewells.

UNIT V SPECIAL TOPICS

9

Artificial Recharge Techniques – Sea water Intrusion – Introduction to Ground water modeling Techniques – Ground water pollution and legislation - Groundwater quality –Dose response assessment – Risk analysis

TOTAL: 45 PERIODS

OUTCOMES:

- Students know the technical aspects of groundwater, its availability, assessment and utilization
- Familiarized with the theory behind well design, construction and management of wells.

TEXTBOOKS:

1. Karanth, K.R. Groundwater Assessment, Development and Management. Tata Mc-Graw Hill, 2008.
2. Raghunath, H.M. Groundwater Hydrology, Wiley Eastern Ltd., 2000.

REFERENCES:

1. Rastogi,A.K. Numerical Groundwater Hydrology, Penram International Publishing. Pvt. Ltd., Bombay, 2008.
2. David Keith Todd. Groundwater Hydrology, John Wiley & Sons, Inc. 2007
3. Fletcher.G.Driscoll, "Groundwater and Wells", Johnson Revision, New York, 1987.

OBJECTIVES :

- To introduce the students to dairy industry, properties and processing of milk, manufacture of dairy products , sanitation and effluent treatment in dairy industry
 - To expose the students to the fundamental knowledge of food, its properties and different methods of food processing

9

Dairy Industry – importance and status – Milk Types – Composition and properties of milk - Production of high quality milk - Method of raw milk procurement and preservation - Processing – Staining - Filtering and Clarification - cream separation – Pasteurization – Homogenization - sterilization, UHT processing and aseptic packaging – emulsification - Fortification.

UNIT II DAIRY PRODUCTS

9

Manufacture of Milk Powder - Processing of Milk Products - Condensed Milk - Skim milk - Butter milk - Flavoured Milk, whey, casein, yoghurt and paneer - Manufacture of Butter - Cheese Ghee, ice creams and frozen desserts - standards for milk and milk products - Packaging of Milk and Milk Products - Cleaning and Sanitation - Dairy effluent treatment and disposal .

UNIT III FOOD AND ITS PROPERTIES, REACTION AND KINETICS

9

Constituents of food - thermal processing of foods - cooking, blanching, sterilization, pasteurization, canning - Interaction of heat energy on food components, reaction kinetics, Arrhenius equation, TDT curves - water activity, sorption behaviour of foods – isotherm models - monolayer value, BET isotherms, Raoult's law, Norrish, Ross, Salwin-Slawson equations.

UNIT IV PROCESSING AND PRESERVATION OF FOODS

10

Coffee, Tea processing - Concentration of foods, freeze concentration - osmotic and reverse osmotic concentration - drying and dehydration of food - Tray, tunnel, belt, vacuum and freeze dryers - rehydration of dehydrated foods - Fat and oil processing, sources, extraction, methods and equipment, refining of oils, hydrogenation, manufacture of margarine - Food preservation methods - preservation by irradiation, microwave and dielectric heating of food.

UNIT V PACKAGING AND QUALITY CONTROL

8

Food packaging, importance, flexible pouches - retort pouches - aseptic packaging, granules, powder and liquid packaging machines - nanotechnology – principles - applications in food processing – food plant location - Quality control of processed food products - Factors affecting quality.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will gain knowledge about Dairy and Food process engineering
 - Understand the process of manufacturing of dairy products and thermal processing of food.
 - Students will understand the importance of quality control and food preservation and packaging.

TEXTBOOKS:

1. Chandra Gopala Rao. Essentials of Food Process Engineering. B.S. Publications, Hyderabad, 2006.
 2. Walstra. P., Jan T. M. Wouters., Tom J. Geurts "Dairy Science and Technology", CRC press, 2005.
 3. Ananthakrishnan, C.P., and Sinha, N.N., "Technology and Engineering of Dairy Plant Operations, Laxmi Publications, New Delhi, 1999.

REFERENCES:

1. Subbulakshmi.G., and Shobha A. Udupi, Food Processing and Preservation, New Age International Publications, New Delhi, 2007.
 2. Toledo, R.T., "Fundamentals of Food Process Engineering", CBS Publishers and Distribution, New Delhi, 1997.
 3. Tufail Ahmed., "Dairy Plant Engineering and Management", Kitab Mahal Publishers, Allahabad, 1997.
 4. Dairy Science and Technology Handbook, Volumes 1-3, John Wiley & Sons, 1993.
 5. Charm, S.E., "Fundamentals of Food Engineering", AVI Pub.Co.Inc, New York, 1997.

AI8603

PROTECTED CULTIVATION

L T P C
3 003

OBJECTIVES:

- To impart knowledge on the protected cultivation of vegetables, fruits and flower crops.
 - To sensitize the students on hi-tech production technology of fruits, vegetables and flower crops.

UNIT I PROTECTED CULTIVATION AND ITS TYPES

9

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 PROTECTED CULTIVATION OF VEGETABLE CROPS

9

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 PROTECTED CULTIVATION OF FLOWER CROPS

9

UNIT III 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 PRECISION FARMING TECHNIQUES

9

Concept and introduction of precision farming – 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 – georeferencing and photometric correction – Sensors for information gathering – UAV - geostatistics – robotics in horticulture - postharvest process management (PPM) – remote sensing

UNIT V PRECISION FARMING OF HORTICULTURAL CROPS

9

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, tuberoose, china aster, turmeric, coriander, coleus and gloria.

TOTAL · 45 PERIODS

OUTCOMES-

- The students will be able to appreciate the different methods of protected cultivation practices available for vegetable crops and flowers
 - A clear understanding of precision farming techniques and its application to horticultural crops is possible

TEXTBOOKS:

1. Joe.J.Hanan. 1998. Green houses: Advanced Technology for Protected Horticulture, CRC Press, LLC. Florida.
2. Paul V. Nelson. 1991. Green house operation and management. Ball publishing USA.

REFERENCES:

1. Lyn. Malone, Anita M. Palmer, Christine L. Vloghat Jach Dangeermond. 2002. Mapping out world: GIS lessons for Education. ESRI press.
2. David Reed. 1996. Water, media and nutrition for green house crops. Ball publishing USA.
3. Adams, C.R. K.M. Bandford and M.P. Early. 1996. Principles of Horticulture. CBS publishers and distributors. Darya ganj, New Delhi.

AI8604**SOLAR AND WIND ENERGY ENGINEERING****L T P C
3 0 0 3****OBJECTIVE:**

- To impart knowledge on solar energy systems, wind energy systems and its applications.

UNIT I SOLAR ENERGY RADIATION AND SOLAR THERMAL COLLECTORS 9

Solar radiation availability - radiation measurement – transmittance - absorptance – Basic earth sun angles - estimation of average solar radiation, radiation on tilted surface - Flat plate collectors - heat transfer correlations - collector efficiency - heat balance – absorber plate – types - selective surfaces. Solar water heaters - types- their performance. Solar driers – types – heat transfer - performance of solar dryers – agro industrial applications.

UNIT II SOLAR CONCENTRATING COLLECTORS 9

Concentrating collectors – types – reflectors - solar thermal power stations – principle and applications - Solar energy storage systems – thermal - sensible and latent heat, chemical, electrical, electro-magnetic energy storage – selection of materials for energy storage - Solar distillation – application - Solar stills - types - Solar pond - performance – characteristics - applications – Solar refrigeration.

UNIT III SOLAR PV TECHNOLOGY 9

Solar photovoltaic technology –introduction – solar cell basics – Types of solar cells and modules – encapsulation – Design of solar PV system – load estimation - batteries – invertors – operation - system controls. Standalone and grid connected systems - PV powered water pumping - Hybrid system - Solar technologies in green buildings.

UNIT IV WIND ENERGY 9

Nature of the wind – power in the wind – factors influencing wind – wind energy potential and installation in India- wind speed monitoring - wind resource assessment -wind power laws - velocity and power duration curves - Betz limit - site selection.

UNIT V WIND MILL TYPES AND APPLICATIONS 9

Wind energy conversion devices - classification, characteristics, applications – Design of horizontal axis wind mill rotor diameter - Wind energy storage - wind farms - wheeling and banking - testing and certification procedures. Water pumping - Hybrid systems – Wind mill safety and environmental aspects.

TOTAL: 45 PERIODS**OUTCOMES :**

The student will be able to understand

- The concepts of solar and wind energy resources.
- The applications of solar and wind energy systems.

TEXTBOOKS:

1. Rai., G.D. "Solar Energy Utilization" Khanna publishers, New Delhi, 2002.
2. More, H.S and R.C. Maheshwari, " Wind Energy Utilization in India" CIAE Publication – Bhopal, 1982.
3. Solanki, C.S. "Renewable Energy Technologies: A Practical guide for beginners". PHI learning Pvt. Ltd, New Delhi. 2008.

REFERENCES:

1. Solanki, C.S. "Solar Photovoltaic Technology and Systems", PHI learning Pvt. Ltd., New Delhi, 2013.
2. Rai. G.D. "Non Conventional Sources of Energy", Khanna Publishers, New Delhi, 2002.
3. Rao. S and B.B. Parulekar. "Energy Technology – Non conventional, Renewable and Conventional". Khanna Publishers, Delhi, 2000.
4. Rajput. R.K. "Non- Conventional Energy Sources and Utilization", S. Chand & Company Pvt. Ltd, New Delhi, 2013.

AI8611

CAD FOR AGRICULTURAL ENGINEERING**L T P C****0 0 4 2****OBJECTIVES:**

- To draft the agricultural engineering related machineries and structures manually and also by computer aided methods.
 1. Design and Drawing of Underground pipeline system
 2. Design and Drawing of Check dam
 3. Design and Drawing of Mould board plough
 4. Design and Drawing of Disk plough
 5. Design and Drawing of Post harvest technology units (threshers and winnowers)
 6. Design and Drawing of Biogas plant.
 7. Introduction & demonstration on 3D modeling softwares like Pro/E, Creo, Solid works, Solid Edge etc.

TOTAL: 60 PERIODS**OUTCOMES:**

- The student will be able to understand the plan and layout of underground pipes, post harvesting units and check dams.
- The students also will be able to design and draw the components using computer aided methods

REFERENCES:

1. Michael, A.M. "Irrigation Theory and Practice", Vikas Publishing House, New Delhi, 1999.
2. Rai, G.D. "Nonconventional Sources of Energy", Khanna publishers, New Delhi, 1995.
3. Srivastava, A.C."Elements of Farm Machinery", Oxford and IBH Publications Co., New Delhi, 1990.
4. Vijay Duggal. "A general guide to Computer Aided Design & Drafting, Mailmax Publications, 2000
5. Tadeusz Stolarski et al. "Engineering Analysis with ANSYS Software", Butterworth Heinemann Publications, 2006
6. Louis Gary Lamit, "Introduction to Pro/ENGINEER" SDC Publications, 2004.

AI8612

DRAWING OF FARM STRUCTURES

**L T P C
0 0 4 2**

OBJECTIVES:

- To conceive and design various farm structures related to agricultural engineering.
- 1. Planning and Layout of farmstead
- 2. Design of stall barn
- 3. Design of loose housing and milk parlors
- 4. Design of poultry house
- 5. Design of a sheep / goat house
- 6. Design of ventilation system for dairy and poultry house
- 7. Design of silos – over ground and underground and hay storages
- 8. Design of farm fencing system
- 9. Design of machinery and equipment shed and workshops
- 10. Design of septic tank and sanitary structures
- 11. Design of rural/farm roads and culverts.

TOTAL: 60 PERIODS

OUTCOME:

- At the end of the course, the student will be able to design and draw all farm structures connected to agricultural engineering including animal housing, grain storage, small civil structures.

TEXTBOOKS:

1. Barre, H.J. and Sammet, L.L. "Farm Structures". John Wiley and Sons Inc. 1950."
2. Neubaur, L. W. and Walker, H.B. "Farm Buildings Design". Prentice Hall Inc., 1961.
3. Khanna, S.K. and Justo, C.E.G. "Highway Engineering". Nemchand and Bros., Roorkee, India.
4. Dutta, B.N. "Estimating and Costing in Civil Engineering Theory and Practice". S. Dutta and Co.
5. Bazirani, V.N. and Ratwani, M.M. "Steel Structures". Khanna Publishers, Delhi, 1981.
6. Justo, C.E.G. and Khanna, S.K. "Highway Engineering". Nemchand and Bros., Roorkee, India (Revised).

AI8614

FOOD PROCESS ENGINEERING LABORATORY

**L T P C
0 0 4 2**

OBJECTIVES:

- To get hands on experience on various aspects of food science and food process engineering.
- Determination of cooking properties of parboiled and raw rice.
- Estimation of microbial load in food materials.
- Determination of rehydration ratio of dehydrated foods.
- Experiment on osmotic dehydration of foods
- Experiment of food extruder
- Experiment on properties of food through microwave oven heating.
- Determination of properties of milk
- Experiments on cream separator to determine the separation efficiency
- Experiments on construction and operation of butter churn and butter working accessories
- Experiments on detection of Food Adulteration

- Experiments on estimation of protein in food.
- Experiment on expansion and Oil absorption characteristic of snacks on frying

The lab includes visit to food processing and dairy industry

TOTAL: 60 PERIODS

OUTCOME:

- On completion of the lab course, the students will be able to get experience on various aspects of food processing, preservation.

LIST OF EQUIPMENTS REQUIRED

1. Extruder -1no.
2. Pasteurizer – 1no.
3. Hot air oven-1no.
4. Hand refractometer-1 no.
5. Dessicator-1no.
6. Dean and Stark s apparatus-1 no.
7. Cabinet dryer – 1 no.
8. Soxhlet flask -1no.
9. Distillation column – 1 no.
10. Kjeldahl flask – 1no.
11. Distillation apparatus – 1 no.
12. Microwave oven –1 no.
13. Cream separator -1 no.
14. Butter churner -1 no.

Other basic requirements like weighing balance, physical balance, blotting papers, tracing sheets, burette, vernier calipers, pipette, conical flask, test tubes, beakers, spatula and other glasswares, food samples, chemicals should be available.

TEXTBOOKS:

1. Singh, R.Paul. and Heldman, R.Dennis.2004. Introduction to Food Engineering. 3rd Edition. Academic Press, London.
2. Kessler, H.G.1981. Food engineering and dairy technology. Verlag A.Kessler, Freising.

REFERENCES:

1. Walstra, P. T.J. Geurts, A. Nooman, A. Jellema and M.A. J.S Van Boekel. 2005. Dairy Technology. Marcel Dekker Inc. New york.
2. Clunie Harvey, W.M and Harry Hill. 2009 Milk Products. IV Edition Biotech Books, New Delhi.
3. Robinson, R.K.1986. Modern dairy technology Vol.I Advances in Milk processing. Elsevier Applied Science Publishes, London.
4. Charm, S.E.1971. The fundamentals of Food engineering, AVI pub.Co.,Inc,
5. Karel Marcus, Fennama, R.Owen and Lund, B.Dayal. 1975. Principles of food science, Part II - Physical principles of food preservation, Marcel Dakker, Inc.
6. Hall,C.W and T.J.Hedrick. 1971. Drying of milk and milk products. AVI Publishing Co., West Port, Connecticut.

AI8701

SOIL AND WATER CONSERVATION ENGINEERING

L T P C

3 0 0 3

OBJECTIVES:

- To present the concepts of erosion so that students get a sound knowledge about the problems associated with it.
- To enable the students to make use of the principles and concepts to solve issues related to soil and water management.

UNIT I SOIL EROSION PRINCIPLES

9

Approaches to soil conservation – Soil conservation in India - Erosion – Agents - Causes - Mechanics of water erosion – Soil erosion problems - Types of water erosion: Raindrop erosion, Sheet erosion, Rill erosion, Gully erosion, Stream bank erosion – Classification of Gully – Gully Control Structures: Drop Spillway, Drop Inlet, Chute Spillways - Prerequisites for soil and water conservation measures.

UNIT II ESTIMATION OF SOIL EROSION

9

Runoff computation for soil conservation: SCS-CN method – Evolution of Universal Soil Loss Equation: Applications and Limitations – Modified Universal Soil Loss Equation – Revised Universal Soil Loss Equation- Permissible erosion – Land use capability classification - Classification of eroded soils.

UNIT III EROSION CONTROL MEASURES

10

Agronomic practices: contour cultivation - strip cropping – tillage practices – Soil management practices – Bunding: Types and design specifications - Mechanical measures for hill slopes – Terracing: Classification and design specification of bench terrace – Grassed waterways: Location, construction and maintenance – Types of temporary and permanent gully control structures.

UNIT IV WATER CONSERVATION MEASURES

9

In-situ soil moisture conservation – Water harvesting principles and techniques: Micro catchments, catchment yield using morphometric analysis - Farm ponds: Components, Design, Construction and Protection – Check dams - Earthen dam – Retaining wall.

UNIT V SEDIMENTATION

8

Sediment: Sources – Types of sediment load – Mechanics of sediment transport – Estimation of bed load – Sediment Graph - Reservoir sedimentation: Basics - Factors affecting sediment distribution pattern, Rates of reservoir sedimentation - Silt Detention Tanks – sediment control methods.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will be able to gain fundamental knowledge on the concepts of erosion and sedimentation.
- They will have sufficient knowledge on soil and water conservation measures.

TEXTBOOKS:

1. Suresh, R., "Soil and Water Conservation Engineering", Standard Publication, New Delhi, 2007.
2. Ghanshyam Das, "Hydrology and Soil Conservation Engineering", Prentice Hall of India Private Limited, New Delhi, 2000.
3. "Sedimentation Engineering", 2006, ASCE manual and Report on Engineering Practice No. 54, Edited by Vito A. Vanoni. ASCE publishing.

REFERENCES:

1. Murthy, V.V.N., "Land and Water Management Engineering", Kalyani Publishers, Ludhiana, 1998.
2. Gurmail Singh, "A Manual on Soil and Water Conservation", ICAR Publication, New Delhi, 1982.
3. Mal, B.C., "Introduction to Soil and Water Conservation Engineering", Kalyani Publishers, New Delhi, 2002

AI8702	REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM	L T P C
		3 0 0 3

OBJECTIVES:

- To introduce the principles and basic concepts of Remote Sensing and GIS
- To introduce the remote sensing systems, data products and analysis
- To introduce the spatial data models, analysis and presentation techniques
- To study the applications of Remote Sensing and GIS in agriculture, soil and water resources

UNIT I CONCEPTS OF REMOTE SENSING AND SATELLITES 9

Definition- Historical background - Components of remote sensing – Energy source, electromagnetic spectrum, radiation principle, platforms and sensors - Active and passive remote sensing interference - Atmospheric effects on remote sensing – Energy interaction with earth surface feature - Data acquisition - Reflectance, spectral signatures for water, soil and vegetation.- Satellites - Types - Sun synchronous - Geo synchronous remote sensing satellites - LANDSAT,SPOT & IRS - Resolution - Spectral, spatial, radiometric and Temporal resolution - Recent satellites with its applications

UNIT II DATA PRODUCTS AND IMAGE ANALYSIS 9

Data products –based on level of processing- o/p – scale – area/coverage – data availability – data ordering- data price - Image interpretation – Visual interpretation elements – interpretation key. Digital image processing – Image enhancement – image classification – Supervised and unsupervised – Vegetation Indices.

UNIT III CONCEPTS OF GIS 9

Definition – Map and their influences – Characteristics of Maps – Elements – Map scale, Projection, Coordinate systems – Sources of spatial data – History and development of GIS – Definition – Components – Hardware and Software.

UNIT IV DATA INPUT AND ANALYSIS 9

Data – Spatial, Non-Spatial – Database models – Hierarchical network, Relational and Object Oriented Data Models – Raster and Vector – Methods of Data input – Data Editing – Files and formats – Data structure – Data compression. Introduction to analysis – Measurements – Queries – Reclassification – Simple spatial analysis – Buffering – Neighboring functions – Map overlay – Vector and raster – Spatial interpolation – Modelling in GIS – Digital Elevation Modelling – Expert systems

UNIT V APPLICATION OF RS AND GIS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

- The students will understand the remote sensing principles, remote sensing systems satellite data processing and available data products.
- The students will understand decision making process using DBMS and utilization of these advanced techniques in addressing the real world problems.

TEXTBOOKS:

1. Anji Reddy. M, Remote Sensing and Geographical Information Systems, BS Publications, Hyderabad, 2001
2. Lillesand, T. M., and Kiefer, R.W., Remote Sensing and Image Interpretation, John Wiley and Sons, New York, 2000.

REFERENCES:

1. Bettinger, P., and Michael, G.W., "Geographical Information System: Applications in Forestry and Natural Resources Management," Tata McGraw-Hill Higher Education, New Delhi, 2003
2. Ian Heywood., "An Introduction to GIS", Pearson Education, New Delhi, 2001.
3. Jeffery Star and John Estes, "Geographical Information System – An Introduction," Prentice Hall India Pvt. Ltd., New Delhi, 1998.
4. Patel A.N & Surendra Singh, "Remote sensing principles & applications", Scientific Publishers , Jodhpur 1992

AI8703**BIO - ENERGY RESOURCE TECHNOLOGY****L T P C**
3 0 0 3**OBJECTIVES:**

- To impart the fundamental knowledge on the importance of Bio resources, Bio energy and reactors.
- Alcohol and ethanol production and
- Energy and Environment

UNIT I BIO RESOURCE - AN INTRODUCTION'**9**

Bio resource – origin – biomass types and characteristics- biomass conversion technology- Biodegradation - steps in biogas production- parameters affecting gas production- Types of biogas plants- Construction details- operation and maintenance.

UNIT II BIO ENERGY**9**

Slurry handling- enrichment and utilization – Biogas appliances- Biochemical characteristics of bio resources- Bioenergetics –Biocatalysis –Kinetics of product formation.

UNIT III BIO REACTORS AND FERMENTORS**9**

Bio reactors/ fermentors – Batch type – continuous stirred tank reactors- Biological waste water treatment- Activated sludge process- Down stream processing-Recovery and purification of products.

UNIT IV ALCOHOL PRODUCTION**9**

Alcohol ethanol production - Acid hydrolysis - enzyme hydrolysis-Methanol synthesis - Antibiotics- enzymes- principles of thermochemical conversion – combustion - pyrolysis- Gasification – types of gasifiers.

UNIT V ENERGY AND ENVIRONMENT**9**

Principles of operation- chemical reaction- cleaning and cooling - Utilization- Improved wood burning stove - Energy plantations- Biomass briquetting - co generation- Impact on Environment – – Bioenergy policy.

TOTAL: 45 PERIODS**OUTCOME:**

- The students will be able to understand the concepts of bio energy sources and its applications.

TEXTBOOKS:

1. Rai G.D,Non conventional sources of Energy, Khanna publishers, New Delhi, 1995.
2. Bouley James .E & David Follis - Biochemical Engineering Fundamentals Mc Graw-Hill publishing company, Tokyo.1986

REFERENCE:

- Chawla O.P, Advances in Biogas Technology ICAR publication New Delhi 1986

AI8711

GIS LABORATORY FOR AGRICULTURAL ENGINEERSL T P C
0 0 4 2**OBJECTIVES:**

- To introduce the principles and basic concepts of Remote Sensing and GIS through hands on training
- Measurement of relief displacement using parallax bar
- Stereoscopic vision test
- Aerial photo interpretation - visual
- Satellite images interpretation – visual
- Introduction to QGIS
- Geo-referencing of images
- Image enhancement practice
- Supervised classification practice
- Unsupervised classification practice
- Database Management Systems
- Spatial data input and editing - Digitising
- Raster analysis problems – Database query
- GIS applications in DEM and its analysis
- GIS application in watershed analysis
- GIS application in rainfall-runoff modelling
- GIS application in soil erosion modelling

TOTAL: 60 PERIODS**OUTCOME:**

- On completion of the lab course, the students will have adequate knowledge in application of RS and GIS in various fields of agricultural engineering.

TEXTBOOKS:

- Lillesand, T.M. and Kiefer, R.W. 2005. "Remote Sensing and Image Interpretation ", II edition. John Wiley & sons.
- Heywood, I., Cornelius. S., Carver. S 2002. An Introduction to Geographical Information Systems. Addison Wesley Longman, New York.

REFERENCES:

- Floyd F.Sabins. 2005. "Remote Sensing: Principles and Interpretation", III edition. Freeman and Company New York.
- Jensen, J.R., 2004. "Introductory Digital Image Processing: A Remote Sensing Perspective". Prentice – Hall. New Jersey.

AI8712

RENEWABLE ENERGY LABORATORYL T P C
0 0 4 2**OBJECTIVE:**

- To gain the practical knowledge on various renewable energy gadgets.

EXPERIMENTS:

- Characterization of biomass – proximate analysis
- Determination of caloric value of fuels – solids and gases
- Design of KVIC / Deenbandhu model biogas plant

4. Study of UASB biomethanation plant
5. Purification of biogas – CO₂ and H₂S removal
6. Performance evaluation of agro based gasifier
7. Study on pyrolysis unit – Biochar, Charcoal and Tar making process
8. Testing of biogas/producer gas engines
9. Study on briquetting and Stoichiometric calculations
10. Automatic weather station – Analysis of wind data and prediction
11. Testing of solar water heater
12. Testing of natural convection solar dryer
13. Study on Solar power and I-V Characteristics
14. Testing of solar photovoltaic water pumping system

The lab includes visit to biomass power plant and wind farms.

TOTAL: 60 PERIODS

OUTCOME:

On completion of the lab course, the students will

- Be exposed to renewable energy sources and their applications.

REFERENCES:

1. Khandelwal, K.C. and Mahdi, S.S. "Biogas Technology". Tata Mc Graw Hill Pub. Co. Ltd., New Delhi, 1986.
2. Nijaguna, B. T. "Biogas Technology" New Age International Pvt. Ltd., New Delhi, 2006.
3. Rao. S and B.B. Parulekar. Energy Technology – Non conventional, Renewable and Conventional. Khanna Publishers, New Delhi, 2000.
4. Solanki, C.S. "Solar Photovoltaics – Fundamentals, Technologies and Applications", PHI Learning Pvt. Ltd., New Delhi, 2011.

LIST OF EQUIPMENTS REQUIRED

1. Hot air oven- 1 no.
2. Muffle furnace - 1 no.
3. Junkers gas calorimeter- 1 no.
4. Bomb calorimeter- 1 no.
5. Model of Biogas and Deenabandhu biogas plant- 1 no.
6. Biogas scrubbing unit - 1 no.
7. Gasifier - Lab Scale -1 no.
8. Pyrolysis unit -1 no.
9. Biogas/ Producer gas dual fuel Engine -1 no.
10. Briquetting Machine - Lab Scale -1 no.
11. Automatic weather station -1 no.
12. Solar water heater-1 no.
13. Solar dryer-1 no.
14. Solar PV training kit- 1 no.
15. Solar PV water pumping system -1 no.

*The equipments includes the basic requirements like petri plates, silica crucible with lid, weighing balance, tongs, gloves, solarimeter, hand held anemometer, temperature and humidity sensor.

AI8713

ICT IN AGRICULTURAL ENGINEERING LAB EXERCISES

L T P C
0 0 2 1

OBJECTIVES:

- To gain practical knowledge on various technologies in information and communication for agriculture.

EXPERIMENTS:

1. Configuring timers for automatic switching “on and off” of irrigation systems
2. Experience with solenoid valves for pressurized irrigation
3. Using sensors for Agro meteorological measurements
4. Employing Printed Circuit Board (PCB) or Breadboard for controlling or triggering an agricultural system
5. Use of mobile apps for controlling or triggering an agricultural system
6. Construction of crop growth functions (best fit) for crop yields simulations
7. Image processing as tool for biotic and abiotic stress identification
8. Experience with existing open source crop simulation models
9. Exposing cloud resources for agricultural applications
10. Developing automated agro advisory systems

LIST OF EQUIPMENTS REQUIRED

1. Timing devices and small pumps for simulations – required nos.
2. Solenoid valves and layout of drip or sprinkler system – required nos.
3. Time Domain Reflectometer (TDR)
4. Digital thermometer – 1 no.
5. Breadboards, relays etc.
6. MATLAB software
7. Open source Crop simulation models – any one for demonstration
8. Other facilities for cloud resources, agro advisory systems etc.

TOTAL: 30 PERIODS**AI8714****INDUSTRIAL TRAINING
(4 WEEKS DURING VI SEMESTER –SUMMER)****L T P C
0 0 0 2****OBJECTIVES:**

- To train the students in field work by attaching to any industry / organization so as to have a firsthand knowledge of practical problems in Agricultural Engineering
- To gain working experience and skills in carrying out engineering tasks related to various fields of agriculture.

The students individually undertake training in reputed engineering companies / Govt organisations / NGOs / Educational Institutions who work in the area of Agricultural Engineering for the specified duration. At the end of the training, a report on the work done will be prepared and presented. The students will be evaluated through a viva-voce examination by a team of internal staff.

AI8811**PROJECT WORK****L T P C
0 0 20 10****OBJECTIVE:**

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

Students in a group of 3 or 4 shall work on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on three reviews by the review committee constituted by the Head of the Department. The project

work is evaluated based on oral presentation and the final project report jointly by a team of examiners including one external examiner.

OUTCOME:

- On completion of the project work, students will be in a position to take up any challenging practical problem and find solution by formulating proper methodology.

AI8001	SYSTEMS ANALYSIS AND SOFT COMPUTING IN AGRICULTURAL ENGINEERING	L T P C
		3 0 0 3

OBJECTIVES:

- To introduce the students to the application of systems concept to agricultural engineering problems, planning and management.
- Soft computing techniques for modeling different problems in the field agricultural engineering

UNIT I	SYSTEM CONCEPTS	9
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Definition, classification, and characteristics of systems – Scope and steps in systems engineering – Need for systems approach to water resources and irrigation.

UNIT II	LINEAR PROGRAMMING & DYNAMIC PROGRAMMING	9
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Introduction to operations research – Linear programming, problem formulation, graphical solution, solution by simplex method – Sensitivity analysis – application - Bellman's optimality criteria problem formulation and solutions – application.

UNIT III	SIMULATION	9
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Basic principles and concepts – Random variate and random process – Monte Carlo techniques – Model development – Inputs and outputs – Deterministic and stochastic simulation – Irrigation Scheduling - application.

UNIT IV	NEURAL NETWORKS	9
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Neuron, Nerve structure and synapse, Artificial Neuron and its model, Neural network architecture: networks, Various learning techniques; perception and convergence rule, Auto-associative and hetero-associative memory- Architecture: model, solution, single layer and multilayer perception model; back propagation learning methods, applications.

UNIT V	FUZZY LOGIC AND GENETIC ALGORITHM	9
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Basic concepts of fuzzy logic, Fuzzy set theory and operations, Properties of fuzzy sets, Membership functions, inference in fuzzy logic, Fuzzy implications and Fuzzy algorithms, Fuzzy Controller, Industrial applications.

Genetic Algorithm (GA) - Basic concepts, working principle, procedures, flow chart, Genetic representations, encoding, Initialization and selection, Genetic operators, Mutation - applications

TOTAL: 45 PERIODS

OUTCOME:

- Upon completion of the course, the student will have the knowledge on system concepts and will be able to apply the optimization techniques like LP, DP, ANN, FL and GA for problems in agriculture.

TEXTBOOKS:

1. Vedula, S., and Majumdar, P.P. Water Resources Systems – Modeling Techniques and Analysis Tata McGraw Hill, New Delhi, Fifth reprint, 2010.
2. Robert M Peart and W David Shoup, Agricultural Systems Management – Optimizing efficiency and performance, CRC Press, 2013.
3. Gupta, P.K., and Man Mohan, "Problems in Operations Research", (Methods and Solutions), Sultan Chand and Sons, New Delhi, 1995.

REFERENCES:

1. Chaturvedi, M.C., "Water Resources Systems Planning and Management", Tata McGraw Hill, New Delhi, 1997.
2. Taha, H.A., "Operations Research", McMillan Publication Co., New York, 1995.
3. Hiller, F.S., and Liebermann, G.J., "Operations Research", CBS Publications and Distributions, New Delhi, 1992.
4. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" Wiley India.
5. S. Rajsekaran & G.A. Vijayalakshmi Pai, "Neural Networks,Fuzzy Logic and Genetic Algorithm: Synthesis and Applications" Prentice Hall of India.

AI8002**IT IN AGRICULTURAL SYSTEMS****L T P C**
3 0 0 3**OBJECTIVES:**

- To introduce the students to areas of agricultural systems in which IT and computers play a major role.
- To also expose the students to IT applications in precision farming, environmental control systems, agricultural systems management and weather prediction models.

UNIT I PRECISION FARMING**9**

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

UNIT II ENVIRONMENT CONTROL SYSTEMS**9**

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.

UNIT III AGRICULTURAL SYSTEMS MANAGEMENT**9**

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 IV WEATHER PREDICTION MODELS**9**

Importance of climate variability and seasonal forecasting, Understanding and predicting world's climate system, Global climatic models and their potential for seasonal climate forecasting, General systems approach to applying seasonal climate forecasts.

UNIT V E-GOVERNANCE IN AGRICULTURAL SYSTEMS**9**

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.

TOTAL: 45 PERIODS

OUTCOME:

- The students shall be able to understand the IT applications in environmental control systems, precision farming, agricultural systems management and weather prediction models.

TEXTBOOKS:

1. National Research Council, "Precision Agriculture in the 21st Century", National Academies Press, Canada, 1997.
2. H. Krug, Liebig, H.P. "International Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation", 1989.

REFERENCES:

1. Peart, R.M., and Shoup, W. D., "Agricultural Systems Management", Marcel Dekker, New York, 2004.
2. Hammer, G.L., Nicholls, N., and Mitchell, C., "Applications of Seasonal Climate", Springer, Germany, 2000.

AI8003

CLIMATE CHANGE AND ADAPTATION**L T P C
3 0 0 3****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.

UNIT I EARTH'S CLIMATE SYSTEM**9**

Role of ozone in environment - ozone layer - ozone depleting gases - Green House Effect, Radiative effects of Greenhouse Gases - Hydrological Cycle - Green House Gases and Global Warming – Carbon Cycle.

UNIT II ATMOSPHERE AND ITS COMPONENTS**9**

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 IMPACTS OF CLIMATE CHANGE**9**

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 Scenarios – Projected Impacts for Different Regions – Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

UNIT IV OBSERVED CHANGES AND ITS CAUSES**9**

Climate change and Carbon credits- CDM- Initiatives in India-Kyoto Protocol Intergovernmental Panel on Climate change- Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC– IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India .

UNIT V CLIMATE CHANGE AND MITIGATION MEASURES**9**

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) - Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.

TOTAL: 45 PERIODS

OUTCOMES:

After successful completion of this course students are expected to be able to:

- Demonstrate an understanding of how the threats and opportunities of predicted climate change will influence specific sectors at global and regional scale;
- Critically evaluate the relative opportunities and needs for mitigation and adaptation (including vulnerability assessments) in a variety of sectoral contexts;
- Understand and critically evaluate the scientific insights underlying the assessment reports of the IPCC, with a focus on impacts, adaptation and mitigation.

TEXTBOOK:

1. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007.

REFERENCES:

1. Adaptation and mitigation of climate change-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.

GE8071

DISASTER MANAGEMENT

L T P C

3 0 0 3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS

9

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 ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR)

9

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 stakeholders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III	INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT	9
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	DISASTER RISK MANAGEMENT IN INDIA	9
Hazard 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	DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS	9
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.		

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.

TEXTBOOKS:

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES:

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy, 2009.

GE8074

HUMAN RIGHTS

L T P C
3 0 0 3

OBJECTIVE :

- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I	9
Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.	

UNIT II	9
Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.	
UNIT III	9
Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.	
UNIT IV	9
Human Rights in India – Constitutional Provisions / Guarantees.	
UNIT V	9
Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.	

TOTAL : 45 PERIODS

OUTCOME:

- Engineering students will acquire the basic knowledge of human rights.

REFERENCES:

- Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
- Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
- Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi

AI8004	AGRICULTURAL BUSINESS MANAGEMENT	L T P C
		3 0 0 3

OBJECTIVES:

- To introduce the importance of Agri-business management, its characteristics and principles
- To impart knowledge on the functional areas of Agri-business like Marketing management, Product pricing methods and Market potential assessment.

UNIT I	CONCEPTS OF AGRICULTURAL BUSINESS	9
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Agri-business - scope, characteristics, types. Management - importance, definition, management and administration, management thoughts, Small business - characteristics and stages of growth - Management functions - planning, organizing, leading.

UNIT II	AGRI – BUSINESS ORGANIZATION	9
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Principles, forms of agri-business organizations, staffing, directing, supervision and motivation. Controlling - types, performance evaluation and control techniques. Management approaches - Profit Centered Approach, Management by objectives and Quality Circles. Strength, Weakness, Opportunities and Threat (SWOT) Analysis.

UNIT III	AGRICULTURAL MARKETING	9
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Functional areas of Agri-business - Production and Operations management - functions, planning physical facilities and managing quality. Agro-inputs and products inventory management - raw material procurement, inventory types, and costs. Marketing management- Marketing environment, marketing mix - Agricultural input marketing firms.

UNIT IV AGRICULTURAL BUSINESS FINANCE 9

Forms of agri-business organizations - Role of lead bank in agribusiness finance - Financial management. Acquiring capital- Budget analysis. Concepts and determinants- Business project scheduling of raw material procurement - production management - launching products (branding, placement) - Input marketing promotion activities.

UNIT V MARKET PROMOTION AND HUMAN RESOURCES 9

Agricultural products - marketing promotion activities - product pricing methods. District Industries Centre - Consumer survey - Agricultural inputs retailing - Market potential assessment - types of distribution channels - Return on Investment - Personnel management. Recruitment, selection and training - Technology in Agri Business

TOTAL: 45 PERIODS**OUTCOME:**

- The students shall be exposed to various trends in agricultural business management.

TEXTBOOKS:

1. Himanshu, "Agri Business Management – Problems and prospects", Ritu Publications, Jaipur, 2005.
2. Smita Diwase, "Indian Agriculture and Agribusiness Management", Krishi resource Management Network, Pune 2004.

REFERENCES:

1. Chandra Prasanna, "Projects: Preparation, Appraisal, Budgeting and Implementation", Tata McGraw Hill Publications, New Delhi, 2001.
2. Kotler, P., "Marketing Management. Analysis, Planning and Control", Prentice Hall Inc., New York, 2001.
3. Rao, V.S.P., and Narayana, P.S., "Principles and Practices of Management", Konark Publishing Private Limited, New Delhi, 2001.
4. Tripathy, P.C., and Reddy, P.N., "Principles of Management", Tata McGraw Hill Publications, New Delhi, 2000.

**AI8005 AGRICULTURAL ECONOMICS AND FARM MANAGEMENT L T P C
3 0 0 3****OBJECTIVES :**

- To impart the fundamental knowledge and basic concepts of Economics and Farm Management
- To understand the types of resources and Investment analysis in agriculture sector
- Farm financial analysis, Investment and Budgeting for farms

UNIT I FARM MANAGEMENT 9

Agricultural Economics – definition and scope – Farm Management – definition – scope- Classification of farms – Basic concepts in farm management - Relationship between farm management and other basic sciences - Farm layout – Farm records and accounts – Farm appraisal techniques – Valuation .

UNIT II LAWS OF ECONOMICS 9

Basic laws of economics – demand and supply concepts – law of increasing, diminishing and constant returns – Equi-marginal returns - Product relationship – Production function – definition and types – Production function curves – Optimum level of input use – Economies of scale external and internal economies and diseconomies - Cost concepts – types - Opportunity cost – comparison of costs – Factor relationship – concepts.

UNIT III COST CURVES

9

Principle of substitution – isoquant, isoline, expansion path, ridge line and least cost combination of inputs-Product-product relationship – Production possibility curve, isorevenue line and optimum combination of outputs – Cost curves –Optimum input and output levels – Factor –factor relationship – Least cost combination of inputs – Estimation of cost of cultivation and cost of production of crops - annual and perennial crops – Preparation of interview schedule and farm visit for data collection.

UNIT IV MANAGEMENT OF RESOURCES

9

Concept of risk and uncertainty – causes for uncertainty – Managerial decisions to reduce risks in production process – Management of resources – types of resources- land, labour, capital and measurement of their efficiencies – Mobilization of farm resources- Cost of machinery and maintenance – Break even analysis – Investment analysis – Discounting techniques.

UNIT V FARM MANAGEMENT AND FINANCIAL ANALYSIS

9

Farm management- need and analysis – Farm financial analysis – Balance sheet – Income statement – Cash flow analysis – Farm investment analysis – Time comparison principles – Farm planning – Elements of farm planning – Whole farm planning and partial planning – Farm level management system – Farm budgeting – whole farm budgeting and partial budgeting – Estimation of credit - examples of farm planning and budgeting.

TOTAL: 45 PERIODS**OUTCOME:**

- Students are able to plan the financial aspects related to farm management in a cost effective manner.

TEXTBOOKS:

1. Johl, S.S., and Kapur, T.R., "Fundamentals of Farm Business Management", Kalyani publishers, Ludhiana, 2007.
2. Subba Reddy, S., Raghu Ram, P., Neelakanta Sastry T.V and Bhavani
3. Devi, I., "Agricultural Economics" Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2006.

REFERENCES:

1. Raju, V.T., "Essentials of Farm Management", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2002.
2. Subba Reddy, S., and Raghu Ram, P. , "Agricultural Finance and Management", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2002.
3. Sankhyayan, P.L. , "Introduction to Farm Management", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2001
4. Muniraj, R., "Farm Finance for Development", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2000.

AI8006**AGRICULTURAL EXTENSION****L T P C**
3 0 0 3**OBJECTIVE:**

- To expose the students to different extension methods for communication to take the work from lab to field

UNIT I COMMUNICATION AND PROGRAMME PLANNING

9

Communication – meaning – definition – models – elements and their characteristics – types and barriers in communication. Programme planning – meaning, definition, principles, steps in programme development process, monitoring and evaluation of extension programmes.

UNIT II EXTENSION TEACHING METHODS 9

Extension teaching methods - Audio-Visual aids – definition – classification – purpose, planning and selection, combination and use – individual, group and mass contact methods – merits and demerits.

UNIT III MODERN COMMUNICATION GADGETS 9

Modern communication sources – internet, video and teleconferencing, Interactive Multimedia Compact Disk (IMCD), village kiosks, Kisan Call Centre (KCC), mobile phone

UNIT IV DIFFUSION AND ADOPTION 9

Diffusion – meaning and elements. Adoption – meaning – adopter categories and factors influencing adoption, stages of adoption, Innovation decision process and attributes of innovation consequences of adoption.

UNIT V CAPACITY BUILDING 9

Capacity building of extension personnel and farmers – meaning – definition, types of training, training to farmers, farm women and rural youth, FTC & KVK.

TOTAL: 45 PERIODS

OUTCOME:

- After completion of this course, the students will be familiar with various extension methods, communication gadgets. Be trained in capacity building techniques

TEXT BOOKS:

1. Ray, G.L., 1999. Extension Communication and Management, Naya Prokash, 206, Bidhan Sarani, Calcutta.
2. Sandhu, A.S. 1996. Extension Programme Planning, Oxford & IBH Publishing Co. pvt. Ltd, New Delhi

REFERENCES:

1. Rogers, E.M. 1995. Diffusion of Innovations, The Free Press, Newyork
2. Sandhu, A.S. 1996. Agricultural Communication: Process and Methods, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.

MA8491**NUMERICAL METHODS****L T P C
4 0 0 4****OBJECTIVES :**

- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals in real life situations.
- To acquaint the student with understanding of numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT II INTERPOLATION AND APPROXIMATION 12

Interpolation with unequal intervals - Lagrange's interpolation – Newton's divided difference interpolation – Cubic Splines - Difference operators and relations - Interpolation with equal intervals - Newton's forward and backward difference formulae.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's Method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 12

Single step methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge - Kutta method for solving first order equations - Multi step methods - Milne's and Adams - Bashforth predictor corrector methods for solving first order equations.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS

Finite difference methods for solving second order two - point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank-Nicholson) methods – One dimensional wave equation by explicit method.

TOTAL : 60 PERIODS

OUTCOMES :

Upon successful completion of the course, students should be able to:

- Understand the basic concepts and techniques of solving algebraic and transcendental equations.
 - Appreciate the numerical techniques of interpolation and error approximations in various intervals in real life situations.
 - Apply the numerical techniques of differentiation and integration for engineering problems.
 - Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
 - Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXTBOOKS :

- REFERENCES**

 1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
 2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.

REFERENCES :

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 2007.
 2. Gerald. C. F. and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6th Edition, New Delhi, 2006.
 3. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall, 1992.
 4. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3rd Edition, New Delhi, 2007.
 5. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015.

GE8075

INTELLECTUAL PROPERTY RIGHTS

**L T P C
3 0 0 3**

OBJECTIVE:

- To give an idea about IPR, registration and its enforcement.

UNIT I INTRODUCTION

9

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II REGISTRATION OF IPRs

10

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

UNIT III AGREEMENTS AND LEGISLATIONS

10

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT IV DIGITAL PRODUCTS AND LAW

9

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT V ENFORCEMENT OF IPRs

7

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

TOTAL :45 PERIODS

OUTCOME:

- Ability to manage Intellectual Property portfolio to enhance the value of the firm.

TEXT BOOKS:

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India Pvt Ltd, 2012
2. S. V. Satakar, "Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002

REFERENCES:

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli,"Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

AI8007

AGRICULTURAL WASTE MANAGEMENT

**L T P C
3 0 0 3**

OBJECTIVE:

- To impart knowledge to students on various methods of agricultural waste management for eco-friendly energy and manure production.

UNIT I	INTRODUCTION	7
Availability of different types of agriculture wastes - its overall characteristics – classification of agro wastes based on their characteristics- its recycling and utilization potential- current constraints in collection and handling of agricultural wastes – its environmental impact.		
UNIT II	COMPOSTING	10
Definition- Solid waste suitable for composting – Methods of composting - vermicomposting - Mineralization process in composting - Biochemistry of composting – Factors involved – Infrastructure required – maturity parameters – value addition – application methods		
UNIT III	BIMASS BRIQUETTING	9
Definition – potential agro residues and their characteristics for briquetting – fundamental aspects and technologies involved in briquetting – economic analysis of briquetting – setting up of briquetting plant- appliances for biomass briquettes.		
UNIT IV	BIOCHAR PRODUCTION	9
Definition - characteristics of agro wastes suitable for Biochar production – Methods of Biochar production – fast and slow pyrolysis – characteristics of Biochar – role of Biochar in soil nutrition and carbon sequestration.		
UNIT V	BIOGAS AND BIO ETHANOL PRODUCTION	10
Screening of suitable lingo cellulosic substrate for biogas production -determination of bio-energy potential of agro-waste by estimating total solids - volatile solids - Calorific value- per cent total carbohydrates, moisture, lignin and cellulosic contents – preparation of feed stocks for anaerobic bio- digestion – types of digesters – factors affecting - nutrient value and utilization of biogas slurry. Ethanol production from lingo cellulosic wastes - Processing of Biomass to Ethanol –pre-treatment-fermentation-distillation.		

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course student will be able to understand

- Various eco-friendly methods for agricultural waste management.
- Nutritive value and energy production potential of agro wastes.

TEXT BOOKS:

1. Raymond C Loehr, "Agricultural Waste Management- problems, processes and approaches". First edition, Academic press, 1974.
2. Diaz,I.F.,M. de Bertoldi and W. Bidlingmaier. 2007. Compost science and technology, Elsevier pub., PP.1-380.
3. Uta Krogmann, Ina Körne and Luis F. Diaz.2010. Solid waste technology and management (Vol 1 and2). Blackwel Pub Ltd., Wiley Online library.
4. Yong Sik Ok, Sophie M. Uchimiya, Scott X. Chang, Nanthi Bolan., " Biochar-production characterization and applications". 2015. CRC press

REFERENCES:

1. P.D. Grover & S.K. Mishra, "Biomass Briquetting: Technology and Practices". Published by FAO Regional Wood Energy Development Programme in Asia, Bangkok, Thailand, 1996.
2. Magdalena Muradin and Zenon Foltynowicz, "Potential for Producing Biogas from Agricultural Waste in Rural Plants in Poland". *Sustainability*, 2014, 6, 5065-5074.
3. Biochar production from agricultural wastes via low-temperature microwave carbonization
4. Qian Kang, Lise Appels, Tianwei Tan and Raf Dewil, "Bioethanol from Lignocellulosic Biomass: Current Findings Determine Research Priorities" *The Scientific World Journal*, 2014, Article ID 298153, 13 pages

AI8008

SUSTAINABLE AGRICULTURE AND FOOD SECURITY

L T P C

3 0 0 3

OBJECTIVES:

- To study the importance of sustainable agriculture for the growing population, various resources required and their sustainability.
- Importance of science, food security and ecological balance.

UNIT I LAND RESOURCE AND ITS SUSTAINABILITY

9

Land Resources of India, Population and land, Land utilization, Net Area Sown, changes in cropping pattern, land degradation.

UNIT II WATER RESOURCE AND ITS SUSTAINABILITY

9

Rainfall forecasting - Adequacy of Rainfall for crop growth – Rainfall, Drought and production instability – Irrigation potential – Available, created and utilized – River basins; Watersheds and Utilizable surface water – Utilizable water in future (Ground water & Surface water)

UNIT III SUSTAINABLE AGRICULTURE & ORGANIC FARMING

9

Agro-ecosystems - Impact of climate change on Agriculture, Effect on crop yield, effect on Soil fertility – Food grain production at State Level – Indicators of Sustainable food availability – Indicators of food production sustenance – Natural farming principles – Sustainability in rainfed farming – organic farming – principles and practices.

UNIT IV FOOD PRODUCTION AND FOOD SECURITY

9

Performance of Major Food Crops over the past decades – trends in food production – Decline in total factor productivity growth – Demand and supply projections – Impact of market force – Rural Land Market – Emerging Water market – Vertical farming - Sustainable food security indicators and index – Indicator of sustainability of food Security – Path to sustainable development.

UNIT V POLICES AND PROGRAMMES FOR SUSTAINABLE AGRICULTURE AND FOOD SECURITY

9

Food and Crop Production polices – Agricultural credit Policy – Crop insurance –Policies of Natural Resources Use – Policies for sustainable Livelihoods – Virtual water and trade - Sustainable food Security Action Plan.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students will gain knowledge on the need for sustainable agriculture
- They will be able to comprehend the need for food security on global level and the Nutritional Security.
- The students will be able to demonstrate how ecological balance is required for sustainability of agriculture.

TEXTBOOKS:

1. B.K.Desai and Pujari, B.T. Sustainable Agriculture : A vision for future, New India Publishing Agency, New Delhi, 2007.
2. Saroja Raman, Agricultural Sustainability – Principles, Processes and Prospects, CRC Press, 2013

REFERENCES:

1. Swarna S.Vepa etal., Atlas of the sustainability of food security. MSSRF, Chennai, 2004.
2. Sithamparanathan, J., Rengasamy, A., Arunachalam, N. Ecosystem principles and sustainable agriculture, Scitech Publications, Chennai, 1999.
3. Gangadhar Banerjee and Srijeet Banerji, Economics of sustainable agriculture and alternate production systems, Ane Books Pvt Ltd., 2017
4. M.S.Swaminathan, Science and sustainable food security, World Scientific Publishing Co., Singapore, 2010.

AI8009

**REFRIGERATION AND AIRCONDITIONING FOR
AGRICULTURAL ENGINEERS**

**L T P C
3 0 0 3**

OBJECTIVES:

- To understand the underlying principles of operation in different refrigeration & Air conditioning systems and components.
- To provide knowledge on basic design aspects of Refrigeration & Air conditioning systems.

UNIT I REFRIGERATION CYCLE**8**

Review of thermodynamic principles of refrigeration. Concept of Air refrigeration system. Vapour compression refrigeration cycle – use of P.H charts – multistage and multiple evaporator systems – cascade system – COP comparison.

UNIT II REFRIGERANTS, SYSTEM COMPONENTS AND BALANCING**9**

Compressors – reciprocating & rotary (elementary treatment) – condensers – evaporators cooling towers. Refrigerants – Properties – selection of refrigerants, Alternative refrigerants, cycle controls.

UNIT III PSYCHROMETRY**10**

Psychrometric processes use of psychrometric charts – grand and room sensible heat factors – bypass factors – air washers, requirements of comfort air conditioning, summer and winter air conditioning.

UNIT IV AIR CONDITIONING SYSTEMS**9**

Cooling load calculation working principles of – centralized Air conditioning systems, split, ductable split, packaged air conditioning, VAV & VRV systems. Duct design by equal friction method, indoor air quality concepts.

UNIT V UNCONVENTIONAL REFRIGERATION CYCLES**9**

Vapor absorption systems – Ejector jet, steam jet refrigeration, thermo electric refrigeration. Applications: ice – plant – food storage plants – milk chilling plants.

TOTAL: 45 PERIODS

OUTCOME:

- The students will have a clear understanding of psychrometry, refrigeration and air conditioning and their applications to agriculture

TEXTBOOKS:

1. Manohar Prasad, "Refrigeration and Air Conditioning", Wiley Eastern Ltd., New Delhi, 1983.
2. Arora, C.P., "Refrigeration and Air Conditioning", Tata McGraw Hill, New Delhi, 1988.

REFERENCES:

1. Dossat, R.J., "Principles of Refrigeration and Air Conditioning", Pearson Education Pvt. Ltd., New Delhi, 1997.
2. Jordon and Priester, "Refrigeration and Air Conditioning", Prentice Hall of India Pvt. Ltd., New Delhi, 1985.
3. Stoecker, N.F., and Jones, "Refrigeration and Air Conditioning", Tata McGraw Hill, New Delhi, 1981.

AI8010

STORAGE AND PACKAGING TECHNOLOGY

**L T P C
3 0 0 3**

OBJECTIVES:

- To understand the underlying principles of spoilage and storage
- To provide knowledge on different storage methods and packaging techniques.

UNIT I SPOILAGE AND STORAGE 9

Direct damages, Indirect damages of perishable and durable commodities – control measures - factors affecting storage – types of storage – Losses in storage and estimation of losses.

UNIT II STORAGE METHODS 9

Improved storage methods for grain-modern storage structures-infestation-temperature and moisture changes in storage structures-CAP storage-CA storage of grains and perishables construction operation and maintenance of CA storage facilities

UNIT III FUNCTIONS OF PACKAGING MATERIALS 9

Introduction – packaging strategies for various environment – functions of package – packaging materials – cushioning materials – bio degradable packaging materials – shrink and stretch packaging materials.

UNIT IV FOOD PACKAGING MATERIALS AND TESTING 9

Introduction – paper and paper boards - flexible - plastics - glass containers – cans – aluminium foils - package material testing-tensile, bursting and tear strength.

UNIT V SPECIAL PACKAGING TECHNIQUES 9

Vacuum and gas packaging - aseptic packaging - retort pouching – edible film packaging – tetra packaging – antimicrobial packaging – shrink and stretch packaging.

TOTAL: 45 PERIODS

OUTCOME:

- The students will have a clear understanding of various methods of storage and different packaging techniques for food

TEXTBOOKS:

1. Sahay, K.M. and K.K.Singh. 1996. Unit operations of agricultural processing. Vikas Publishing House Pvt. Ltd., New Delhi.
2. Food Packaging Technology, Hand book, 2004. NIIR Board, New Delhi.
3. Pandey, P.H.2002. Post harvest engineering of horticultural crops through objectives. Saroj Prakasam. Allahabad.

REFERENCES:

1. Himangshu Barman. 2008, Post Harvest Food grain storage. Agrobios (India), Jodhpur.
2. Chakaraverty, A. 2000. 3rd edition. Post harvest technology of cereals, pulses and oil seeds. Oxford & IBH publishing & Co.Pvt.Ltd. New Delhi.

AI8011**SEED PROCESSING TECHNOLOGY****L T P C****3 0 0 3****OBJECTIVES:**

- To expose the students to scope and importance of good quality seed production.
- To acquaint them with the principles and special techniques used in the process of production of good quality seed using specific examples.
- To familiarize them with planning, development and organization of seed programmes.

UNIT I SEED CHARACTERS 9

Definition and characteristics of seed and how it differs from grain; Propagation of crop plants through true seed and vegetative means; Features of good quality seed; Importance of seed in successful crop production; Floral biology: self and cross pollination; Methods of genetic improvement of crop plants such as selection, hybridization, mutation and polyploidy; Seed legislations promulgated in India from 1966 to date and the purpose of each of these legislations.

UNIT II	SEED PRODUCTION AND CERTIFICATION	9
Multiplication of seed and seed material: systems of seed multiplication, classes of seed, multiplication models, multiplication ratio, field selection, planting ratio, isolation needs and rouging; Harvest and extraction of seed; Methods of hybrid seed production; Genetic deterioration during crop production cycles; Seed certification process: legal basis, pre-requisites for applicability, detailed description of the specific steps of the certification process (with particular emphasis on field inspection).		
UNIT III	SEED PROCESSING AND TESTING	9
Components of seed processing in a broader sense; Steps in seed processing in its narrower sense: preliminary cleaning, basic cleaning and grading, and equipment used in each of the steps; Seed treatment; Seed drying; Seed sampling; Seed testing: details of specific tests conducted for different purposes (service, certification and seed law enforcement); Standards prescribed for different crops.		
UNIT IV	DEVELOPING SEED PROGRAMMES	9
Types of organizations involved in seed production (public, quasi-governmental, private and cooperative), and their objectives and features; Organizational set up of a seed company; Steps involved in planning and developing a seed programme; Seed marketing activities, and analysis of seed demand and supply; Costing and pricing strategies; Economics of production of different crop seed; Seed packaging; Opportunities for Indian seed companies to have a greater share of world seed market; Visit to seed organizations; Preparing seed projects to obtain credit; Export procedures and formalities; Seed/plant quarantine methods.		
UNIT V	SEED PRODUCTION IN SPECIFIC CROPS	9
Principles and special techniques used for seed production in important horticultural crops by selecting representatives of vegetable / flower / fruit / spice / condiment / plantation crops.		
		TOTAL: 45 PERIODS

OUTCOMES:

- The students will be able to appreciate the different methods of seed production, processing and testing
 - They will also have the knowledge on different seed programmes

TEXTBOOKS:

1. Singh, S.P., Commercial Vegetable Seed Production, Kalyani Publishers, Chennai, 2001.
 2. Agarwal, R.L., Seed Technology, Oxford IBH Publishing Co., New Delhi, 1995.

REFERENCES:

- REFERENCES:**

 1. Subir Sen and Ghosh, N., Seed Science, Kalyani Publishers, Chennai, 1999.
 2. Dahiya, B.S., and Rai, K.N., Seed Technology, Kalyani Publishers, Chennai, 1997.
 3. George, Raymond, A.T., Vegetable Seed Production, Longman Orient Press, London and New York, 1985.
 4. Hand Book of Seedling Evaluation, ISTA, 1979.

AI8012 HEAT AND MASS TRANSFER FOR AGRICULTURAL ENGINEERS L T P C
3 0 0 3

OBJECTIVES:

- The course is intended to build up necessary background for the understanding of the physical behavior of the various modes of heat transfer, like, conduction, convection and radiation.
 - To understand the application of various experimental heat transfer correlations in engineering calculations.
 - To learn the thermal analysis and sizing of heat exchangers and to understand the basic concepts of mass transfer.

UNIT I CONDUCTION 9

Basic concepts – Mechanism of heat transfer – Conduction, convection and radiation – General differential equation of heat conduction – Fourier law of conduction – Cartesian and cylindrical coordinates – one dimensional steady state heat conduction – Conduction through plane walls, cylinders and spherical systems – Composite systems – Conduction with internal heat generation – Extended surfaces – Unsteady heat conduction – Lumped analysis – Use of Heislers chart.

UNIT II CONVECTION 9

Basic concepts – Convective heat transfer coefficients – Boundary Layer concept – Types of convection – Forced convection – Dimensional analysis – External flow – Flow over plates, Cylinders and spheres – Internal flow – Laminar and turbulent flow – Combined Laminar and turbulent flow – Flow over bank of tubes – Free convection - Dimensional analysis – Flow over vertical plates, horizontal plate, inclined plate, cylinders and spheres.

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 9

Nusselts theory of condensation – Pool boiling, flow boiling, correlations in boiling and condensation, types of heat exchangers – LMTD method of heat exchanger analysis – Overall heat transfer coefficient – Fouling Factors.

UNIT IV RADIATION 9

Basic concepts, law of radiation – Stefan Boltzmann law, Kirchoff law – Black body radiation – Grey body radiation shape factor algebra – Electrical analogy – Radiation shields – introduction to gas radiation.

UNIT V MASS TRANSFER 9

Basic concepts – Diffusion mass transfer – Fick's Law of diffusion – Steady state molecular diffusion – Convective mass transfer – Momentum, heat and mass transfer analogy – Convective mass transfer correlations.

TOTAL :45 PERIODS

TEXT BOOKS:

1. Sachdeva, R.C., "Fundamentals of Engineering Heat and Mass Transfer", New Age International, New Delhi, 1995.
2. Yadav, R., "Heat and Mass Transfer", Central Publishing House, New Delhi, 1995.

REFERENCES:

1. Ozisik, M.H., "Heat Transfer", McGraw Hill Book Co., New York, 1994.
2. Nag, P.K., "Heat Transfer", Tata McGraw Hill Book Co., New Delhi, 2002.
3. Holman, J.P., Heat and Mass transfer, Tata McGraw Hill Book Co., New York, 2002.
4. Kothandaraman, C.P., "Fundamentals of Engineering Heat and Mass Transfer", New Age International, New Delhi, 1998.
5. Incropera, F. P., and Dewitt, D. P., "Fundamentals of Engineering Heat and Mass Transfer", John Wiley and Sons, New York, 1998.
6. Velraj, R., "Heat & Mass Transfer", Ane Books, New Delhi, 2004.

AI8013 PROCESS ENGINEERING OF FRUITS AND VEGETABLES

L T P C
3 0 0 3

OBJECTIVES:

- To understand the basics of Post Harvest Technology of fruits and vegetables through their structure and composition
- To study the different methods of processing and preservation of fruits and vegetables including drying and dehydration
- To learn the latest methods of storage of fruits and vegetables

UNIT I	STRUCTURE, COMPOSITION, RIPENING AND SPOILAGE	9
Importance of post harvest technology of horticultural crops – post harvest losses – factors causing losses - structure, cellular components, composition and nutritive value of horticultural crops – fruit ripening – mechanism and equipment - spoilage of perishable commodities – mechanism and factors causing spoilage.		
UNIT II	CLEANING, GRADING AND ON-FARM PROCESSING	9
Harvesting and washing of fruits and vegetables – cleaning and grading – fruits and vegetables - peeling - equipments – construction and working – pre-cooling – importance, methods, pretreatments and advantages.		
UNIT III	PRESERVATION OF FRUITS AND VEGETABLES	9
Thermal and non-thermal techniques of preservation of fruits and vegetables and their products - methods - minimal processing of horticultural commodities – fruits and vegetables, advantages - quick freezing preservation - commercial canning of fruits, vegetables and other perishable commodities – processing and concentration of juice - membrane separation process and application - hurdle technology of preservation and techniques.		
UNIT IV	DRYING AND DEHYDRATION	9
Dehydration of fruits and vegetables – types of dryers, construction and working - methods – fluidized bed dryer, freeze drying, osmotic dehydration and foam mat drying – principles, construction, operation and applications - quality parameters and advantages.		
UNIT V	STORAGE	9
Storage of fruits and vegetables – storage under ambient conditions, low temperature storage, evaporative cooling – cold storage of horticultural commodities – estimation of cooling load - controlled atmosphere storage – concept and methods –modified atmosphere packaging – gas composition, quality of storage – waxing of fruits – types of wax, equipment and advantages.		
TOTAL: 45 PERIODS		

OUTCOME:

- At the end of this course, the student will be thorough in various methods of processing, preservation and storage of fruits and vegetables using latest technologies.

TEXT BOOKS:

1. Fellows. P. 2000. Food Processing Technology – Principles and Practice, second edition, CRC Press, Woodland Publishing Limited, Cambridge, England.
 2. Sudheer K. P. and V. Indra.2007. Post harvest Technology of Horticultural Crops. New India Publishing Company, New Delhi.
 3. L.R.Verma and V.K.Joshi. 2000. Post Harvest Technology of Fruits and Vegetables – handling, Processing, Fermentation and waste management. Indus Publishing company, New Delhi.

REFERENCES:

1. Heid,J.L. and M.A.Joslyn. 1983. Food processing operations. Vol. II. AVI Publishing Co. Inc. Westport, Connecticut.
 2. Potter, N.N.1976. Food science. AVI Publishing Co. Inc.Westport, Connecticut, 2nd edition.
 3. Sivetz Michael and N.W.Desrosier. 1979. Coffee Technology. AVI Publishing Co. Inc, Westport, Connecticut.
 4. Frank.H.Slade. 1967. Food Processing Plant. Volume 1. Leonard Hill Books. London.
 5. SudhirGupta.Cold storage unit. Atif printers, LalKuan, Delhi.
 6. NIIR board. Modern techniques on food preservation. Asia pacific business press inc. Delhi
 7. Humberto vega and Gustavo v Barbosa. 1996. Dehydration of foods. Springer Science, Business Media, Chapman&Hall Publishers, U.K.

GE8077

TOTAL QUALITY MANAGEMENT

**L T P C
3 0 0 3**

OBJECTIVE:

- To facilitate the understanding of Quality Management principles and process.

UNIT I INTRODUCTION

9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

UNIT II TQM PRINCIPLES

9

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I

9

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II

9

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY MANAGEMENT SYSTEM

9

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration—**ENVIRONMENTAL MANAGEMENT SYSTEM:** Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

TOTAL: 45 PERIODS

OUTCOME:

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXTBOOK:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. ISO9001-2015 standards

GE8072	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	L T P C
		3 0 0 3

OBJECTIVES:

- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9

Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends - **Introduction to Product Development Methodologies and Management** - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management.

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - **System Design & Modeling** - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT III DESIGN AND TESTING 9

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – **Challenges in Integration of Engineering Disciplines** - Concept Screening & Evaluation - **Detailed Design** - Component Design and Verification – **Mechanical, Electronics and Software Subsystems** - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – **Prototyping** - Introduction to Rapid Prototyping and Rapid Manufacturing - **System Integration, Testing, Certification and Documentation**

UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - **Sustenance** -Maintenance and Repair – Enhancements - **Product EoL** - Obsolescence Management – Configuration Management - EoL Disposal

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –**The IPD Essentials** - Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

- Define, formulate and analyze a problem
- Solve specific problems independently or as part of a team
- Gain knowledge of the Innovation & Product Development process in the Business Context
- Work independently as well as in teams
- Manage a project from start to finish

TEXTBOOKS:

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstrom and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

REFERENCES:

1. Hiriyappa B, "Corporate Strategy – Managing the Business", Author House, 2013.
2. Peter F Drucker, "People and Performance", Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, "Enterprise Resource Planning – Concepts", Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013

AI8014**WATERSHED MANAGEMENT****L T P C****3 0 0 3****OBJECTIVES:**

- To provide the technical know-how of analyzing the degradation of soil and water resources and implementation of the measures for soil and water conservation.
- To provide a comprehensive treatise on the engineering practices of watershed management for realizing the higher benefits of watershed management.

UNIT I INTRODUCTION**9**

Watershed – Definition - concept - Objectives – Land capability classification - priority watersheds - land resource regions in India

UNIT II WATERSHED PLANNING**9**

Planning principles – collection of data – present land use - Preparation of watershed development plan - Estimation of costs and benefits - Financial plan – selection of implementation agency - Monitoring and evaluation system

UNIT III WATERSHED MANAGEMENT**9**

Participatory watershed Management - run off management - Factors affecting runoff - Temporary & Permanent gully control measures - Water conservation practices in irrigated lands - Soil and moisture conservation practices in dry lands

UNIT IV WATER CONSERVATION PRACTICES**9**

In-situ & Ex-situ moisture conservation principle and practices - Afforestation principle - Micro catchment water harvesting - Ground water recharge – percolation ponds -Water harvesting - Farm pond - Supplemental irrigation - Evaporation suppression - Seepage reduction

UNIT V WATERSHED DEVELOPMENT PROGRAMME

9

River Valley Project (RVP) - Hill Area Development Programme (HADP) - National Watershed Development Programme for Rainfed Agriculture (NWDPRA) - Other similar projects operated in India – Govt. of India guidelines on watershed development programme - Watershed based rural development – infrastructure development - Use of Aerial photography and Remote sensing in watershed management - Role of NGOs in watershed development

TOTAL: 45 PERIODS**OUTCOME:**

- After completion of the course, the students will have a thorough knowledge on watershed planning, development and management strategies through different soil and water conservation approaches.

TEXT BOOKS:

1. Suresh, R. 2005. Soil and Water Conservation Engineering, Standard Publishers & Distributors, New Delhi.
2. Ghanashyam Das, "Hydrology and Soil Conservation Engineering", Prentice Hall of India Private Limited, New Delhi, 2000.

REFERENCES:

1. Gurmel Singh et al. 2004. Manual of soil and water conservation practices. Oxford & IBH publishing Co. New Delhi.
2. Suresh, R. 2008. Land and water management principles, Standard Publishers & Distributors, New Delhi.
3. Tripathi R.P. and H.P.Singh 2002, Soil erosion and conservation, Willey Eastern Ltd., New Delhi
4. Murthy, V.V.N. 2005, Land and water management, Kalyani publishing, New Delhi.
5. Tideman, E.M., "Watershed Management", Omega Scientific Publishers, New Delhi, 1996.

AI8015**MICRO IRRIGATION****L T P C**
3 0 0 3**OBJECTIVES:**

- To expose the students to the fundamental knowledge in Pumps for Irrigation use
- To introduce the concept of micro-irrigation and design a Sprinkler & Drip irrigation system

UNIT I WATER LIFTS AND PUMPS

8

Pump classification Variable displacement pumps–Centrifugal pump- Submersible pump- Vertical Turbine pumps mixed flow – Jet and Airlift pumps-Pump selection and installation- Pump troubles and Remedies.

UNIT II PUMP VALVES

7

Types of valves- Pressure relief valve- Gate valve-Isolated valve- Non return valve- Butterfly valve- Solenoid valves- Automated control valve- selection, repair and maintenance.

UNIT III MICRO IRRIGATION CONCEPT AND APPLICATIONS

10

Micro irrigation- Comparison between Traditional and Micro irrigation methods -Merits and demerits of micro-irrigation system, Types and components of micro irrigation system- Scope and potential problem of micro irrigation - Low cost Micro irrigation Technologies- Gravity fed micro irrigation -Care and maintenance of micro-irrigation System- Economics of micro-irrigation system - Automation in micro-irrigation-Surge and cablegation irrigation- Greenhouse irrigation system.

UNIT IV DRIP IRRIGATION DESIGN 10

Drip irrigation - Components- Dripper- types and equations governing flow through drippers- Wetting pattern- Chemigation application- Pump capacity-Installation- Operation and maintenance of Drip irrigation system. - Design of surface and sub-surface drip irrigation.

UNIT V SPRINKLER IRRIGATION DESIGN 10

Sprinkler irrigation- Components and accessories - Hydraulic design - Sprinkler selection and spacing- Capacity of sprinkler system - types - Sprinkler performance- Sprinkler discharge- Water distribution pattern- Droplet size, filtering unit, fertigation - System maintenance

TOTAL: 45 PERIODS

OUTCOME:

- After completion of the course, the students will have a thorough knowledge on micro irrigation, its concepts and design of a sprinkler and drip system

TEXTBOOKS:

1. Suresh, R., "Principles of Micro-Irrigation Engineering", Standard Publishers Distributors, New Delhi, 2010.
2. Michael, A.M., "Irrigation Theory and Practice", Vikas Publishers, New Delhi, 2002.

REFERENCES:

1. Modi, P.N., and Seth, S.M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 1991.
2. Jack Keller and Rond Belisher., "Sprinkler and Trickle Irrigation", Vannistr and Reinhold, New York, 1990.
3. Sivanappan R.K., "Sprinkler Irrigation", Oxford and IBH Publishing Co., New Delhi, 1987.
4. Keller.J and D. Karmeli, "Trickle Irrigation Design", Rainbird Sprinkler Irrigation Manufacturing Corporation, Glendora, California, USA.

AI8016**ON FARM WATER MANAGEMENT****L T P C**
3 0 0 3**OBJECTIVES:**

- To understand the fundamentals of minor irrigation, its types, operation and maintenance and people's participation
- Command Area Development, On farm structures, policy, operation and maintenance

UNIT I DESIGN OF IRRIGATION CHANNELS 9

Design of Erodible and Non-Erodible, Alluvial channels- Kennedy s and Lacey s Theories- Materials for Lining watercourses and field channel - Water control and Diversion structure - Design - Land grading - Land Leveling methods

UNIT II COMMAND AREA 9

Command area - Concept – CADA Programmes in Tamil Nadu - Duty of water - expression - relationship between duty and delta - Warabandhi - water distribution and Rotational Irrigation System – case studies.

UNIT III CONJUNCTIVE USE OF SURFACE AND GROUNDWATER 9

Availability of water - Rainfall, canal supply and groundwater – Irrigation demand - water requirement and utilization - Prediction of over and under utilization of water – Dependable rainfall – Rainfall analysis by Markov chain method – Probability matrix

UNIT IV	WATER BALANCE	9
Groundwater balance model – Weekly water balance - Performance indicators – Adequacy, Dependability, Equity and efficiency – conjunctive use plan by optimization – Agricultural productivity indicators – Water use efficiency		
UNIT V	SPECIAL TOPICS	9
National water policy - Institutional aspects - Socio-economic perspective- Reclamation of salt affected soils- Seepage loss in command area- Irrigation conflicts- Water productivity – Water pricing.		

TOTAL: 45 PERIODS

OUTCOME:

- The students will have a clear understanding of various practices of water management on farm

TEXTBOOK:

1. Michael, A.M. Irrigation Theory and practice, Vikas publishing house, New Delhi, 2006.

REFERENCES:

1. Keller, J. and Bliesner D.Ron, 2001 Sprinkler and Trickle irrigation, An ari book, Published by Van No strand Rein hold New York.
2. Israelson, 2002, Irrigation principles and practices, John Wiley & sons, New York.
3. Modi, P.N., 2002. Irrigation and water resources and water power engineering, Standard Book House, New Delhi.
4. Michael, A.M. and Ojha, T.P. 2002. Principles of Agricultural Engineering Vol II Jain Brothers, New Delhi.
5. Suresh, R. 2008. Land and water management principles, Standard Publishers & Distributors, New Delhi.

AI8017	AUTOMATION IN IRRIGATION	L T P C
		3 0 0 3

OBJECTIVES:

- To expose the students to the concept of Irrigation Automation
- To introduce the concepts of Automatic Systems and IoT applications
- To train the students to explore and use new technologies in Irrigation

UNIT I	INTRODUCTION TO AUTOMATION	9
Automatic Irrigation – Traditional methods of Irrigation – Need for Automation – Comparison between Traditional and Automated Irrigation – Advantages – Disadvantages – Economic Impacts of Automation on Agricultural Firms – Future of Automation.		

UNIT II	SYSTEMS OF AUTOMATION	7
Automated Irrigation – Pneumatic System – Portable timer system – Timer/Sensor Hybrid/SCADA – Methods of automating Irrigation layout – Machine Learning in Tank Monitoring System.		

UNIT III	IoT IN IRRIGATION	10
IoT based Automated Irrigation System – IoT based Smart Irrigation – Sensor based Automation – types – operation – Solar based Automatic Irrigation System – components – operation - Automation by sensing soil moisture – Automation using ANN based controller – operation.		

UNIT IV SURFACE AND MICRO-IRRIGATION AUTOMATION 11
Automation and control in Surface Irrigation Systems – Equipments – benefits – barriers – Automation Design in Bay, Basin and Furrow Irrigation – Automation in Micro Irrigation – Systems of Automation and its components – Design – Cost – Operation and maintenance.

UNIT V ASSESSMENT OF PARAMETERS IN IRRIGATION 8
Crop water estimate using Satellite data – Automation of Lysimeter for PET Measurements and Energy based Remote Sensing model – Remote Monitoring design of Automatic Irrigation system – Cost and Benefits of Automation.

TOTAL: 45 PERIODS

OUTCOMES:

- Student will understand the technologies available for automation
- Students can design conventional methods as automated system to be more efficient

TEXTBOOK:

1. H.R.Haise, E.G.Kruse. et al., 1981. "Automation of Surface Irrigation: 15 years of USDA Research and Development at Fort Collins, Colorado"

REFERENCES:

1. Brian Wahlin and Darell Zimbelman, Canal Automation for Irrigation Systems, American Society of Civil Engineers, 2014
2. Darell D.Zimbelman, Planning, Operation, Rehabilitation and Automation of Irrigation water delivery system, American Society of Agricultural Engineers,1987

GE8076 PROFESSIONAL ETHICS IN ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES 10
Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS 9
Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9
Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES	8
Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.	TOTAL: 45 PERIODS

OUTCOME:

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

TEXT BOOKS:

- Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
- Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES:

- Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
- Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
- John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
- Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
- Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.
- World Community Service Centre, ' Value Education', Vethathiri publications, Erode, 2011.

Web sources:

- www.onlineethics.org
- www.nspe.org
- www.globalethics.org
- www.ethics.org

AI8018	FARM POWER AND MACHINERY MANAGEMENT	L T P C
		3 0 0 3

OBJECTIVES:

- To understand the productivity of farm machines, their maintenance processes and evaluation for right selection and management
- To provide sufficient knowledge of mechanization status in the country and management techniques for future requirements.

UNIT I INTRODUCTION TO FARM POWER AND DESIGN CRITERIA	9
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Modern trends, principles, procedures, fundamentals and economic considerations for design and development of farm power and machinery systems - Reliability criteria in design and its application.

UNIT II MACHINERY MANAGEMENT	9
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Maintenance and scheduling of operations. Replacement of old machines, repair and maintenance of agricultural machinery, inventory control of spare parts, work study, productivity, method study. First order Markov chains and their applications in sales forecasting and in problems of inventory control and modeling of workshop processes and quality control.

UNIT III SYSTEM APPROACH 9

System approach in farm machinery management and application of programming techniques to the problems of farm power and machinery selection.

UNIT IV PLANNING OF MACHINERY 9

Time and motion study. Man-machine task system in farm operations, planning of work system in agriculture. Computer application in selection of power units and to optimize mechanization system.

UNIT V ECONOMIC ANALYSIS 9

Energy conservation - performance and power analysis - cost analysis of machinery - fixed cost and variable costs, effect of inflation on cost; selection of optimum machinery and replacement criteria- Break-even analysis, reliability and cash flow problems; mechanization planning

TOTAL: 45 PERIODS

OUTCOME:

- The students will be able to understand the concepts of bio energy sources and its applications.

TEXTBOOKS:

1. Bainer, R. Kepner, R.A. and Barger, E.L. 1978. Principles of farm machinery. John Wiley and Sons. New York.
2. Liljedahl, B: Tumquist, PK: Smith, DW; and Hoki, M. 1989. Tractor and its Power Units. Van Nostrand Reinhold
3. Culpin, C. 1978. Farm Machinery. Granada Publishing Ltd., London.
4. Kepner, R.A., Bainer, R. and Barger, E.L. 1987. Principles of Farm Machinery. C.S.B. Publishers and distributors, New Delhi.
5. Smith, H.P. and Wilkes, L.H. 1979. Farm Machinery and Equipment. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.

AI8019	MECHANICS OF TILLAGE AND TRACTION	L T P C
		3 0 0 3

OBJECTIVES:

- To impart the fundamental knowledge of mechanics and dynamics in various tillage implements
- To study the tyres, traction and its applications

UNIT I MECHANICS OF TILLAGE 9

Introduction to mechanics of tillage tools, engineering properties of soil, principles and concepts, stress strain relationship,

UNIT II DYNAMICS OF TILLAGE 9

Design of tillage tools principles of soil cutting, design equation, force analysis, application of dimensional analysis in soil dynamics performance of tillage tools.

UNIT III TRACTION 9

Introduction to traction and mechanics, off road traction and mobility, traction model, traction improvement, traction prediction,

UNIT IV TYRES 9

Tyre size, tyre lug geometry and their effects, tyre testing

UNIT V APPLICATIONS 9

Soil compaction and plant growth, variability and geo statistics, application of GIS in soil dynamics.

TOTAL: 45 PERIODS

OUTCOME:

- After completion of the course, the students will be able to understand the concepts of mechanics, dynamics and traction of implements and their applications.

TEXTBOOKS:

1. Klenin, N.L.; Popov, I.F. and V.A. Sakum, (1985). Agricultural machines. Amerind Pub. Co. New York
2. J. B. Liljedahl, P. K. Turnquist, D. W. Smith, & M. Hoki , 1996. Tractors and their power units. Fourth ed. American Society of Agricultural Engineers, ASAE
3. Kepner, R. A., Roy Bainer and E. L. Barger. 1978. Principles of farm machinery. Third edition; AVI Publishing Company Inc: Westport, Connecticut.

REFERENCES:

1. Ralph Alcock.1986. Tractor Implements System. AVI Publ.
2. S. C. Jain, Farm Machinery- An Approach

AI8020

SPECIAL FARM EQUIPMENTL T P C
3 0 0 3**OBJECTIVE:**

- To study the special machineries used for agricultural applications

UNIT I MOWERS AND WEEDING EQUIPMENT

9

Weeding and intercultural equipment. Junior hoe - guntaka - blade harrow - rotary weeders for upland and low land - selection, constructional features and adjustments - Spading machine – coir pith applicators --Mower mechanism – lawn mowers.

UNIT II SPRAYERS AND DUSTERS

9

Sprayers – Sprayer operation – boom sprayer - precaution - coverage - factors affecting drift. Rotating disc sprayers – Controlled Droplet Application (CDA) - Electrostatic sprayers - Areal spraying – Air assist sprayers - orchard sprayers - Dusters - types - mist blower cum duster - other plant protection devices, care and maintenance.

UNIT III THRESHERS AND HARVESTERS

9

Construction and adjustments - registration and alignment. Windrowers, reapers, reaper binders and forage harvesters. Diggers for potato, groundnut and other tubers. Sugarcane harvesters - cotton pickers - corn harvesters - fruit crop harvesters – vegetable harvesters.

UNIT IV THRESHERS AND OTHER MACHINERIES

9

Thresher – construction and working of multi crop thresher. Forest machinery - shrub cutters - tree cutting machines – post hole diggers – Chaff cutter- flail mowers - lawn mowers – tree pruners

UNIT V SPECIALIZED FARM EQUIPMENT

9

Pneumatic planters – air seeders – improved ploughs – reversible ploughs – suction traps – seed and fertilizer broadcasting devices, manure spreaders, sweep weeders – direct paddy seeders, direct paddy cum daincha seeder, coconut tree climbing devices, tractor operated hoist, tractor operated rhizome planter - Transplanters and Balers.

TOTAL: 45 PERIODS**OUTCOME:**

- After completion of the course, the students will have a thorough knowledge on special farm equipment required for various agricultural operations.

TEXTBOOKS:

1. Jagdishwar Sahay. 2010. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi 6.
2. Michael and Ojha. 2005. Principles of Agricultural Engineering. Jain brothers, New Delhi.

REFERENCES:

1. Kepner, R.A., et al. 1997. Principles of farm machinery. CBS Publishers and Distributors, Delhi.
2. Harris Pearson Smith et al. 1996. Farm machinery and equipments. Tata McGraw-Hill pub., New Delhi.
3. Srivastava, A.C. 1990. Elements of Farm Machinery. Oxford and IBH Pub. Co., New Delhi

AI8021

ENERGY AUDITING AND MANAGEMENTL T P C
3 0 0 3**OBJECTIVE:**

- To acquaint and equip the students in energy auditing in industries and house hold sectors for increasing energy efficiency.

UNIT I ENERGY CONSERVATION CONCEPTS**9**

Energy – classification – scenario – energy pricing – energy and environment – energy conservation and its importance – energy strategy for the future – energy conservation act and its features.

UNIT II ENERGY AUDITING AND ECONOMICS**9**

Objectives of energy management – principles – energy audit strategy - types – detailed energy audit –steps. Energy performance - bench marking – fuel substitutions – energy audit instruments – material and energy balance – energy conversion – energy index – cost index – financial management – financing options.

UNIT III THERMAL ENERGY AUDIT**9**

Energy efficiency in thermal utilities – methodology – stoichiometric analysis of combustion in a boiler – performance evaluation – boiler losses - analysis – feed water treatment – energy conservation opportunities in boilers and steam system – furnaces – insulation and refractories – cogeneration – principles of operation - waste heat recovery systems – case study – analysis.

UNIT IV ELECTRICAL ENERGY AUDIT – I**9**

Electrical systems – introduction – electricity billing – load management – power factor – improvements and benefits – transformers – distribution losses – analysis – energy audit in electrical utilities methodology – energy conservation opportunities in motors – efficiency – energy efficient motors – motor losses – analysis – energy efficiency in compressed air system

UNIT V ELECTRICAL ENERGY AUDIT - II**9**

HVAC and refrigeration system – fans and blowers – fan performance – pumps - lighting system - energy auditing and reporting in industries – replacement of renewable energy technology option – case study in agro-industries

TOTAL: 45 PERIODS**OUTCOME:**

- The students will acquire the knowledge on fundamentals of economic operation of an electrical system and understand the basic principles of energy auditing, types and objectives, instruments used.

TEXTBOOKS:

1. Guide books for National Certification Examination for Energy Managers and Energy Auditors, Book 1, 2, 3 & 4. Bureau Energy Efficiency, New Delhi. 2005.

2. Murphy, W.R. and McKay, G. Energy Management. Butterworth & Co., Publishers Ltd., London. 1982.
 3. Craig B. Smith. Energy Management Principles, Applications, benefits & savings. Pergamon Press Inc. 1981.
 4. Murgai, M.P. and Ram Chandra. Progress in Energy Auditing and Conservation - Boiler Operations, Wiley Eastern Ltd. 1990.

REFERENCES:

1. Victor B.Ottaviano,Energy Management. An OTIS Publication. Ottaviano Technical Service Inc. 150. Broad Hollow Road, Melville, New York. 11747.
 2. Richard Porter and Tim Roberts, 1985. Energy saving by Waste recycling. Elsevier applied science publishers.
 3. Energy Management - Bi-monthly journal published by National Productivity Council, New Delhi.

**AI8022 ERGONOMICS AND SAFETY IN AGRICULTURAL ENGINEERING L T P C
3 0 0 3**

OBJECTIVE:

- To study the physical work load, equipment/work place design, safety and occupational health hazards in farm operations.

UNIT I **ERGONOMICS** **9**

Ergonomics- introduction- Role of ergonomics in Agriculture - Human metabolism- energy liberation in human body- Types of human metabolism- energy requirements at work - acceptable work load.

UNIT II PHYSIOLOGICAL FUNCTIONS

Human Skeletal system – muscle, structure and function - Physiological stress - Efficiency of work - Physical functions - Age and individual differences in physical functions- Physiological and operational criteria of physical activity.

UNIT III ENERGY EXPENDITURE

Energy expenditure of activities-keeping energy expenditure within bounds- Energy expenditure of Spraying-Weeding operations - Movements of body members- Strength and endurance of movements - Movement of body members related to Agricultural activities - Speed and accuracy of movements - Time and distance of movements - Reaction time.

UNIT IV ANTHROPOOMETRY 9

Anthropometry – introduction- Types of data- Principles of applied anthropometry - concept of percentile – Normal distribution – Estimating the range – Minimum and Maximum dimensions-Cost benefit analysis - applications of anthropometric data. Anthropometric consideration in tool / equipment design.

UNIT V HUMAN ENGINEERING IN TRACTOR DESIGN 9

The operator – Machine Interface – Operator exposure to environmental factors – Thermal comport for tractor operator – Spatial, Visual and Control requirement of the operator – Occupational health hazards - Noise – Dust- Vibration in Tractor.

OUTCOME:

- The student will gain knowledge to improve the performance of the farm systems by improving the human - machine interaction with safety measures.

TEXT BOOKS:

1. Bridger, R.S. Introduction to ergonomics. McGraw Hill, INC. New York, 1995.

- Sharma, D.N and Mukesh, S. Design of Agricultural Tractor- Principles and Problems, Jain Brothers, New Delhi. 2012.
- Hand Book of Agricultural Engineering, Indian Council of Agricultural Research, New Delhi. 2013. (ISBN : 978-81-7164-134-5)

REFERENCE:

- Wesley E.Woodson. Human Factors design Hand Book. McGraw Hill Book Co., New York. 1981.

GE8073

FUNDAMENTALS OF NANOSCIENCE

**L T P C
3 0 0 3**

OBJECTIVE:

- To learn about basis of nanomaterial science, preparation method, types and application

UNIT I INTRODUCTION

8

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION

9

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS

12

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO₂, MgO, ZrO₂, NiO, nanoalumina, CaO, AgTiO₂, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

UNIT IV CHARACTERIZATION TECHNIQUES

9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

UNIT V APPLICATIONS

7

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.

TOTAL : 45 PERIODS

OUTCOMES:

- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

TEXT BOOKS :

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCES:

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia, "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.