College of Engineering, Pune

(An Autonomous Institute of Govt. of Maharashtra, Permanently Affiliated to S.P. Pune University)

Department of Electronics & Telecommunication

Curriculum Structure & Detailed Syllabus (UG Program)

Second Year B.Tech.

(Revision: A.Y. 2015-16, Effective from: A.Y. 2016-17)

INDEX

UG PROGRAMS
(FOR AWARD of B.TECH.DEGREE)

ACADEMIC RULES and REGULATIONS

1. Short Title and Commencement:

(a) These Regulations shall be called the "College of Engineering, Pune Regulations for the Award of B.Tech. Degree";

(b) They shall come into effect from the date of getting approval from the Board of Governors of the College.

(c) They shall be applicable for students enrolling for B. Tech. Degree programmes at the College during the year 2007-08.

2. Definitions:

(a) "B. Tech." means Bachelor of Technology, an Under Graduate Degree awarded by and from the University;

(b) "Board" means Board of Governors of the college;

(c) "College" means College of Engineering, Pune;

(d) "Council" means All India Council for Technical Education;

(e) "Dean" means Dean of the College, with the specific functions also indicated along with the title;

(f) "Deputy Director" means Deputy Director of the College;

(g) "Director" means Director of the College;

(h) "Government" means Government of the Maharashtra;

(i) "Prescribed" means prescribed by these or any other Regulations of the College;

(j) "Regulations" means College of Engineering, Pune Regulations for the Award of B. Tech. Degree;

(k) "Senate" means Senate of the College;

(l) "University" means Savitribai Phule Pune University

3. Preamble:

The Regulations prescribed herein have been made by the College, an autonomous institution affiliated to the Savitribai Phule Pune University, to facilitate the smooth and orderly conduct of its academic programmes and activities at the B. Tech level. It

is expected that the Regulations will enable the students to take advantage of the various academic opportunities at the College and prepare themselves to face the challenges in their professional careers ahead. It may be noted that:

(a) The provisions made herein shall be applicable to all the B. Tech. Programmes offered at the College, at present;

(b) They shall also be applicable to all the new B. Tech. Programmes which may be started at the College in the future;

(c) Academic and non-academic requirements prescribed by the Senate have to be fulfilled by a student for eligibility to the Award of B.Tech. degree.

4. Academic Calendar:

Table 1: Suggested Breakdown of Academic Year into Semesters

1. No. of Semesters/ Year	Three; Two being Main Semesters (Odd and Even) and One being a Supplementary Semester; (Note: Supplementary Semester is primarily to assist weak and/or failed students through make up courses, wherever possible. However, the College may use this Semester to arrange Add-On Courses for other students and/or for deputing them for practical training elsewhere.)
2. Semester Durations:	Main Semesters: 19 Weeks each; Supplementary Semester: 8 Weeks;
3. Academic Activities (Weeks):	Main Semester (Odd or Even) Registration of Courses- 0.5; Course work- 15.5; Examination Preparation-1.0; Examinations- 1.0; Declaration of Results- 1.0; Total: 19; Supplementary Semester (only for make up Courses): Registration of Courses- 0.1; Course Work- 7.0; Examination Preparation-0.2; Examinations- 0.2; Declaration of Results- 0.5; Total: 8; Inter-Semester Recess: After each Main Semester- 2; After Supplementary Semester- 2; Total: 14 (for good students) and 6 (for weak students) *(Note: In each Semester, there shall be provision for students for Registration of Courses at the beginning, Dropping of Courses in the middle under the advice of Faculty Members and approved by Departmental Undergraduate Programme Committee (DUPC).*

4. Examinations:	Continuous Internal Evaluation (CIE) and Semester End Examination (ESE), both having equal weightage in the students' performance in Course Work/Laboratory Work and other activities; (Note: The CIE shall be conducted throughout the Semester on dates announced in advance by the subject teacher, and its results made known to the students from time to time. This would be of help to the students to decide on Dropping or Withdrawal from Courses in consultation with their Advisors. However, the dates for the Mid-Semester Examination (MSE) which is a part of the CIE and ESE shall be fixed at the College level.
5. Other Items:	• Care shall be taken to ensure that the total number of days for academic work are > 180/year; • Academic schedules prescribed shall be strictly adhered to by all the Departments; • Supplementary Semester shall be mainly for Make up Courses, to benefit weak or failed students to the extent possible; • Students failed in a course shall attend a Course fully when it is offered again, and appear for all components of evaluation; • Specified Min. /Max. Course load per Semester shall be followed at all times.

(a) Each academic year shall be divided into two main semesters, each of 19 weeks, viz., odd semester (Jul. – Dec.) and even semester (Dec. – Apr.), and an 8-week supplementary semester (Apr.-Jun.).

(b) The College shall arrange regular academic activities for the students during the two main semesters and makeup and other courses for the students during the supplementary semester;

(c) The academic activities in a semester shall normally include course registration, course work, continuous internal evaluation, dropping/withdrawal from courses, semester-end examination, and declaration of results.

(d) The College shall announce the schedule for all the academic activities well before the commencement of the academic year and take all the necessary steps to follow them scrupulously.

(e) The college shall also announce adequate intra-semester and inter-semester breaks for the students and ensure that a minimum of 180 academic working days are available during the academic year.

(f) A typical breakdown of the academic year for the B. Tech programme at the College shall be as suggested in Table 1:

5. Admissions:

(a) The intake capacity of each programme, including the number of seats to be reserved for students of different categories shall be decided by the Board by following the Government directives and Council approvals.

(b) Admissions to the first year of all the programmes shall be made before the start of each academic year, through the Maharashtra Combined Entrance Test (MHCET) conducted by the Government.

(c) The College shall also admit to first year of the programmes, a limited number of students of Non-Resident Indian (NRI), Persons of Indian Origin (PIO) and Foreign National categories, as per Government rules.

(d) There shall also be a merit-based, lateral admission of students having Diploma qualification to the second year of all the programmes at the College in accordance with the Government rules applicable for such admissions.

(e) The College reserves the right to revoke the admission made to a candidate, if it is found at any time after admission that he/she does not fulfill all the requirements stipulated in the offer of admission.

(f) The College also reserves the right to cancel the admission of any student and discontinue his/her studies at any stage of studentship for unsatisfactory academic performance and/or undisciplined conduct.

6. In-campus Residence:

(a) Interested students may apply for hostel accommodation at the time of admissions, as the College is partially residential and it can admit a limited number of men and women students in the hostels.

(b) The method of admission to students' hostels, rent payable per each seat allotted and the discipline to be followed by the residents shall be governed by "rules and regulations" framed by the College in this behalf.

(c) Each student selected for hostel admission shall be provided a seat in one of the hostel rooms identified for this purpose and there shall be no family accommodation available in the hostel for married students.

(d) Students residing in the hostels shall adhere to the prescribed hostel discipline and pay the hostel/mess charges regularly, as any failure to do so, may lead to withdrawal of hostel facilities to such students.

(e) Hostel residents shall apply for leave of absence and get the same approved before leaving the hostel even for a few days, as any failure to do so may lead to cancellation of hostel admission to such students.

(f) Students residing in the hostels shall be required to clear all the hostel dues and vacate their rooms at the end of each academic year, as they will be considered for hostel admission afresh for the New Year.

7. Attendance:

(a) Each student shall be required to attend at least 75 per cent of all the classes arranged like, lectures, tutorials, laboratories, studios and workshops for being permitted to attend the semester-end examination.

(b) Extra Academic Activities (EAC) like Yoga, NSS, Physical Training, NCC and, Boat Club shall be compulsory for students of the first year, with at least a minimum attendance of 75 percent in each of them.

(c) Students shall also be required to take part in any other academic and non-academic activities and attend the camps, as and when arranged by the College during the academic year.

(d) Students desirous of leave of absence for less than two weeks during a semester shall apply for it in advance to the Head of the Department giving reasons & supporting documents, if any and get it approved.

(e) Absence due to illness or any other reason for a period less than two weeks in a semester, for which a student could not make prior application, may be condoned by the Head of the Department after proper verification.

(f) The Dean, Academic Affairs shall be the Authority for sanctioning the leave of students outside clauses (4) and (5) above, after receiving their applications along with recommendations of the Heads of Departments.

(g) In the case of long absence of a student in a semester with prior approval or otherwise, the Dean, Academic Affairs shall decide whether the student be asked to withdraw from the programme for that particular semester.

(h) In all the cases of leave of absence as per Clauses (4)-(6) above, the period of leave taken shall not be condoned for the purposes of fulfilling the attendance requirements stipulated in the Clauses (1) and (2).

(i) It shall be the responsibility of a student residing in the hostel to intimate the Warden of his/her hostel and also the concerned course instructors regarding his/her absence before proceeding on leave.

8. Code of Conduct and Discipline:

(a) All students shall be required to conduct themselves in a manner befitting the students of a national institution of high reputation, within and outside the precincts of the College.

(b) Unsocial activities like ragging in any form shall not be permitted within or outside the precincts of the College and the students found indulging in them shall be dealt with severely and dismissed from the College.

(c) The following additional acts of omission and/or commission by the students within or outside the precincts of the College shall constitute gross violation of code of conduct punishable as indiscipline:

i. Lack of courtesy and decorum, as well as indecent behaviour;
ii. Willful damage of property of the College/Hostel or of fellow students;
iii. Possession/consumption/distribution of alcoholic drinks and banned drugs;

iv. Mutilation or unauthorized possession of library material, like. books;

v. Noisy and unseemly behaviour, disturbing peace in the College/Hostel;

vi. Hacking in computer systems, either hardware or software or both;

vii. vii. Any other act considered by the College as of gross indiscipline.

(d) In each case above, the punishment shall be based on the gravity of offence, covering from reprimand, levy of fine, expulsion from Hostel, debar from examination, rustication for a period, to outright expulsion.

(e) The reprimanding Authority for an offence committed by students in the Hostels and in the Department or the classroom shall be respectively, the Rector of the Hostels and the Head of the concerned Department.

(f) In all the cases of offence committed by students in jurisdictions outside the purview of Clause (5), the Dean, Students Affairs shall be the Authority to reprimand them.

(g) All major acts of indiscipline involving punishment other than mere reprimand, shall be considered and decided by the Chairman, Students Disciplinary Committee appointed by the Senate.

(h) All other cases of indiscipline of students, like adoption of unfair means in the examinations shall be reported to the Dean, Academic Affairs, for taking appropriate action and deciding on the punishment to be levied.

(i) In all the cases of punishment levied on the students for any offence committed, the aggrieved party shall have the right to appeal to the Director, who shall constitute appropriate Committees to review the case.

9. Change of Branch:

(a) Change of branch shall be permissible for a limited number of special cases in the third semester as per following regulations.

(b) Only those students who have completed the common credits required in the first two semesters in their first attempt with a minimum CGPA of 8.5 shall only be eligible for making application for a change of branch.

(c) There shall be a maximum number of only two students admitted in any discipline in the third semester through the branch change rule.

(d) Intending students eligible for change of branch shall apply for the same to the Office of Academic Affairs of the College before the closing date notified at the beginning of odd semester of each academic year.

(e) Such students shall be required to indicate up to three branches, in order of preference to which they wish to change over, as the change shall be strictly based on their merit, subject to availability of vacancies.

(f) The change of branch shall be permitted purely on inter-se merit of all the eligible applicants. The CGPA of students at the end of the second semester shall be considered for rank ordering of the applicants seeking change of branch and in the case of a tie, the MHCET ranks shall also be considered.

(g) All the changes of branch permitted for intending students as per the above clauses

shall be effective from their third semester only and no further change of branch shall be permitted after this.

(h) All the changes of branch permitted at this stage shall be final and binding on the applicants and no student shall be permitted, under any circumstances, to refuse the change of branch offered.

(i) The candidates who have sought admission under Tuition Fee Waiver Scheme are not eligible for the branch change.

10. Course Structure:

a) Each course offered in the B. Tech. curriculum at the College shall be listed by using a total of five/six digits, the first two being letters and the remaining being numerals, as follows:

   i. The first two letters to represent the Department offering the Course in abbreviated form, e.g., CE for Civil Engineering;

   ii. The first numeral that follows to represent the year of the programme, such as 1, 2, 3 and 4, leading to 100,- 400 series;

   iii. The next two numerals to represent the Course Number allotted for the subject by the Department, i.e., 01, 02, 03, up to 99;

   iv. Thus, as an example, courses offered at the Department of Civil Engineering could be listed from CE 101 up to CE 499;

b) All the courses in the B. Tech. Curriculum shall be unitized, with one credit being assigned to each unit of course work, after the student completes its teaching-learning process successfully.

c) The assignment of credits to course work shall follow the well accepted practice at leading institutions, with one credit being defined to mean:

   1. Lecture course conducted for one hour per week in a semester;

   2. Tutorial conducted for one hour per week in a semester;

   3. Laboratory/Practical conducted for two/three hours per week in a semester;

   4. Project work conducted for two hours per week in a semester;

d) Each student for the B. Tech, Degree award shall be required to earn a total of 180 credits during his/her studentship at the College. While a student can register for more than 180 credits at the College, only 180 credits shall be reckoned for the Degree award. On the other hand, a student having less than 180 credits shall have to earn the remaining credits to make up the total to 180 credits so as to qualify for the Degree award. The total number of credits earned to complete the course depends on the academic schema for which the student has enrolled for.

e) In addition to the credit requirement prescribed above for the Degree award, each student shall have to complete the requirements of Extra Academic Activities (EAA) as referred to earlier in Clause 2 of Section 7, during the first two semesters of the programme. All the students shall receive certification as PP (for Passed), and NP (for not passed) in EAA, in the Grade Card. While obtaining certification as PP is a mandatory requirement for the Degree award of a student, this shall not be taken

into account for computing the final Grade Point Average.

1. Each student shall register for an average of 22 credits per semester during his/her studentship at the College, with the minimum and maximum credits being fixed as 16 and 28 credits per semester respectively. The exact number of credits to be registered by a student in a semester in a particular Department shall be decided by his/her Faculty Advisor based on the student's academic performance in the preceding semester and approval by the Departmental Undergraduate Programme Committee (DUPC).
2. The medium of instruction for course work and examinations at the College shall be English. The course work for the Programme shall be broadly divided into SEVEN main subject groups, as follows:
    - Humanities, Social Sciences and Management Courses;
    - Engineering Foundation Courses
    - Basic Sciences including Mathematics;
    - Mandatory Learning & Liberal Learning Courses;
    - Professional Core and Elective Subjects;
    - Skill based Laboratory Courses
    - Mini and Major Project
3. The total course package for the Programme at a Department shall have the following components:
    - Institutional Core subjects
    - Departmental Core subjects
    - Departmental Elective subjects
    - Other Elective subjects

f) The DUPC shall be responsible for planning the curriculum and syllabi for all the courses included for the Programme for approval by the Senate However, the Institutional Undergraduate Programme Committee (IUPC) shall be in charge for College wide implementation of course work, time tables and related requirements for the Programme.

g) Each Department shall have the flexibility to include industrial training and/or field work of 8 weeks for all its students as a compulsory requirement for the Degree award and this can be assigned credits, as approved by the Senate. However, these shall be arranged during the supplementary semester period following the sixth semester of studies at the College.

h) Each Department shall assign Faculty Advisors for all its students in consultation with the Dean, Academic Affairs and Dean, Students Affairs. It shall be the responsibility of the Faculty Advisors to help the students in planning their course work and other academic activities at the Department and also to regularly monitor and advise them on their academic and other performance at the College. For students of the first two semesters in any Department, the Dean, Students Affairs may assign Faculty Advisors from among the faculty of Basic Science including Mathematics and HSS Departments.

11. Course Registration for the Semester:

(a) Each student shall be required to register for course work by following the advice of the Faculty Advisor at the commencement of each semester on the day fixed for such registration and notified in the Academic Calendar.

(b) Students who fail to register for course work on the notified day may be permitted by the Department for late registration on another day announced in the Academic Calendar after payment of an additional fee fixed by the College.

(c) Only those students shall be permitted to register for course work who have:

i. Cleared all dues of the College, Hostel and Library including fines (if any) of the previous semester,

ii. Made all the required advance payments towards the College and Hostel dues for the current semester before the closing date, and

iii. Not been debarred from registration of courses on any other specific ground.

(d) Each student shall fulfill the following conditions at the time of registration of course work in any semester:

i. Each student of the first year shall register for all the courses in the first two semesters, with flexibility to drop one/two courses up to the minimum permissible limit of 18 credits in each case. Similarly Direct Diploma students will also register for all courses in third and fourth semester.

ii. A student shall be permitted to register for more than the average course load, i.e., up to a maximum of 28 credits, if he/she has shown outstanding performance in course work in the previous semesters, i.e., CGPA>=8.0.

iii. On the other hand, a student whose performance is not so good in the preceding semesters, i. e., =<5.0, shall be permitted to register 18 credits, the students who have secured CGPA in between 5 and 6 are allowed for normal credits (i.e. The credits offered by the department in that semester) and the students who have secured more than 6 CGPA are allowed to register for one additional course. The students are mandatorily required to register for backlog subjects first. The faculty advisor is required to check for the pre-requisites if any at the time of registration.

(e) All the students shall note the following special features of the credit system, which shall be strictly followed at the College:

i. There shall be no re-examination facility as in the conventional academic system and ESE shall be conducted for the course once in a semester, except to meet the needs of students specially permitted by the College.

ii. A student shall have to re-register in all the failed courses (i.e., Getting Grade FF) at any further semester when they are offered again, freedom being given to the student to change the course only if it is an elective.

iii. Also, a student getting certification as NP in the Extra Academic Activities

(EAC), shall re- register for them in a following semester/s until he/she obtains certification as PP.

(f) A student shall have the possibility to drop a course in the middle of a semester as per the Academic Calendar, without mention in the Grade Card, with the concurrence of the Faculty Advisor, and after intimating the concerned course instructor/s and the academic section. However, it shall not be possible for a student to register for an alternative course in that semester.

12. Supplementary Semester:

(a) Departments shall have the flexibility to conduct supplementary semesters during summer months for FY B.Tech backlog subjects, as per the Academic Calendar. Such a semester shall be offered on the recommendation of DUPC and with the approval of the Dean, Academic Affairs. A student shall be allowed to register for a maximum of three subjects in a supplementary semester.

(b) The supplementary semester shall be utilized primarily to facilitate the failed students to attend **the FY courses in which they have failed and not for launching any new courses for credit.** However, a Department shall be free to arrange any Add-On courses for its students during this semester.

(c) The academic activity in the supplementary semester shall be at double the rate as compared to a normal semester; e.g., 1 credit of course work shall require two hours/week in the class room, so that the contact hours are maintained the same as in a normal semester. It shall also be necessary to fulfill the requirements of CIE and ESE for all the courses like in a normal semester.

(d) Courses planned for the supplementary semester shall be announced by the Dean, Academic Affairs in each year, well before the conclusion of the even semester. Students intending to avail of this facility shall have to register for the courses offered by paying the prescribed fees within the stipulated time.

(e) It shall be the responsibility of the Department to plan in advance the faculty and non-teaching staff requirements to conduct the supplementary semester and take necessary steps including the institutional approvals for organizing the same.

(f) The student who are either dropped or detained in the course/s during regular semester is not allowed to register for that course/s in summer.

(g) Re-exam (ONLY for 60 marks equivalent to end semester exam) shall be conducted for all other classes three weeks after grade approval by DUPC/DPPC. The re exam shall be conducted after every semester, for the subjects offered in that semester. For final grading, T1, T2 scores of respective semester shall be used. Grade ranges shall be same as that of regular semester for that subject

13. Programme Duration:

(a) The Programme duration for a student to complete the academic and other requirements at the College and qualify for the award of Degree by the University shall be normally 8 semesters.

(b) However, it shall be possible for an outstanding student to qualify for the Degree award in less than eight semesters, by registering for more number of credits i.e., up to the maximum permissible limit of 28 credits per semester from the third semester onwards to complete the Programme requirements of 180 credits. In such a case, the College shall issue a Provisional Certificate to the student who shall await the completion of eight semesters for the Degree award by the University.

(c) This flexibility shall also enable academically weaker students to conduct their studies at a slower pace and complete their Degree requirements in more than eight semesters. The maximum duration for the course completion will be 12 semesters.

(d) Clause (3) above shall be applicable to two types of students at the College:

i. Those wishing to complete the Degree requirements comfortably without encountering failure in any course;

(e) In both the above cases, a student shall have to complete the Programme requirements for the Degree of 180 credits within 12 semesters. Failure to complete the Programme requirements by any student in this period shall lead to the cancellation of his/her admission to the College forthwith. The Senate on case to case basis on the recommendations of the Director and Dean-Academics can extend the term.

(f) A student will not be awarded degree if his/her CGPA at the end of the course is less than 5. For such students the performance improvement scheme is recommended wherein he/she is eligible to take any three subjects for the improvement.

14. Temporary Withdrawal:

(a) Student shall be permitted to withdraw temporarily from the College on the grounds like prolonged illness, grave calamity in the family or any other serious happening. The withdrawal shall be for periods which are integral multiples of a semester, provided that

i. He/She applies to the College within at least 6 weeks of the commencement of the semester or from the date he/she last attended the classes, whichever is later, stating fully the reasons for such withdrawal together with supporting documents and endorsement of his/her guardian.

ii. The College is satisfied that, even by taking into account the expected period of withdrawal, the student has the possibility to complete the Programme requirements of 180 credits within the time limits specified earlier.

iii. The student shall have settled all the dues or demands at the College including those of Hostel, Department, Library and other units.

(b) A student availing of temporary withdrawal from the College under the above provision shall be required to pay such fees and/or charges as may be fixed by the College until such time as the students name appears on the Roll List. However, it shall be noted that the fees/charges once paid shall not be refunded.

(c) Normally, a student shall be entitled to avail of the temporary withdrawal facility only once during his/her studentship of the Programme at the College.

15. Termination from the Programme:

A student shall be required to leave the College on the following grounds

i. Absence from classes for more than six weeks at a time in a semester without leave of absence being approved by the competent authorities, shall result in the student's name being struck off the College rolls.

ii. Failure to meet the standards of discipline as prescribed by the College from time to time shall also result in the student being recommended by the Students Disciplinary Committee to leave the College.

16. Performance Assessment:

(a) There shall be achievement testing of all the students attending a course, like lecture course, laboratory/design/drawing course or a combination of the two. This shall be in two parts, as follows, both of them being important in assessing the students performance and achievement in the particular course:

1. Sessional, involving Continuous Internal Evaluation (CIE), to be normally conducted by the subject teacher all through the semester; This shall include mid-term tests, weekly/fortnightly class tests, home work assignments, problem solving, group discussions, quiz, seminar, mini-project and other means. The subject teacher shall announce the detailed methodology for conducting the various segments of CIE together with their weightages at the beginning of the semester.
2. Terminal, often designated as End Semester- Examination (ESE), to be conducted by the subject teacher, preferably jointly with an external examiner; This shall include a written examination for theory courses and practical/design/drawing examination with built-in oral part for laboratory/ design/drawing courses.
3. Both CIE and ESE shall have equal (50:50) weightage. A student's performance in a subject shall be judged by taking into account the results of CIE and ESE together.
4. The evaluation of the project work shall be based on Sessional Work assigned by the project supervisor, seminar presentation, project report and assessment by Project Evaluation Committee, as covered in Clause(7) later in this Section.
5. In the case of other requirements, such as, seminar, comprehensive viva voce and EAA the assessment shall be made as determined by the Grade Awarding Authority of the College.
6. While the conduct of CIE for a course shall be the responsibility of the subject teacher and the Department concerned, MSE and ESE shall be conducted centrally by the Examination Section of the College. The records of both CIE and ESE shall be maintained by the Examination Section.
7. The performance of students at every stage of the CIE shall be announced by the concerned subject teacher within a fortnight of the date of the particular assessment. The subject teacher shall also show the assessed answer books to the students before submission of the final marks to the Controller of Examinations.

8. The concerned subject teacher shall also be responsible to award letter grades to the students after the ESE is completed and to submit the final results of the course within one week of the last date of ESE to the Controller of Examinations through the Head of his/her Department.

(b) Question Papers: For being able to conduct achievement testing of the students in an effective manner, good question papers shall be used as the principal tool, making it necessary for the question papers at CIE and ESE to:

i. Cover all sections of the course syllabus uniformly;
ii. Be unambiguous and free from any defects/errors;
iii. Emphasize knowledge testing, problem solving & quantitative methods;
iv. Contain adequate data/ other information on the problems assigned;
v. Have clear and complete instructions to the candidates.

(c) Therefore, the question papers, particularly at ESE, shall be set covering the entire syllabus and the students given opportunity to answer questions from the full syllabus of the course by restricting their choice out of each unit in the syllabus. For this to be realized,

(d) Besides, the course syllabi shall be well drafted, be defect-free and properly unitized (or modularized) to enable the distribution of questions in the question papers to cover the whole syllabus. These aspects shall have to be taken into account, in particular, by the concerned DUPCs.

(e) There shall be two types of questions to be set by the subject teacher for the question papers at both CIE and ESE, viz.,

i. Multiple Choice Questions, having each question to be answered by tick marking the correct answer from the choices (commonly four) given against it. Such a question paper shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students. Usually, no more than 15- 20% of the questions in a paper for CIE or ESE shall be of this type.
ii. Comprehensive Questions, having all questions of the regular type to be answered in detail. Such a question paper shall be useful in the testing of overall achievement and maturity of the students in a subject, through long questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation.

(f) Examinations: The College shall maintain a high standard in both CIE and ESE and ensure the declaration of final results including SGPA and CGPA of the courses attended by a student in a semester before the end of the semester as per the Academic Calendar. For meeting these requirements, the College shall take the following steps:

i. CIE shall be conducted exclusively by the subject teacher, who shall spell out the components of CIE in advance, maintain transparency in its operation, declare the evaluation results in time and return the answer scripts and assignment sheets to the students on a regular basis after the evaluation is completed. The teacher shall also solve the questions asked in the tests at the tutorial sessions for the benefit of weak students.
ii. ESE shall be preferably conducted jointly by the subject teacher and an

external examiner appointed for this purpose by the College. In this case, considering the tight time schedule for the various tasks connected with ESE, the external examiner shall be associated with the teacher only in the setting of the question paper.

iii. The answer scripts of ESE shall be evaluated by the subject teacher only; but, an external review of the entire ESE shall be conducted under the aegis of the Board of Examiners of the College before declaring the results. This step shall be useful to the College to gain the confidence of the University on the fairness and transparency in the system.

iv. Suggested passing standard for each of the courses shall be 50marks from the CIE and ESE taken together.

v. Attendance at all examinations, both CIE and ESE of each course shall be compulsory for the students. Students having the following deficiencies shall not be permitted to attend the ESE:

A. Disciplinary action by the College pending against him/her;
B. Irregular in attendance at lecture/laboratory and other classes;
C. Failure to meet the standards of attendance prescribed;
D. CIE Performance far below the passing standard

(g) In the event of a final year student failing in a Laboratory course or scoring very low marks in the CIE of a subject or falling seriously ill during ESE, the subject teacher concerned shall have the discretion to grant the student extra time, not exceeding 12 weeks for satisfactorily completing the concerned course after awarding an I grade. If no such extra time is sought/granted, the concerned student shall have to re-register for the same in a succeeding semester and take steps to fulfill the requirements for the Degree award. The I grade shall be required to be converted into a regular grade within stipulated period indicated in the academic calendar.

(h) Re-Examination: There shall be no re-examination for any course at the College to take care of the failed students. Hence, the failed students shall re-register for the course (the same course, if it is hard core, or an alternative course, if it is a soft core or an elective) when it is offered again (either in a main or supplementary semester) and fulfill the passing standards laid down to earn the specified credits. However, there shall be make- up examination for a course to take care of students with the I or X grades in ESE.

(i) Make Up Examination: This facility shall be available to students who may have missed to attend the ESE of one or more courses in a semester for valid reasons and given the I grade; also, students having the X grade shall also be eligible to take advantage of this facility. The make up examination shall be held as per dates notified in the Academic Calendar. However, it shall be possible to hold a make up examination at any other time in the semester with the permission of the Dean, Academic Affairs. The standard of conducting this examination shall be the same as the normal ESE.

(j) Evaluation of Project work The project work shall be normally conducted in two stages, spread over one or two sequential semesters.

i. At the end of first stage, the student shall be required to submit for evaluation, a preliminary report of the work done before a prescribed date to the Project Coordinator, DUPC and present the same before an Internal Project Evaluation Committee. This shall be followed by taking up the second stage of work either in the same or the following semester.

ii. The Controller of Examinations shall receive a panel of names from the Chairman, DUPC for identifying the project examiners for the student, at least two weeks before the submission of the second stage of project work. This shall comprise of three unbound, typed copies of the project report (one for each examiner), prepared according to the prescribed format to be submitted to the Department at least one week before the date of oral examination.

iii. The Department shall record the date of submission of the project report and arrange to send copies of the same to the examiners a few days before the date fixed for the oral examination. The project coordinator shall notify the date of the oral examination to the examiners and also the student, with a copy marked to the Controller of Examinations. Then the project report shall be evaluated by the Project Evaluation Committee and the result submitted to the Project Coordinator, who in turn shall forward it to the Controller of Examinations.

iv. On successful completion of the oral examination, the student shall be required to submit two bound copies of the final, corrected project report, one being for the Department and the other for the project supervisor(s).

v. A student desirous of extension of time, up to a maximum of 3 months from the prescribed date for submission of the project report, shall seek permission for the same from the Project supervisor(s) and Head of the Department. The DUPC shall consider such requests, case by case, before giving the permission.

vi. If the DUPC is convinced that the progress of a student in project work is insufficient, the concerned students shall be temporarily awarded the I grade. Further, if the project report of the student is not submitted within the extended time period, the I grade shall be automatically converted to the FF grade.

vii. Such of the students who fail in the first stage assessment of project work shall be required to re-register for the first stage in the following semester. Likewise, those who obtain the FF grade in the second stage assessment shall be required to re-register for the same in the subsequent semester(s).

(k) The evaluation of performance in EAAc shall be done by the concerned faculty members, who shall communicate the student's performance to the Examination Section, soon thereafter.

17. Grading System:

(a) The College shall follow the award of letter grades and the corresponding grade points to the students based on their performance at the end of every semester, as given in Table 2, In addition to the grades given in the Table 2, the instructors shall use two transitional grades I and X as described in Clause (3) in this Section.

Table 2: Letter Grades and Grade Points

Grade	Grade Points
AA	10
AB	9
BB	8
BC	7
CC	6
CD	5
DD	4
FF	0
PP (Only for Compulsory Non Credit Subjects)	0
AU (Audit Subject)	0
NP (Only for Non Credit Subjects)	Not Passed

(b) A student is considered to have completed a course successfully and earned the credits if he/she secures a letter grade other than I, 'X' or FF in that course. Letter grade FF in any course implies failure in that course.

(c) The Transitional Grades I and 'X' shall be awarded by the teachers in the following cases:

i. Grade I to a student only on satisfactory attendance at classes and performance in other components of assessment, but absence from ESE in a semester for valid and convincing reasons acceptable to the Department, such as,

A. Illness or accident, which disabled him/her from appearing at the examination;

B. A calamity in the family at the time of the examination, which required the student to be away from the College;

ii. Grades X to a student on his/her overall performance in the course during the semester, highly satisfactory, i.e., high CIE rating, but a very low ESE performance resulting in an overall F Grade in the course.

iii. All the I and X grades awarded to the students shall be converted by the teachers to appropriate letter grades and communicated to the Academic Section (through Head of the Department) within two days of the respective make-up ESEs. Any outstanding I and X grades two days after the last scheduled make-up ESEs shall be automatically converted to FF grade.

(d) A *Semester Grade Point Average* (SGPA) shall be computed for all the students in a Department for each semester, as follows:

$SGPA = (C_1 * G_1 + C_2 * G_2 + C_3 * G_3 + \ldots + C_n * G_n) / (C_1 + C_2 + C_3 + \ldots + C_n)$

where, n is the number of courses registered during the semester, C_i is the number of credits allotted to a particular course, and G_i is the grade points corresponding to the grade awarded for the course.

(e) A *Cumulative Grade Point Average* (CGPA) shall be computed for all the students in a Department at the end of each semester by taking into consideration their performance in the present and the past semesters as follows:

$CGPA = (C_1 * G_1 + C_2 * G_2 + C_3 * G_3 + \ldots + C_m * G_m) / (C_1 + C_2 + C_3 + \ldots + C_m)$

where, m is the number of courses registered upto that semester, C_i is the number of credits allotted to a particular course, and G_i is the grade points corresponding to the grade awarded for the course.

(f) Whenever, a student repeats or substitutes a course in any semester, the lower of the two grades obtained by him/her in the course shall be ignored in the computation of CGPA from that semester onwards and the students shall be given the benefit of a higher grade.

(g) Both the SGPA and CGPA shall be rounded off to the second place of decimal and recorded as such for ease of presentation. Whenever the CGPAs are to be used for the purpose of determining the merit ranking in a group of students, only the rounded off values shall be made use of.

(h) When a student gets the grade I or X for any course during a semester, the SGPA for that semester and the CGPA at the end of that semester shall be tentatively calculated ignoring the I and X graded course(s). The SGPA and CGPA for that semester shall be finally recalculated after conversion of I and X grade(s) to appropriate grade(s), taking into account the converted grade(s).

(i) Other academic requirements for the Programme include the following two certifications as indicated earlier in clause (5) of Section 10, viz., PP (Passed) and NP (Not Passed) for EAA. However, there shall be no grade points are associated with these certifications and they do not figure in the calculation of SGPA or CGPA. But, obtaining a PP shall be a mandatory requirement to qualify for, the Degree award.

(j) It shall be open to each student to take additional courses for audit from the fifth semester onwards, with the concurrence of the Faculty Advisor. Students having CGPA ¿= 8.0 shall be normally encouraged to take such courses. While the performance of the student in audited courses shall be included in the Grade Card, they do not contribute to SGPA or CGPA of the concerned student.

18. Method of Awarding Letter Grades:

(a) The subject teacher(s) shall award the letter grade(s) to students based on the marks secured by them in both CIE and ESE together in the course(s) registered. This shall be done by following a relative grading system based on the use of statistics, for which the IUPC shall make available an appropriate software package.

(b) The subject teacher(s) shall submit two copies of the result sheet for each course, giving both the marks and the grades awarded to the Head of the Department, before the due date specified in the Academic Calendar. This shall be forwarded to the Controller of Examinations soon thereafter by the Head of the Department, after preliminary scrutiny and moderation (if necessary) at the DUPC level.

(c) All the evaluated answer scripts of CIE in a subject shall be returned to the students from time to time during the semester. However, the answer scripts of ESE shall only be shown to the students during the specified period after the evaluation and the detailed marks sheets together with ESE answer scripts and any other relevant papers connected with ESE shall be submitted by the subject teacher(s) to the Controller of Examinations who shall hold it for a period of at least one semester. Steps shall be taken to destroy the same only after obtaining permission from the Dean of Academic Affairs at the end of the prescribed period.

(d) Appeal: A student shall have the possibility to appeal to the Director against a subject teacher for awarding lower grade in a course than that expected by him/her, on payment of prescribed fees, before the commencement of the next semester. In such a case, the DUPC shall arrange a meeting of the aggrieved student together with a Committee comprising of the subject teacher, another subject expert from the College and the Head of the Department, who shall reconsider the evaluation done, show the answer script to the student. If the student is satisfied, the matter shall be closed at this stage. On the other hand, if a revision of marks allotted is called for, the same shall be carried out and all the records, including the Grade Card, corrected soon thereafter. In the latter case, the prescribed fee paid by the student shall be returned.

(e) Withholding of Grades: The Grades of a student in a semester shall be withheld and not declared if the student fails to pay the dues to the College or has disciplinary action pending against him/her.

19. **Eligibility for the Award of Degree**:

(a) A student shall be eligible for the award of B. Tech. Degree from the College and the University provided, he/she has:

(b) The Senate shall be the Recommending Authority for the award of B. Tech. Degree to students fulfilling the requirements specified under Clause (1) above and the Board shall be the Approving Authority.

(c) The Degree award shall then be granted by the University.

i. Completed all the prescribed credit requirements for the award of Degree with grade DD or higher, in each of the courses, like Theory, Laboratory, Studio, Workshop, Seminar and Project Work;
ii. Satisfactorily completed all the non-credit requirements with PP certification, covering EAA and Industrial Training, Field work, (if any);
iii. Obtained a CGPA of >= 5.00 at the end of the semester in which he/she completes all the requirements for the award of Degree;

iv. Paid all the dues to the College including the Department, Hostels, Library and other units; and,
v. No case or disciplinary action pending against him/her.

20. Eligibility for the CGPA improvement after completion of pre-requisite credits for the award of Degree:

Students who secure CGPA between 5 and 6.75 after completing the pre-requisite credits for the award of degree, and wish to improve their CGPA are permitted for CGPA improvement. Such students be permitted to withdraw their grade in a given course with poor grade and permitted to reappear for the examinations for improving the grade and in turn CGPA.

a) Student can appear for grade improvement examination within one year from the date of passing his/her PG or UG Examination. He should not have taken (i) Leaving Certificate from the Institute and ii) Degree from University of Pune through convocation. He/she will submit a written application to dean academics seeking his/her permission to register for class improvement within one month from the date of declaration of result or one week before the date of convocation of University of Pune whichever is earlier. This application will be forwarded to dean academics through the Head of the Department from where he/she has graduated. No student will be admitted once the subject registration process of that semester ends.
b) For grade improvement student will have to take maximum 3 subjects in which he/she has secured DD or CD grades from the same semester in one stretch.
c) Student can choose maximum three theory courses from a particular semester offered for T.Y and B. Tech (either odd or even) in which he/she has secured DD or CD grade. Student will have to register for these courses in a particular semester in which those subjects are offered.
d) At the time of registration student will surrender all the original mark lists given to him by the institute He will have to give an affidavit on 100 Rs. judicial stamp paper that he/she will not do any use of surrendered mark lists till he/she gets official result of the subjects for which he/she wishes to appear for grade improvement. No change of subjects or drop of subjects will be allowed after registration.
e) Student wishing to improve his/her grade will have to pay appropriate fees as laid down by the institute time to time.
f) Student wishing to appear for grade improvement is exempted from attending regular classes as he/she has already undergone the course instructions but he/she will have to appear for all the evaluation tests conducted for the particular subjects. No re-exam or retest will be allowed for the class improvement, in case of such students misses any of the tests or examinations. Absentee for End-semester examination will automatically lead to award of FF grade in that subject.
g) The grading process as used for the regular students appearing for that subject will be applicable and no concession of any sort will be granted on account of absentee for any of the examinations.
h) Student wishing to use the facility of grade improvement will have to pass in all the three subjects at a time for which he/she has registered for. He/she will not

be entitled for the summer term or re-examination in such cases.

i) Only one attempt will be permissible for any candidate wishing to use the facility of grade improvement. If the student fails to secure higher grades resulting in reduction in overall CGPA then the original resul t of the student before registering for grade improvement will be retained.

j) Student who improves his/her CGPA will be issued fresh mark lists by the institute. These mark lists will have star against the subjects for which he/she has appeared for grade improvement and will state *"Grade Improvement".* The date on the new mark lists will be that as issued for other students appearing in those subjects. Name of the student will be communicated to Pune University and he/she will have to apply for degree certificate from University of Pune thereafter.

21. Honors and Minor Certification Schemes at the Institute (To be implemented w.e.f A.Y. 2017-18 for Third Year Students:

- Aspiring student has to register for additional FOUR THEORY courses and acquire a additional (minimum) 12 credits (3 credits/course) for any ONE of BOTH the Schemes.
- Honors Certificate for Vertical in his/her OWN Branch for Research orientation; Minor in any OTHER Branch for Improving Employability.

- **For MINOR scheme:**
  - Every Department to develop and submit 'Minor-Courses-List' of 5-6 Theory courses with Titles and detailed syllabi, separately.
    - e.g. E & TC dept.: Linear & Digital ICs, DSP, Embedded Processors, Digital Communication, Communication Networks.
  - Student from ANY department is ELIGIBLE to apply for Minor from ANY OTHER DEPARTMENT.
  - The Scheme would start from 5th Semester of UG program and applicant must have a minimum CGPA of 6.0 (up to 4th Sem).
  - Host Department to float a SINGLE course from Minor-List, ONE in EVERY Semester starting from 5th Semester (Four courses in Four Semesters viz. 5, 6, 7, 8).
  - NO Lab course/Internship/Mini-project/MOOC permitted in Minor Scheme.
  - All Minor Courses to be designed and delivered by Departments only.

- **For HONORS Scheme:**
  - Every Department to develop and submit a 'Honors-Courses-List' of 5-6 Theory courses with Titles and detailed syllabi. MOOCs are permitted to be part of the list, so also a few PG courses. Multiple Verticals are encouraged. (e.g. Digital Communication/Signal Processing/Communication Networks/VLSI Design/Embedded Systems/ etc.)
  - Student from Host Department to undertake the Honors scheme for his/her own branch.
  - Scheme would begin from 5th Semester of UG program.

- Applicant should have CGPA score of 6.0 (up to 4th Semester)
- Host Department to float the courses from Honors-List as ONE in each Semester (viz. 5th, 6th, 7th, 8th Sem, of which preferably the SECOND course could be a MOOC from NPTEL/edX/Coursera/Udacity//PurdueNext/Khan Academy/QEEE etc. with examination given by the Department.

- **Implementation:**
  - 01 Minor & 01 Honors each = 02 Courses in every Semester beginning from 5th Sem. upto 8th Sem. Total: 08 Courses.
  - A Student opting for 'Honors' will NOT be ENTITLED to register for 'Minor'.
  - Allotment of SLOT in Time table on the line of ILOE (e.g. Mon-Wed: 9 to 10 am).
  - Department to identify and appoint a faculty member as 'Honors/Minor Coordinator' for guiding the aspirants.

- **Specific Remarks:**
  - Normal UG program for B.Tech. degree is therefore of **reduced credits in comparison to previous iterations of Curriculum revision, (170 credits across Eight semesters).**
  - Mediocre learner would find it bit easier to complete the program with good scores, with such reduced credits.
  - So, for Brighter Students opting Honors/Minor scheme, the UG program would be of **170 + 12 = 182 credits**.
  - Average learners can receive B.Tech degree with normal 170 credits.
  - The remedial assessment schemes such as Re-examination or Summer term will NOT be applicable for Minor or Honors schemes. Student failing in any of the Minor or Honors courses, at any stage will be discontinued from the Scheme.
  - The schemes shall also be open for Second Year Direct Admitted Diploma Students, with CGPA of Second Year at COEP exceeding 6.0.

****

Program Education Objectives (PEOs)

The Undergraduate students will demonstrate..

I. To prepare students to excel in postgraduate programs or to succeed in industry/technical profession through global and comprehensive education.

II. To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve engineering problems and also to pursue higher studies.

III. To train students with good scientific and engineering breadth so as to comprehend, analyze, design and create novel products and solutions for real life problems.

IV. To inculcate in students professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach and an ability to relate engineering issues to broader social context.

V. To prepare student with an academic environment aware of excellence, leadership, written ethical codes and guidelines and the life-long learning needed for a successful professional career.

Program Outcomes (POs):

The Undergraduate Students will demonstrate...

1. Knowledge of differential equations, vector calculus, complex variables, matrix theory, probability theory, physics, chemistry and network and EM field analysis of electrical and electronics objects.
2. An ability to identify, formulate and solve electrical engineering problems.
3. An ability to design electrical and electronic circuits and conduct experiments on electrical systems, analyze and interpret data.
4. An ability to design digital and analog systems and component.
5. An ability to visualize and work on laboratory and multidisciplinary tasks.
6. Skills to use modern engineering tools, software and equipment to analyze problems.
7. Knowledge of professional and ethical responsibilities.
8. An ability to communicate effectively in both verbal and written form.
9. The understanding of impact of engineering solutions on the society and will also be aware of contemporary issues.
10. Confidence for self education and ability for life-long learning.
11. An ability to participate and succeed in competitive examinations like GATE and/or seek employment in the industry.

Correlation between the PEOs and the POs

PO→ PEO↓	1	2	3	4	5	6	7	8	9	10	11
I	✓	✓	✓	✓	✓		✓				✓
II	✓	✓	✓	✓	✓	✓			✓	✓	✓
III	✓	✓	✓	✓	✓	✓			✓	✓	
IV							✓	✓	✓		
V							✓	✓	✓	✓	✓

Note: The cells filled in with ✓ indicate the fulfillment/correlation of the concerned PEO with the PO.

List of Abbreviations

Abbreviation	Title
S.P. P.U.	Savitribai Phule Pune University
A.Y.	Academic Year
BSC	Basic Science Course
EFC	Engineering Foundation Course
MLC	Mandatory Learning Course
ILOE	Institute Level Open Elective Course
SLC	Self Learning Course
HSMC	Humanities/Social Sciences/Management Course
LLC	Liberal Learning Course
SBC	Skill Based Course
PCC	Program Core Course
DEC	Department Elective Course
LC	Laboratory Course

Semester III

Sr. No.	Course Type	Course Name	Teaching Scheme			Credits
			L	T	P	
1	BSC	Ordinary Differential Equations and Multivariate Calculus	2	1	-	**3**
2	MLC	Professional Ethics & Values	1	-	-	**0**
3	HSMC	Innovation	1	-	-	**1**
4	SBC	Data Structures Lab	2	-	2	**3**
5	PCC1	Electronic Devices and Circuits	3	-	-	**3**
6	PCC2	Digital System Design	3	-	-	**3**
7	PCC3	Signals and Systems	2	1	-	**3**
8	PCC4	Network Synthesis and Analog Filters	3	-	-	**3**
9	LC1	Electronic Devices and Circuits Lab	-	-	2	**1**
10	LC2	Digital System Design Lab	-	-	2	**1**
11	LC3	Network Synthesis and Analog Filters Lab	-	-	2	**1**
			17	**2**	**8**	**22**
		Total Academic Engagement and Credits	**27**			**22**

Semester IV

Sr. No.	Course Type	Course Name	Teaching Scheme			Credits
			L	T	P	
1	BSC	Vector Calculus and Partial Differential Equations	2	1	-	**3**
2	BSC	Science of Living Systems	3	-	-	**3**
3	ILOE	1. Principles of Electronic Communication **OR** 2. Microcontroller Based Systems [For Other Departments]	3	-	-	**3**
4	SBC	Circuit Simulation lab	-	-	2	**1**
5	PCC1	Analog Communications Systems	3	-	-	**3**
6	PCC2	Microcontrollers and Applications	3	1	-	**4**
7	PCC3	Integrated Circuits and Applications	2	-	-	**2**
8	LC1	Analog Communications Systems Lab	-	-	2	**1**
9	LC2	Micro-controllers and Applications Lab	-	-	2	**1**
10	LC3	Integrated Circuits and Applications Lab	-	-	2	**1**
			16	**2**	**8**	**22**
		Total Academic Engagement and Credits	**26**			**22**

Semester III (For Direct Second Year Admitted Diploma Students)

Sr. No.	Course Type	Course Name	Teaching Scheme			Credits
			L	T	P	
1	BSC	Linear Algebra and Univariate Calculus	4	1	-	5
2	BSC	Foundation of Physics	3	0	-	3
3	MLC	Professional Ethics & Values	1	-	-	1
4	HSMC	Innovation	1	-	-	1
5	SBC	Data Structures Lab	2	-	2	3
6	PCC1	Electronic Devices and Circuits	3	-	-	3
7	PCC2	Digital System Design	3	-	-	3
8	PCC3	Signals and Systems	2	1	-	3
9	PCC4	Network Synthesis and Analog Filters	3	-	-	3
10	LC1	Electronic Devices and Circuits Lab	-	-	2	1
11	LC2	Digital System Design Lab	-	-	2	1
12	LC3	Network Synthesis and Analog Filters Lab	-	-	2	1
			19	**02**	**8**	**25**
		Total Academic Engagement Credits	**32**			**28**

Semester-IV

Sr. No.	Course Type	Course Name	Teaching Scheme			Credits
			L	T	P	
1	BSC	Multivariate Calculus and Differential Equations	4	1	-	5
2	BSC	Science of Living Systems	3	-	-	3
3	ILOE	1. Principles of Electronic Communication **OR** 2. Microcontroller Based Systems [For Other Departments]	3	-	-	3
4	SBC	Circuit simulation lab	-	-	2	1
5	PCC1	Analog Communications Systems	3	-	-	3
6	PCC2	Microcontrollers and Applications	3	1	-	4
7	PCC3	Integrated Circuits and Applications	2	-	-	2
8	LC1	Analog Communications Systems Lab	-	-	2	1
9	LC2	Micro-controllers and Applications Lab	-	-	2	1
10	LC3	Integrated Circuits and Applications Lab	-	-	2	1
			18	**2**	**8**	**24**
		Total Academic Engagement and Credits	**28**			**24**

Semester-III

(MA 16001) Ordinary Differential Equations and Multivariate Calculus

Teaching Scheme:
Lectures : 2 Hrs/week
Tutorial: 1Hr/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Students will be able to:

1. Know and recall core knowledge of the syllabus. (To measure this outcome, questions may be of the type- define, identify, state, match, list, name etc.)
2. Understand basic concepts. (To measure this outcome, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc.)
3. Analyze the problem and apply the appropriate concept. (To measure this outcome, questions will be based on applications of core concepts)

Unit I:

Review of first order differential equations, Reduction of order, linear differential equations, homogeneous higher order linear differential equations, non-homogeneous higher order linear differential equations with constant coefficients and reducible to differential equations with constant coefficients (method of undetermined coefficients and method of variation of parameters), systems of differential equations, applications to orthogonal trajectories, mass spring systems and electrical circuits.

[10 Hrs]

Unit II:

Functions of several variables, level curves and level surfaces, partial and directional derivatives, differentiability, chain rule, local extreme values and saddle points, constrained optimization

[05 hrs]

Unit III:

Double integrals in Cartesian and polar co-ordinates, iterated integrals, change of variables, triple integrals in Cartesian, spherical and cylindrical co-ordinates, and substitutions in multiple integrals, Applications to Area, Volume, Moments and Center of Mass. **[11 Hrs]**

Text Books:

- Thomas' Calculus (12^{th} edition) by Maurice D. Weir, Joel Hass, Frank R. Giordano, Pearson Education.
- Advanced Engineering Mathematics (10^{th} edition) by Erwin Kreyszig, Wiley eastern Ltd.

Reference Books:

- K.D Joshi, "Calculus for Scientists and Engineers", CRC Press.
- Sudhir Ghorpade & Balmohan Limaye, "A Course in Multivariate Calculus and Analysis", Springer Science and Business Media.
- George Simmons, "Differential Equations with Applications and Historical notes", Tata Mc-Graw Hill publishing company Ltd, New Delhi.
- C.R. Wylie, " Advanced Engineering Mathematics" , McGraw Hill Publications, New Delhi
- Peter V. O' Neil, "Advanced Engineering Mathematics", (7^{th} edition) , Thomson.Brooks / Cole, Singapore.
- Michael D. Greenberg, "Advanced Engineering Mathematics", (2^{nd} edition) by, Pearson Education.

(MA) Linear Algebra and Univariate Calculus

(For Students Directly admitted to S.Y. after their Diploma)

Teaching Scheme:
Lectures : 4 Hrs/week
Tutorial: 1Hr/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Students will be able to:

1. Know and recall core knowledge of the syllabus. (To measure this outcome, questions may be of the type- define, identify, state, match, list, name etc.)
2. Understand basic concepts. (To measure this outcome, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc.)
3. Analyze the problem and apply the appropriate concept. (To measure this outcome, questions will be based on applications of core concepts)
4. Give reasoning. (To measure this outcome, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, prove implications or corollaries of theorems, etc.)
5. Apply core concepts to new situations. (To measure this outcome, some questions will be based on self-study topics and also comprehension of unseen passages.)

Unit I: Matrices and linear equations: basic properties of matrices, row operations and Gauss elimination, Determinants and their basic properties. Basic concepts in linear algebra: vector spaces, subspaces, linear

independence and dependence of vectors, bases, dimensions. Row and Column spaces, rank, Applications to systems of linear equations **[14 Hrs]**

Unit II: Linear mappings, representation by matrices, rank-nullity theorem, Eigen values, Eigen vectors and their basic properties, diagonalization. **[12 Hrs]**

Unit III: Review of limits, continuity and differentiability, Mean value theorems, Taylor's theorem, local extrema, increasing and decreasing functions, concavity, points of inflection. **[10 Hrs]**

Unit IV: Integrals as limits of Riemann sums, fundamental theorem of calculus, surface area, integrals by special techniques: reduction formulae, arc length, solids of revolution, improper integrals, tests for convergence, Gamma and Beta functions. **[12 Hrs]**

Text Books:

- Thomas' Calculus (12^{th} edition) by Maurice D. Weir, Joel Hass, Frank R. Giordano, Pearson Education.
- Advanced Engineering Mathematics (10^{th} edition) by Erwin Kreyszig, Wiley eastern Ltd.

Reference Books:

- Serge Lang, "Introduction to Linear Algebra (2^{nd} edition)", Springer.
- Howard Anton and Chris Rorres, " Elementary Linear Algebra (10^{th} edition)", John Wiley and sons.
- K.D Joshi, "Calculus for Scientists and Engineers" , CRC Press.
- Sudhir Ghorpade and Balmohan Limaye, "A Course in Calculus and Real Analysis (1^{st} edition)", Springer-Verlag, New York.
- C.R. Wylie, " Advanced Engineering Mathematics" , McGraw Hill Publications, New Delhi.
- Peter V. O' Neil, " Advanced Engineering Mathematics (7^{th} edition)", Thomson.Brooks / Cole, Singapore.
- Shanti Narayan, " Differential Calculus", S. Chand and company, New Delhi.
- P.N. Wartikar and J.N. Wartikar, " Applied Mathematics Vol. I", (Reprint July 2014) , Pune Vidyarthi Griha Prakashan Pune.

(ML 16001) PROFESSIONAL ETHICS AND HUMAN VALUES

Teaching Scheme
Lectures: 1 hour per week

Examination Scheme
To be announced by the Teacher, preferably in the form of team assignments

OBJECTIVE

Engineers, being a special group of professionals, need to be conscious of their duties, responsibilities and actions because these affect the society and environment in which they work. Therefore, ethics and human values become as central, if not more, to the practice of engineering as to any other profession. The objective of this course could be summarized as:

- To create a general awareness about Professional Ethics and Human Values.
- To enable future professional engineers to contribute to Society and human well-being.
- To inculcate professional behavior and a sound work / workplace ethic in young minds
- To understand social responsibility at the personal, professional and corporate levels.
- To appreciate the concept of gender diversity and related issues from an ethical viewpoint
- To appreciate ethical dilemma while discharging duties in professional life.

Course Outcomes

a. Understand the need, basic guidelines, content and process for value education.
b. Understand the need of self and body, harmony of self with body.
c. Understand the harmony in the family, difference between respect and differentiation.
d. Understand the harmony in nature, interconnectedness and mutual fulfillment in nature, holistic perception of harmony.
e. Understand natural acceptance of human values, competence in professional ethics.

Unit 1: HUMAN VALUES [3 hours]

Morals, Values and Ethics – Integrity – Work Ethic – Honesty – Commitment – Courage –Empathy – Self-Confidence – Character – Caring and Sharing – Empathy and Leadership.

Unit 2: PROFESSIONAL ETHICS [3 hours]

Introduction to and history of Ethics – profession and professionalism – professional roles played by an engineer – engineering ethics – senses of 'Engineering Ethics' – variety of moral issues supported by case studies, e.g. moral / ethical dilemma, moral autonomy, consensus and controversy, etc. – models of professional roles – codes of conduct and codes of ethics – valuing time – co-operation – commitment – ethics at the workplace – gender diversity – diversity at the workplace – women's empowerment – sexual harassment at work, etc..

Unit 3: GLOBAL ISSUES [2 hours]

Types of technology (e.g. simple, high, intermediate, and appropriate technologies) and their ethical application – transfer of technology, its benefits and drawbacks – role of multinational corporations in technology transfer – environmental ethics – need for sustainable development, environmental hazards due to irresponsible technological development e.g. global warming, acid rain, etc., with case studies – computer ethics, prevention of IPR infringement, computer crime, social problems resulting from computerization, ethical social networking, etc.

Unit 4: ENGINEERING AS SOCIAL EXPERIMENTATION [2 hours]

Meaning of experimentation – engineering as experimentation – engineers as responsible social experimenters to benefit society – R&D efforts towards ethically and environmentally sustainable design of products and systems – codes of ethics and a balanced view towards legal, ethical and business aspects of technology use

Unit 5: SAFETY, RESPONSIBILITIES AND RIGHTS [2 hours]

Knowledge of safety and risk – uncertainty of design – ethical need to reduce safety and risk – need for testing product and system designs for safety – concept of risk benefit analysis – ethical issues in cost-benefit analysis – difference between gifts and bribes – protecting employee rights – human rights and human responsibilities – case studies involving natural and manmade disasters, e.g. Chernobyl, Bhopal Gas Tragedy, floods in Uttarakhand, Mumbai, etc.

6. WHISTLE BLOWING [1 hours]

Meaning and brief history of whistle blowing – internal and external whistle blowing – Ethical and legal issues involved – Managing whistle blowing – case studies involving whistle blowers like Manjunath, Satyendra Dubey, etc.

TEXT BOOKS

1. Mike Martin and Roland Schinzinger - “Ethics in Engineering”, McGraw-Hill, New York (1996).
2. Govindarajan M, Natarajan S, Senthil Kumar V. S - “Engineering Ethics”, Prentice Hall of India, New Delhi, (2004).
3. Alavudeen A, KalilRahman R., Jayakumaran M. – “Professional Ethics and Human Values”, University Science Press (an imprint of Laxmi Publications Pvt. Ltd.), New Delhi (2011)
4. Naagarazan, R.S. “A Textbook on Professional Ethics and Human Values” (As per Anna University Syllabus) (2009)

REFERENCES

1. Charles D. Fleddermann, “Engineering Ethics”, Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint now available).
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, “Engineering Ethics – Concepts and Cases”, Wadsworth Thompson Leatning, United States, 2000 (Indian Reprint now available)

3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.

(HS 16001) Innovation

Teaching Scheme:
Lectures : 1 Hr/week

Examination Scheme:
"To be declared by the Instructor"

Course Outcomes:

At the end of the Course, Student will be able to:

1. Discover the creative / innovative side within her/him.
2. Hone entrepreneurial and leadership skills within his/her personality.
3. Develop new ways of thinking and Learn the entire innovation cycle from Ideation to Go-To-Market.
4. Study frameworks, strategies, techniques and business models for conceived ideas.
5. Develop skills for evaluating, articulating, refining, and pitching a new product or service.

Syllabus:

Introduction to Innovation, Personal thinking preferences, ‘Innovation’ mind set, Everyday creativity and eliminating mental blocks, Introduction to Innovation, Creative thinking techniques, Innovation types, Idea management and approaches, Teaming techniques for creativity, Idea Conception, Idea Scoping, Self Evaluation, Idea Brainstorming sessions, Idea Verification, Market Evaluation, Concept Evaluation, Idea Verification, Prototype Evaluation, Protection/Patent review, Innovation Case Study, Idea Presentations, Idea Incubation, Product and Market Plan, Product and Market Development, Innovation Case Studies, Idea Incubation and Product Launch, Marketing and selling, Post Launch Review

Reference Books:

- Jeff Dyer, Hal Gregersen, Clayton M. Christensen, " The Innovator's DNA: Mastering the Five Skills of Disruptive Innovators, Harvard Business Review Press, 2011.
- Paddy Miller, Thomas Wedell-Wedellsborg, "Innovation as Usual: How to Help Your People Bring Great Ideas to Life , Harvard Business Review Press, Kindle Edition.

(ET 16003) Electronic Devices and Circuits

Teaching Scheme:
Lectures : 3 hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam : 60 marks

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Analyze different types of semiconductor devices, their operation and characteristics.
2. Design and analyze the DC bias circuitry of BJT and FET.
3. Analyze and model BJT and FET for small signal.
4. Apply concept of feedback to improve stability of circuits.
5. Design circuits using the transistors and oscillators.

Unit 1

Transistors: - BJT - structure, operation, characteristics and Biasing

BJT structure, Symbol, Basic operation. Input and Output Characteristics in CE, CB and CC configuration, Comparison of transistor configurations. BJT biasing, Stability factor. Ratings and specifications of BJT from data sheet. **[06 Hrs]**

Unit 2

Transistors: JFET, MOSFET- structure, operation, characteristics and Biasing

JFET: - Structure, Symbol, Basic operation, Drain and Transfer Characteristics (Shockley's Equation). Biasing arrangements for JFET, Biasing against device variation, biasing for zero current drift. Universal JFET bias curve, Ratings and specifications of JFET from data sheet

MOSFET: - Structure, Symbol, Basic operation, Drain and Transfer Characteristics. Non ideal voltage-current characteristics viz. Finite output resistance, body effect, sub threshold conduction, breakdown effects and temperature effects. MOSFET Biasing. N-MOS, P-MOS and CMOS devices. Handling precautions for CMOS devices. Comparison of BJT and FET **[08 Hrs]**

Unit 3

Single Stage Amplifiers

BJT small signal model – Analysis of CE, CB, CC amplifiers, FET small signal model– Analysis of CS, CG and CD amplifiers. Concept of frequency response, Square wave testing of amplifiers, Miller's theorem, Effect of coupling, bypass, junction and stray capacitances on frequency response for BJT and FET amplifiers. **[08 Hrs]**

Unit 4

Multistage Amplifiers

Need for multistage amplifiers, block diagram, selection of configurations in multistage amplifiers, analysis

of multistage amplifier. **[05 Hrs]**

Unit 5

Power Amplifiers

Classes of power amplifiers – Class A, Class B, Class AB, Class C and Class D amplifiers, Analysis of Class A, Class B, Class AB amplifiers, Distortions in amplifiers, concept of Total Harmonic Distortion (THD), Comparison of power amplifiers **[05 Hrs]**

Unit 6

Feedback Amplifiers and Oscillators

Feedback Amplifiers: - Feedback Concept, Classification of amplifiers based on feedback topology, (Voltage, Current, Transconductance and Transresistance amplifiers), Effect of negative feedback on various performance parameters of an amplifier, Analysis of one circuit for each feedback topology.

Oscillators: - Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators. **[08 Hrs]**

Text Books

- Millman & Halkies, "Electronic Device and Circuits", Second Edition, Tata McGraw Hill.
- Boylestead & Nashelsky, "Electronic devices and Circuits Theory" Eighth edition, PHI

Reference Books

- Millman Halkies, "Integrated Electronics", Tata McGraw Hill.
- David A. Bell," Electronic Device and Circuits", Fourth Edition, PHI.
- Floyd," Electronic Devices", Seventh Edition, Pearson.

(ET 16005) Digital System Design

Teaching Scheme:
Lectures: 3 hrs/week

Examination Scheme:
T1 and T2-20 marks each
End-Sem Exam: 60 marks

Course outcomes:

At the end of this course students will demonstrate the ability to

1. Design & analyze combinational logic circuits

2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder etc
3. Design & analyze synchronous sequential logic circuits
4. Use HDL & appropriate EDA tool for digital logic design and simulation

Unit 1

Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion **[06 Hrs]**

Unit 2

MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU **[06 Hrs]**

Unit 3

Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation **[08 Hrs]**

Unit 4

Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of PLDs like PAL, PLA, CPLDs, FPGA etc. Logic implementation using Programmable Devices (ROM, PLA) **[08 Hrs]**

Unit 5

VLSI Design flow: Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation **[08 Hrs]**

Unit 6

VHDL constructs and codes for combinational and sequential circuits **[04 Hrs]**

Text Books:

- R.P. Jain, "Modern digital Electronics", Tata McGraw Hill.
- Douglas Perry, "VHDL", Tata McGraw Hill.

Reference Books:

- Gothman, "Digital Electronics-An introduction to theory and practice", Pearson Education
- Douglas-Hall, "Digital Circuits and Systems", Tata McGraw Hill
- Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill

(ET 16007) Signals & Systems

Teaching Scheme:
Lectures : 2 hrs/week
Tutorial: 1hr/week

Examination Scheme:
T1 and T2: 20 marks each
End-Sem Exam: 60 marks

Course Outcome:

At the end of this course students will demonstrate the ability to

1. Characterize and analyze the properties of CT and DT signals and systems.
2. Analyse the spectral characteristics of continuous-time periodic and a periodic signals using Fourier analysis.
3. Apply Z- transform for analyze of discrete-time signals and systems.

Unit1
Introduction and Classification of Signals and Systems, Elementary Operations on Signals, Properties of System **[04 Hrs]**

Unit 2
Time Domain Representations of Linear Time Invariant (LTI) Systems, Impulse Response, Convolution, Differential and Difference Equation Representation, Block Diagram and State Variable Representation of the System. **[05 hrs]**

Unit 3
Fourier Representation of the Signals: Signal Analysis - Discrete and Continuous, Periodic and Non-Periodic, and Synthesis In Fourier Domain, Properties of Fourier Representations, Application of Fourier Representations. **[05 hrs]**

Unit 4
Representation of Signals Using Discrete-Time Complex Exponentials**:** Z-Transform, Significance and Properties of Region of Convergence, Properties of Z-Transform, Inverse Z-Transform, Analysis of Linear Time Invariant (LTI) System, Computational Structures For Implementing Discrete Time Systems. **[05 hrs]**

Unit 5
Study of Systems with Differential and Difference Equations, Transfer Function, Poles and Zeros, Stability Consideration in Z Domain. **[06 Hrs]**

Text Books:

- Simon Haykins and Barry Van Veen, “Signals and Systems”, John Wiley and sons.
- B. P. Lathi, “Linear Systems and Signals”, OXFORD University Press.

Reference Books:

- Alan V. Oppenheim, Alan S. Willsky with IAN T. Young, “Signals and Systems”, Prentice-Hall.
- S.S. Soliman & M.D. Srinath, “Continuous and Discrete Signals and System”s, Prentice- Hall, 1990.
- Shaila Dinkar Apte “Signals and Systems: Principles and Applications”, Cambridge University Press.

(ET 16008) Network Synthesis and Analog Filters

Teaching Scheme: **Examination Scheme**

Lectures: 3 hrs/week T1 and T2: 20 marks each

End sem: 60 marks.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Analyze various electrical networks in the Laplace domain.
2. Synthesize a network, given the driving point or transfer immitance.
3. Learn various methods for analog active and passive filter design.

Unit1

Laplace Transform, Concept of Poles-Zeros, Pole -Zero plot, Stability, Network functions. Analysis of circuit in s domain, analysis of ladder networks **[05 Hrs]**

Unit 2

Over view of Attenuators, Two port parameters, Relationships between two port parameters, transfer function using two port parameters, interconnection of two-ports, incidental dissipation. **[07 Hrs]**

Unit 3

Realizability theory and synthesis of one-port networks: Causality & stability, Hurwitz polynomials, positive real functions, elementary synthesis procedures, properties & synthesis of L-C, R-C, & R-L one-port circuits, synthesis of certain R-L-C functions. **[08 Hrs]**

Unit 4

Synthesis of two-port networks: Properties of transfer functions, zeros of transmission, synthesis of Y21 & Z21 with a 1 Ω termination, synthesis of constant resistance networks, Impedance and Frequency Denormalization to required values. **[08 Hrs]**

Unit 5

Aspects of filter design problem, approximation problem in network theory, maximally flat low pass filter approximation (Butterworth), Chebyshev approximations **[07 Hrs]**

Unit 6

Synthesis of Active filters: Low Pass, Band Pass, RC-CR Transformation, Sensitivity, Biquad Circuits. **[05 Hrs]**

Text Books:

- Franklin Kuo, "Network Analysis & Synthesis", Wiley International.
- Govind Daryanani, "Analysis and Synthesis of Filters".

Reference Books:

- Kendall Su, " Analog Filters", Kluwer Academic Publisher, 2nd Edition, 2002.
- John O' Malley, "Basic Circuit Analysis", Schaum's series.
- Van Valkenberg, "Network Analysis", Pearson Education.

(ET 16002) Data Structures Lab

Teaching Scheme:
Lectures : 2 hrs/week
Practical: 2 hrs/week

Examination Scheme:
Continuous evaluation: 40 marks
End-Sem Evaluation-: 60 marks

Course outcomes:

At the end of this course students will demonstrate the ability to

1. Analyze and critically evaluate time complexity of various algorithms
2. Select and Apply data structures in engineering examples to implement properly structured solutions
3. Manipulate Data Structure in any Problem Solving Systems

Unit 1

Introduction: Concept of Linear and Non-linear data Structures, Characteristics of an algorithm, analyzing programs, frequency count, Time and Space Complexity, Big 'O' and Ώ' notation, best, average and worst cases.

Arrays: Concept of Sequential Organization, Polynomial representation using arrays **[03 Hrs]**

Unit 2

Linked Lists: Concept of linked organization, Singly linked list, doubly linked list, circular linked list, Operations on linked list, Computation of length, traversal on linked list, Representation &

manipulations of polynomials using linked lists **[03 Hrs]**

Unit 3

Search: Importance of searching, Sequential, Binary Search, Sorting: Quick sort, merge sort, heap sort, shell sort, Radix sort, need of external sorting, Hashing: Hashing functions, chaining **[05 Hrs]**

Unit 4

Stacks and Queues: Stack and Queue, Operations on stack and queue, circular queues, Application of stack for expression evaluation, expression conversion, and Recursion, Priority queue, Doubly Ended Queue, Multiple stacks and queues. **[05 Hrs]**

Unit 5

Two dimensional matrix, Linear Algebraic Equations: Gauss elimination, LU Decomposition and Matrix Inversion **[03 Hrs]**

Unit 6

Trees & Graphs: Basic terminology, binary trees and its representation, binary tree traversals (recursive and non recursive), operations such as copy, equal on binary tree, binary tree representation of trees, Terminology and Representation of graphs using adjacency matrix, adjacency list, Traversals (Depth First and Breadth First Algorithm for shortest path **[06 Hrs]**

Text Books:

- Y. Langsam, M. Augenstin and A. Tannenbaum, "Data Structures using C and C++", Pearson Education Asia, 2nd Edition, 2002, ISBN-81-7808-729-4.
- Ellis Horowitz, S. Sahni, D. Mehta "Fundamentals of Data Structures in C++", Galgotia Book Source, New Delhi 1995 ISBN 16782928

Reference Books:

- Seymour Lipschupz, " Theory and problems of data structures", Tata McGraw Hill, 2002
- ISRD group, Data structures using C, Tata McGraw Hill, 2006
- William J Collins, " Data structures and the standard template library, Tata McGraw Hill, 2003

It shall comprise of 10 programs in C/ C++ for solving problems demonstrating use of various data structures learned in above 6 units.

(ET 16004) Electronic Devices and Circuits Laboratory

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Continuous evaluation : 40 marks
Exam: 60 Marks

Laboratory Outcomes:

At the end of the laboratory work, students will demonstrate the ability to:

1. Identify and characterize basic devices such as BJT and FET from their package information by referring to manufacturers' data sheets.
2. Design, Build, Test and Analyze performance of Linear Applications of abovementioned active devices using equipment set-up like Power Supply, Signal generators, Oscilloscope.
3. Simulate a few of the circuit applications using appropriate Circuit Simulation package.

List of Experiments:

1. Input and Output Characteristics of BJT in CE configuration.
   (Find h parameters from characteristics.)
2. Transfer and Drain Characteristics of JFET.
   (Find g_m, r_d and μ from characteristics.)
3. Single stage JFET CS amplifier.
   (Find performance parameters - Av, Ri, Ro & Bandwidth for JFET CS amplifier.)
4. Single stage BJT CE amplifier.
   (Find performance parameters - Av, Ri, Ro & Bandwidth for BJT CE amplifier.)
5. Comparison of CE, CC, CB configurations for Av, Ri, Ro.
6. Simulate frequency response of single stage BJT CE / FET CS amplifier.
   (Effect of coupling and bypass capacitors.)
7. Design and simulate Power Amplifiers - Class A, Class AB complementary symmetry. (Efficiency calculations and comparison.)
8. Design and simulate Voltage Shunt Feedback Amplifiers.
   (Compare performance of voltage shunt circuit under with and without feedback conditions.)
9. Design and simulate current series Feedback Amplifiers.
   (Compare performance of current series circuit under with and without feedback conditions.)
10. Design and simulate LC and RC oscillators.
    (Compare practical and theoretical oscillation frequency.)
11. Build and test LC or RC oscillator.

(ET 16006) Digital System Design Laboratory

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Continuous evaluation : 40 marks
Exam: 60 Marks

Laboratory Outcomes:

At the end of the laboratory work, students will demonstrate the ability to:

1. Design, simulate, built and debug complex combinational and sequential circuits based on an abstract functional specification
2. Develop and simulate VHDL architectural representations of systems and components using structure, behavior, or data flow concepts describing the internal

List of Practical:

1. Simplification and implementation of a Boolean function using k -map technique e.g. code converter
2. Binary and BCD adders and Subtractor using gates
3. Comparator using IC 7485 and Parity generator and checker using X-OR gate
4. Use of Multiplexers, Encoders, Demultiplexer and decoders for implementing logic
5. Study of characteristics of typical TTL and CMOS IC's like fan out, noise margin, propagation delay
6. Counters
    a. Design of synchronous and asynchronous counter using JK FF ICs
    b. Design of counter using ICs like 7490/93 and 74192/193
7. Design and implementations of non sequential counter using D FF or JK FF ICs
8. Study of shift registers IC 7495 for different modes. Design of pulse train generator using shift register and decoder circuit
9. Understanding VLSI Design flow using EDA tools
10. Writing VHDL codes of simple combinational and sequential circuits, Simulation and synthesis of the written codes using the EDA tool.

(ET 16009) Network Synthesis and Analog Filters Lab

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Continuous evaluation : 40 marks
Exam: 60 Marks

Laboratory Outcomes:

At the end of the laboratory work, students will demonstrate the ability to:

1 Analyze the various electrical and electronic networks using the techniques they learn.
2 Construct a circuit to suit the need.
3 Design various types of Active and Passive filters given the specifications

List of Practical:

1. Verification of Network theorems(Superposition, Thevenin's, Nortons, Reciprocity, Maximum Power Transfer)
2. Two-port network parameters: Determination of z, y, h, T parameters
3. Attenuators: T –type, Ladder, Lattice type attenuators.
4. Passive filters I: Low-pass & high-pass filter.
5. Passive Filters-II: Band-pass & Band-stop filter.
6. Active filters I: Low-pass & high-pass filter. (1^{st} order and 2^{nd} order)
7. Active Filters-II: Band-pass & Band-stop filter. (1^{st} order and 2^{nd} order)

SEMESTER-IV

(MA 16002) Vector Calculus and Partial Differential Equations

Teaching Scheme:
Lectures : 2 hrs/week
Tutorial: 1hr/week

Examination Scheme:
T1 and T2: 20 marks each
End-Sem Exam: 60 marks

Course Outcomes: Students will be able to

1 Know and recall core knowledge of the syllabus. (To measure this outcome, questions may be of the type- define, identify, state, match, list, name etc.)
2 Understand basic concepts. (To measure this outcome, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc.)
3 Analyze the problem and apply the appropriate concept. (To measure this outcome, questions will be based on applications of core concepts)
4 Give reasoning. (To measure this outcome, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, prove implications or corollaries of theorems, etc.)

5 Apply core concepts to new situations. (To measure this outcome, some questions will be based on self-study topics and also comprehension of unseen passages.)
6 Organize and present thoughts. (To measure this outcome, questions may asked to write summaries and short notes on a given topic.)

Unit I :

Vector differentiation, gradient, divergence and curl, line and surface integrals, path independence, statements and illustrations of theorems of Green, Stokes and Gauss, arc length parameterization, applications. **[09 Hrs]**

Unit II:
Partial differential equations with separation of variables, boundary value problems: vibrations of a string, heat equation, potential equation, vibrations of circular membranes. [**10 Hrs]**

Unit III:
Laplace Transforms, its properties, Unit step function, Dirac delta functions, Convolution Theorem, periodic functions, solving differential equations using Laplace transform. **[07 Hrs]**

Text Books:

- Thomas' Calculus (12^{th} edition) by Maurice D. Weir, Joel Hass, Frank R. Giordano, Pearson Education.
- Advanced Engineering Mathematics (10^{th} edition) by Erwin Kreyszig, Wiley eastern Ltd.

Reference Books:

- C.R. Wylie, "Advanced Engineering Mathematics" , McGraw Hill Publications, New Delhi.
- Wendell Fleming, "Functions of several variables" , Springer-Verlag, New York.
- Fritz John, "Partial Differential Equations", (4^{th} edition) , Springer.
- Peter V. O' Neil, "Advanced Engineering Mathematics", (7^{th} edition), Thomson.Brooks / Cole, Singapore.
- Michael D. Greenberg , "Advanced Engineering Mathematics", (2^{nd} edition) , Pearson Education

(AS 16001) Science of Living System

Teaching Scheme
Lectures : 3 lectures/week

Examination Scheme
T1-**20** (Classroom activity),
T2-**20** (Assignment/s)
Semester End Examination-**60**

Objectives: To make students conversant with basic Biology regarding the life processes. To impart knowledge about the common corridors of biology and engineering as biologically inspired technologies like designs in nature, bioenergetics, bioprocesses, biomaterials, biomechanics, Bio-imaging, bioinformatics, bioinstrumentation etc. To introduce recent trends in biology viz. genetic & tissue engineering, stem cell engineering, bio and nanotechnology etc. with the objective of appreciating engineering principles in biological systems.

Unit 1: Understanding Basics (6L)

1. Engineering perspectives of biological sciences: Where engineering meets biology and where biology meets engineering. Biology as an integrated Science; Case studies on integrating biology with engineering.
2. Biopolymers and macromolecules – Structure and Function: Organic and inorganic molecules; Unique Properties of Carbon; Carbohydrates, Amino Acids and proteins, Lipids, Nucleic Acids, Vitamins and Minerals; The Rise of Living Systems.
3. Levels of organization of life : Cell as basic unit of life, prokaryotic and eukaryotic cells, microbes, plant and animal cells; Cell organelles – structure and function; Levels of organization of life - tissues, organs, systems and organism.

Unit 2: Biological Processes and Bioenergetics (6L)

1. **Energy Dynamics in Biology –**
    a) Photosynthesis and energy assimilation: aerobic and anaerobic systems. Applications
    b) Respiration and Electron Transport Chain: Mitochondria and respiration, ATP generation.
2. **Bioenergetics:** Thermodynamic principles applied to biology, negative entropy changes in biological systems, Free Energy, Chemical Equilibrium;
3. **Optimization of biological functions**: Metabolic networks; anabolism and catabolism; flux analysis (MATLAB).

Unit 3: Living Systems (6L)

1. **Transport Phenomena in Biological Systems:** Membrane channels and ion channels; Fluid flow and mass transfer
    a. In plants: Xylem and Phloem

b. In animals: Blood and Lymph

c. Transport of molecules and gases (Oxygen and Carbon dioxide); Heat Transport - Body temperature regulation.

2. **Communication:** Cell junctions, Cell-cell communications – cell signaling, Hormones, Pheromones; Chemotaxis. Communication in living systems by photo, bio, chemotactic methods.
3. **Defense mechanisms in plants and animals:**
   a. In plants: Herbivory, secondary metabolites.

   b. In animals: Innate and Adaptive immune systems.

Unit 4: Techniques and Devices (6L)

1. **Genetic Code** - Expression and Transmission of Genetic Information, The concept of DNA cloning; Mechanisms of Enzyme Action.
2. **Techniques for optimization:**
   a. At molecular level: Genetic Code and protein synthesis, DNA replication, RDT, DNA hybridization, Colony Hybrids, PCR, DNA microarray,

   b. At cell level: Hybridoma technology,

   c. At tissue level: Plant Tissue Culture, Animal Tissue Culture and Microbial Culture techniques; Tissue Engineering.

3. **Instrumental Methods of analysis** – A case study of protein purification and characterization: Principles and types of microscopy and spectroscopy, Chromatography, electrophoresis, diffusion, centrifugation, light scattering.

Unit 5: Discovery and Innovation (6L)

1. **Current trends and advances** in cell and molecular biology
2. **Landmark Discoveries**: Landmark discoveries in the field of Molecular Biology, Cell Biology and Genetics.
3. **Nanobiotechnology:** Micro-/Nanotechnologies for Interfacing Live Cells; Nanotechnology in Medicine – Diagnostics and Therapy; Biosensors; Nanotechnology in Agriculture; Biomemetics.
4. **Biomemetics:** Nature inspired processes applicable to the field of Engineering.

Unit 6: Branch-wise
Branch: Electronics and Telecommunication Engineering
Biosensors – Introduction to Biosensors, transducers, amplifiers; **Bioimaging**-Introduction to medical imaging and different medical Imaging modalities; Review of Signals and system; Electro Physiological Signal Analysis. Bio-telemetry Communication in living systems by photo, bio, chemo, tactic methods;

Diagnostic Devices- Radiography, X-ray Computed Tomography Nuclear Medical Imaging, Ultrasound Imaging, Magnetic Resonance Imaging. **Therapeutic Devices**-Cardiac Pacemakers, Cardiac defibrillators, Surgical Diathermy, Diagnostic application of LASERs, High frequency heat therapy, Hemodialysis, Ventilators, Anesthesia machines, Automatic Drug delivery Systems, Electro Surgical units and safety.

Branch: Instrumentation and Control Engineering

Basic concepts of **Medical Instrumentation**: Generalized medical Instrumentation System, Medical Measurement constraints, Classification of Biomedical Instruments, Generalized static and dynamic characteristics, Design criteria, Commercial Medical Instrumentation Development process, Regulation of Medical Devices. **Biomedical transducers:** optical, photo- electric, electrochemical, electrical, mechanical, electromechanical and thermoelectric. **Specialty areas in Bioinstrumentation**—Confocal, Tunneling, Sequencing, FACS, PCR, MRI, CT,USG, Endoscopy, ECG; Introduction to biosensors and tissue engineering.

Branch: Mechanical Engineering

Biomechanics, Human body motion, Prosthetics; Introduction to Ergonomics; Elements of Anthropometry; Physiology, Anatomy; Mechanical Properties of Bone and Soft Tissues Rehabilitation engineering, Biomimetics; Bio Material Handling; Hand Tool Design; Human Information Processing; Applications of Principles of Biomechanics in two and three dimensional kinematics; Fundamentals of Fluid Mechanics; Introduction to bio sensors and tissue engineering.

Branch: Metallurgy and Material Science

Classification of biomaterials –Comparison of properties of some common biomaterials; Effects of physiological fluid on the properties of biomaterials; Biological responses (extra and intra vascular system) to Metallic, Ceramic and Polymeric implant materials; Introduction to bio sensors and tissue engineering. Metals & alloys, composites and their advantages used in bio-industries; Materials in bio-printing. **Tissue Engineering and cloning:** Engineering cells, tissues and organs; Stem cells and translational medicine; Introduction to Gene Therapy; Bioengineering at molecular, cell and systems level; 3D bio-printing; Engineering Materials for Biomedical Applications.

Branch: Production Engineering and Industrial Management

Bio chemical engineering; Fermentation Technology, Bioreactors; Bio process Engineering; Use of living organisms (mostly microbes) to produce useful products. Biomechanics and ergonomics–production innovations.

Branch: Electrical Engineering

Alternative energy sources; Electrical signaling in biological system; Bioluminescence, bioelectricity, ECG.

Branch: Civil Engineering

Environmental engineering, Understanding ancient engineering. Designs in Nature; Bio radars.

Branch: Computer and Information Technology –

Principles of Bioinformatics, Computational Biology: Role of Computational Biology in Bioengineering; Genomics, Proteomics, Bioinformatics. Computational solutions to Biological Problems, Virtual systems Artificial Intelligence in Biomedical Engineering: Basics of Artificial Neural Networks.

References:

1. Lodish H, Berk A, Zipursky SL, et al. (2000) Molecular Cell Biology. W. H. Freeman.
2. Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2000). *Lehninger principles of biochemistry*. New York: Worth Publishers.
3. Lewin B. (2000) Genes VII. Oxford University Press..
4. Rao CNR, et.al. Chemistry of Nanomaterials: Synthesis, Properties and Applications.
5. Eggins BR. (1006) Biosensors: An Introduction. John Wiley & Sons Publishers.
6. Palsson B.O. and Bhatia S.N. (2009) Tissue Engineering. Pearson.

(MA) Multivariate Calculus and Differential Equations

(For Students Directly admitted to S.Y. after their Diploma)

Teaching Scheme:
Lectures : 4 hrs/week
Tutorial: 1hr/week

Examination Scheme:
T1 and T2: 20 marks each
End-Sem Exam: 60 marks

Course Outcomes: Students will be able to

1 Know and recall core knowledge of the syllabus. (To measure this outcome, questions may be of the type- define, identify, state, match, list, name etc.)

2 Understand basic concepts. (To measure this outcome, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc.)

3 Analyze the problem and apply the appropriate concept. (To measure this outcome, questions will be based on applications of core concepts)

4 Give reasoning. (To measure this outcome, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, proving implications or corollaries of theorems, etc.)

5 Apply core concepts to new situations. (To measure this outcome, some questions will be based on self-study topics and also comprehension of unseen passages.)

Unit I:

Functions of several variables, level curves and level surfaces, partial and directional derivatives, differentiability, chain rule, local extreme values and saddle points **[06 Hrs]**

Unit II:

Double integrals in Cartesian and polar co-ordinates, iterated integrals, change of variables, triple integrals in Cartesian, spherical and cylindrical co-ordinates. **[11 Hrs]**

Unit III:

Vector differentiation, gradient, divergence and curl, line and surface integrals, path independence, statements and illustrations of theorems of Green, Stokes and Gauss **[10 Hrs]**

Unit IV:

Review of first order differential equations, linear differential equations, homogeneous higher order linear differential equations, non-homogeneous higher order linear differential equations with constant coefficients (method of undetermined coefficients and method of variation of parameters **[09 Hrs]**

Unit V:

Laplace Transforms, its properties, Unit step function, Dirac delta functions, Convolution Theorem, periodic functions, solving differential equations using Laplace transform. **[07 Hrs]**

Unit VI:

Partial differential equations with separation of variables, boundary value problems: vibrations of a string, one dimensional heat equation. **[07 Hrs]**

Text Books:

- Maurice D. Weir, Joel Hass, Frank R. Giordano, "Thomas' Calculus", (12^{th} edition) , Pearson Education.
- Erwin Kreyszig, " Advanced Engineering Mathematics", (10^{th} edition) , Wiley eastern Ltd.

Reference Books:

- K.D Joshi, "Calculus for Scientists and Engineers", CRC Press.
- Sudhir Ghorpade and Balmohan Limaye, " A Course in Multivariate Calculus and Analysis" , Springer Science and Business Media.
- George Simmons, " Differential Equations with Applications and Historical notes" , Tata Mc-Graw Hill publishing company Ltd, New Delhi.
- Wendell Fleming, "Functions of several variables" , Springer-Verlag, New York.
- Fritz John, "Partial Differential Equations", (4^{th} edition) , Springer.
- C.R. Wylie, "Advanced Engineering Mathematics", McGraw Hill Publications, New Delhi.
- Advanced Engineering Mathematics (7^{th} edition), Peter V. O' Neil, Thomson Brooks / Cole, Singapore.
- Michael D. Greenberg, "Advanced Engineering Mathematics ",(2^{nd} edition) , Pearson Edn

(ET 16010) Analog Communication Systems

Teaching Scheme:
Lectures: 3 hrs/week

Examination Scheme:
T1 and T2: 20 marks each
End-Sem Exam: 60 marks

Course Outcomes:

At the end of this course, the students should be able to,

1. Analyse different components of analog communication systems such as modulator, demodulator, mixer, receiver etc in time and frequency domain.
2. Compare analog communication systems on the basis of bandwidth, power requirement and the performance in the presence of noise.
3. Design the modulators, demodulators for amplitude and frequency modulated systems.

Unit 1

Introduction

Overview: Signals and their classifications, Fourier Analysis of Signals and Systems. Elements of a Communication System, Need for modulation, Channel, Noise, Band pass transmission: Complex low pass representation of narrowband signals and systems, Equivalent low pass transmission model. **[06 Hrs]**

Unit 2

Amplitude modulation

DSB-FC, DSB-SC, SSB, VSB and ISB transmissions: mathematical Analysis-time and frequency domain analysis, modulation index, generation and detection methods, power requirement of these systems, Comparison of AM modulation schemes, Quadrature Carrier Multiplexing(QAM), frequency division multiplexing. **[10 Hrs]**

Unit 3

Angle Modulation

Frequency Modulation (FM),: Single Tone Frequency Modulation, Spectrum Analysis, Narrowband FM, Wideband FM, Transmission Bandwidth of FM Waves, Generation of FM waves: Direct and Indirect Methods, Demodulation of FM, Phase Locked Loops, Limiting of FM waves, comparison between AM & FM, Phase Modulation, Relation between FM and PM.

[10 Hrs]

Unit 4

Radio Receivers and performance in the noise

Basic receiver (TRF), Super heterodyne receiver for AM and FM, performance parameters for receiver such as sensitivity, selectivity, fidelity, image frequency rejection etc., AGC technique, Sources of noise, Signal to Noise Ratios, Figure of Merit Calculations, Noise in AM, Pre emphasis and De emphasis in FM, Comparison of Noise Performance of different modulation schemes. **[06 Hrs]**

Unit 5

Applications of AM and FM

AM Radio, Television: Video Bandwidth, Choice of Modulation, Colour Television, HDTV, FM Radio, FM Stereo Multiplexing **[04 Hrs]**

Unit 6

Acoustics

Introduction to acoustic transducers, microphone and loud speakers, construction, types, characteristics and applications, Block schematic of Public address system, High quality audio such as stereophonic, dolby, surround, 3-D etc. **[04 Hrs]**

Text Books:

- B.P. Lathi, "Communication Systems", BS publications.
- George Kennedy, "Electronic Communications", McGraw Hill Kennedy.

Reference Books:

- Simon Haykin, "An introduction to analog & digital communications", John Wiley & Sons
- Roddy and Coolen, "Electronic Communication Systems", Pearson Education.
- Frank R. Dungan, "Electronic Communication Systems", Delmar Publishers.

(ET 16011) Micro-controllers and Applications

Teaching Scheme:

Lectures: 3 hrs/week

Tutorial: 1hr/ week

Examination Scheme:

T1 and T2: 20 marks each

End-Sem Exam: 60 marks

Course outcomes

At the end of this course students will demonstrate the ability to

1. Understand the internal architecture and interfacing of different peripheral devices with Microcontrollers
2. Write the programs for microcontroller in Assembly and C
3. Understand the role of embedded systems in industry
4. Understand the design concept of embedded systems

Unit I

8 bit Microprocessor and Microcontroller architecture, comparison, advantages and applications of Harward and Von Neumann architecture, RISC and CISC comparison. Definition of embedded system and its characteristics, Role of microcontroller in embedded System. Limitation of 8 bit microcontrollers, Study of RS232, RS485, I2C, SPI protocols, Software and hardware tools for development of

microcontroller based system such as assembler, compiler, IDÉ, Emulators, debugger, programmer, development board, DSO, Logic Analyzer **[06 Hrs]**

Unit 2

8051 Processor Architecture And Instruction Set: The CPU, Addressing modes, external addressing, Interrupt handling, Instruction execution, Instruction set – data movement; arithmetic; bit operators; branch, Software development tools like assemblers; simulators; cross-compilers, O/P file formats **[08 Hrs]**

Unit 3

PIC Microcontrollers and Instruction Set: PIC Micro-controllers – overview: features, PIC 16c6x/7x architecture, file selection register, Memory organization, Addressing modes, Instruction set, interrupt handling. **[06 Hrs]**

Unit 4

Hardware Features: 8051 – Device packaging, Chip technology, Power considerations, Reset, System clock/oscillators, Parallel I/O, Timers, Interrupts, Serial I/O, External memory devices,

Introduction to high performance microcontrollers: performance improvement to maximize application flexibility and reliability, and minimize cost through elimination of external components over 8-bit microcontrollers, application areas for high-performance microcontrollers **[06 Hrs]**

Unit 5

Port structure, interrupt structure & timers of PIC18F, PWM generation UART, Interfacing of switches, LED, LCD, Keypad, Interfacing serial port, ADC, RTC with I2C and EEPROM with SPI. All programs in embedded C **[08 Hrs]**

Unit 6

Case studies with PIC, Design of DAS system, Design of frequency counter with display on LCD, Design of Digital Multimeter, Design of DC Motor control using PWM **[06 Hrs]**

Text Books:

- Mazidi, "8051 microcontroller & embedded system" 3rdEdition ,Pearson
- Mazidi, " PIC microcontroller & embedded system" 3rdEdition ,Pearson

Reference Books:

- Kenneth J. Ayala, "The 8051 Micro-controller – Architecture, Programming & Applications", Penram International & Thomson Asia, Second Edition.
- John B. Peatman, "Design with PIC Micro-controllers", Pearson Education Asia, Low Price Edition

- Technical references from www.microchip.com

(ET 16012) Integrated Circuits and Applications

Teaching Scheme:
Lectures: 2 hrs/week

Examination Scheme:
T1 and T2: 20 marks each
End-Sem Exam-: 60 marks

Course outcomes

At the end of this course students will demonstrate the ability to

1. Design the linear and non-linear applications of OpAmp and special application ICs
2. Compare the working of multivibrators using IC 555 and OpAmp
3. Classify and comprehend the working principle of data converters.
4. Understand the function of application specific ICs such as Voltage regulators, PLL and its application in communication.

Unit 1

Op-Amp Fundamentals: Op-Amp parameters

Circuits with resistive feedback: Concept of feedback & their types, Inverting & non inverting configurations, current to voltage converters, voltage to current converters, summing amplifier, difference amplifier, instrumentation amplifier. **[04 Hrs]**

Unit2

Non linear circuits: Schmitt trigger**,** Voltage comparators, comparator applications, precision rectifiers, analog switches, peak detectors, sample & hold circuits, Integrators & differentiators, log/antilog amplifiers **[06 Hrs]**

Unit3

Signal Generators: Sine wave generators, Multi vibrators, Monolithic timers, Triangular wave generators, Saw tooth generators, V to F and F to V converters, function generator **[05 Hrs]**

Unit4

D-A and A-D Converters & regulators: Performance specifications, D-A conversion techniques, A-D Conversion techniques, single chip implementation of DAC and ADC. Performance specifications of regulators, linear regulators, modifications for variable voltage, current boost & protection circuits **[04 Hrs]**

Unit5

Phase Locked Loops & multipliers: Block diagram of PLL

free running frequency, lock range, capture range and Sample circuits for each block. Applications of PLL - Frequency synthesizer FM demodulator, AM demodulator, FSK demodulator, Analog multiplier, Multiplier IC **[06 Hrs]**

Text Books:

- Ramakant A Gayakwad, "Op-Amps and Linear Integrated Circuits", PHI, 4th edition
- D.Roy Choudhary, Shail Jain, "Linear Integrated Circuits", New Age Int.

Reference Books:

- Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", Tata McGraw Hill., Third Edition
- Ramakant Gaikwad, "OP-AMP and Integrated Circuits", Pearson Education.
- G.B.Clayton, "Operational Amplifiers", International Edition.

(ET 16013) Analog Communication Systems Lab

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Continuous evaluation : 40 marks
Exam(oral): 60 Marks

Laboratory Outcomes: At the end of laboratory course the students should be able to

1. Observe and analyze the function of different modulators and demodulators of Amplitude and angle modulated systems
2. Observe and analyze multiplexing systems such as FDM,TDM and QAM.
3. Compare different communication systems by analyzing in time and frequency domain using oscilloscope and spectrum analyzer.

List of Practical:

1. Study of Fourier analysis & synthesis using hardware & software.
2. Study of DSB-FC Amplitude Modulation technique, modulation index measurements.
3. Study of DSB-SC modulation and demodulation
4. Demodulation of DSBFC using Envelope Detector.
5. Frequency Division Multiplexing and Demultiplexing
6. Quadrature Amplitude Modulation and Demodulation.
7. Study of Ceramic bandpass filter characteristics.
8. SSB modulation using Hartley Modulator and Demodulation.
9. Time Division Multiplexing and Demultiplexing.
10. Frequency Modulation using reactance modulator, computation of modulation index.
11. Study of phase modulator.

(ET16014) Micro-controllers and Applications Lab

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Continuous evaluation : 40 marks
Exam: 60 Marks

Laboratory outcomes

At the end of laboratory course students will demonstrate the ability to

1. Understand and apply the fundamentals of assembly level programming of microprocessors and microcontroller.
2. Work with microcontroller real time interfaces including GPIO, serial ports, digital-to-analog converters and analog-to-digital converters;
3. Analyze problems and apply a combination of hardware and software to address the problem

List of Practical:
Based on 8051 and PIC micro-controller mini-cards/kits by downloading the binary file in flash memory:

1 Assignment exploiting the various addressing modes for accessing internal as well as external memory and unconditional/conditional branch, loop control instructions.
2 Stack and Stack arithmetic operations, Subroutines and parameter passing via register, stack.
3 Timers and its applications , PWM generation
4 Serial Communication
5 Interfacing – Push buttons
LEDs
Key Matrix
Seven segment display
LCD
ADC/DAC
Stepper motor

(ET 16015) Integrated Circuits and Applications Lab

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Continuous evaluation : 40 marks
Exam: 60 Marks

Laboratory outcomes

At the end of laboratory course students will demonstrate the ability to

1. Analyze and design various applications of Op-Amp.
2. Design and construct waveform generation circuits
3. Design timer and analog and digital circuits using op amps.
4. Design combinational logic circuits using digital ICs

List of Practical:

1. Op-amp applications-I: Integrator, Differentiators.
2. Op-amp applications-II: Comparator (LM 339), Schmitt trigger.
3. Design build and test Precision rectifier.
4. Design, Build and Test a Square wave generator using op-amp.
5. Study of function generator IC8038.
6. Design, build and test different types DAC & study ADC IC.
7. To study the operation of IC 565 as PLL (Measurement of lock range, capture range & one application.
8. Study of Multiplier IC.

(ET 16016) Circuit Simulation lab

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Continuous evaluation : 40 marks
Exam: 60 Marks

Laboratory outcomes

At the end of laboratory course students will demonstrate the ability to

1. Simulate signals and systems using MATLAB.
2. Analyze signals with the help of Fourier analysis.
3. Simulate the circuits and analyze the results using PSPICE.

List of Experiments

1. MATLAB based experiment
   - Introduction to MATLAB
   - Defining and Plotting of standard signals.
   - Sampling of continuous time signals and Aliasing.
   - Fourier Series analysis of periodic signals.
   - Fourier Transform analysis of aperiodic signals.
   - Fixed point toolbox
2. PSPICE based simulation
   - Introduction to PSPICE.
   - Operational Amplifier Characteristics and applications using PSPICE.
   - ransfer Functions and System Parameters using PSPICE.
   - Simulate and Study active Low-pass, high-pass and band-pass filters using PSPICE windows.
   - Simulation of NE555 monostable and stable multivibrator using PSPICE

Institute Level Elective- I

** Institute level Elective offered by E and TC department for other Non Electrical Branches

(ET 16017-A) Principles of Electronic Communication

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
Test-1: 20 marks, Test-2: 20 marks
End-Sem Exam: 60 marks.

Course outcomes

At the end of this course students will demonstrate the ability to

1. Understand basics of electronic communication in analog and digital domain
2. Analyze the working of existing wired and wireless communication
3. Understand a basic of electronic communication to its application

Unit 1

Basic Concepts of Electronic Communication

Introduction to Electronic communication system, Electromagnetic spectrum, need for modulation, concept of modulation, types of modulation, basic concepts of signals, noise, SNR, bandwidth, transmitter, receiver, channel etc. **[06 Hrs]**

Unit 2

Analog Modulation Schemes

Amplitude modulation, AM representation in time domain and frequency domain, modulation index, bandwidth and power relations in AM, Frequency Modulation (FM), FM spectrum, bandwidth, pre-emphasis and de-emphasis, comparison of AM and FM **[08 Hrs]**

Unit 3

Digital Modulation Schemes

Advantages of digital signals, sampling theorem, pulse code modulation (PCM), PCM generation and reception, quantization noise, bit rate, bandwidth in PCM, companding in PCM, techniques of DPCM, DM and ADM, basic shift keying techniques ASK , FSK and PSK **[08 Hrs]**

Unit 4

Fiber Optic and Satellite Communication

Basics of optical communication, structure of optical fiber, advantages and applications of optical fiber communication, basic schematic of satellite communication, role of transponder, LEO, MEO and GEO satellites and their applications. **[06 Hrs]**

Unit 5

PSTN and Mobile communication

Basic telephony, PSTN structure, basics of cellular (mobile) telephony, GSM architecture, Mobile and base identification, mechanisms of originating a call, receiving a call, and handoffs, Introduction to 2G, 3G & 4G **[06 Hrs]**

Unit 6

Information Theory and Source Coding:

Introduction to Information theory, Information and Entropy, Channel coding theorem, Source coding theorem, Huffman & Shannon Fano coding Techniques **[06 Hrs]**

Text book:

- Blake, "Wireless Communication Technology", Thomson publication.
- Kennedy, "Electronic Communication Systems", McGraw Hill publication.

References Books:

- R G. Gallager, "Information theory and reliable communication" Wiley publication
- Simon Haykin, " Introduction to Analog and Digital Communication Systems", John Wiley
- B.P. Lathi, "Communication Systems", BS publications

(ET 16017-B) Microcontroller based systems

Teaching Scheme
Lectures : 3 Hrs/week

Examination Scheme
Test-1: 20 marks, Test-2: 20 marks
End-Sem Exam: 60 marks

Course outcomes

At the end of this course students will demonstrate the ability to

1. Understand the internal architecture and interfacing of different peripheral devices with PIC/AVR Microcontrollers
2. Understand the role and design concept of embedded systems in industry
3. Design layout of PCB using PCB layout design tool

Unit1

Overview of combinational and sequential digital design and its applications **[04 Hrs]**

Unit2

Understanding embedded system:
Overview of Processors & Microcontrollers, Memory (RAM, ROM, EPROM, EEPROM, FLASH), I/O Interface, RISC, CISC, Harvard Architecture, Von-Neuman Architecture **[06 Hrs]**

Unit 3

Microcontroller architecture – PIC/ AVR family: RISC Architecture of AVR, PIC, ARM family, Addressing modes, Instruction Set, Assembly Programming, Programming Exercises. **[08 Hrs]**

Unit 4

Interfacing of PIC and AVR with LEDs, Switches, DC Motor, Stepper Motor, Relay, ADC, DAC, Temperature Sensor, Serial Communication, LCD, Seven segments displays **[08 Hrs]**

Unit 5

PCB design - History of PCB/ Types of PCB/Base Material: Design Rules IPC-Standard 2221, Design Factors, Entry of Schematic Diagram / Net list File Creation, Layout Rules & Parameters/Library & Its Components, Practical Component Placement, Layout Checklist (general/electrical/physical), Cross Probing, Conductor routing. **[08 Hrs]**

Unit 6:

Mini project using any of the above technology **[06 Hrs]**

Text Books:

- Mazidi, Naimi, "The AVR microcontroller and embedded systems using assembly and c", Pearson
- Mazidi, Kinlay, Causey, " PIC Microcontroller and Embedded Systems-using Assembly and C", Prentice Hall

Reference Books:

- Bates Martin, " PIC microcontrollers – an introduction to microelectronics", 3rd edition, Newness
- R.S Khandpur, **"**Printed Circuit Boards: Design, Fabrication, and Assembly", Mc-Graw hill
- Raj Kamal, " Embedded systems", Tata McGraw-Hill, 2nd edition, 2011

(PH 16001) Foundation of Physics

Teaching Scheme :
Lectures:3 hrs /week

Examination scheme:
Test 1 & 2: 20 marks each
End Sem exam: 60 Marks

Course Outcomes:

At the end of the course student should be able to

a) Develop the understanding of laws of thermodynamics and their application in various processes, optics and their applications.
b) Solve the basic problems in Classical Mechanics
c) Derive the Wave Mechanics of microscopic bodies.
d) Formulate and solve the engineering problems on Electromagnetism.

Unit 1 Thermodynamics **(6 hrs)**

i) Heat as a form of energy , mechanical equivalent of heat, thermodynamic systems,
ii) Zeroth law and concept of temperature, first law & its mathematical statement,
iii) Second law and concept of entropy, third law of thermodynamics,
v) Concept of free energy; Gibbs and Helmoltz free energy.

Unit 2 Waves motion & Optics **(6 hrs)**

i) Logitudinal and transeverse waves, Light as an EM wave and it's graphical representation,
ii) General equation of traveling wave,
iii) Superposition principle, formation of stationary waves (with derivation),
iv) Huygen's Principle, Young's double slit experiment,
v) Interference of light due to thin film of uniform thickness and conditions for darkness and brightness,
vi) Diffraction due to a single slit; conditions of maxima and minima.

Unit 3 General Mechanics **(6 hrs)**

i) Kinetic energy and potential energy,
ii) Work done (single particle system only); work energy theorem,
iii) Conservative and non conservative forces, concept of central force, properties of central force,
iv) Laws of planetary motion (with mathematical statement).

Unit 4 Introduction to Quantum Mechanics **(6 hrs)**

i) Drawbacks of classical mechanics, Plank's quantum hypothesis, Dual nature of matter,
ii) De Broglie's hypothesis, de Broglie's wavelength,
iii) Photoelectric effect, Davisson-Germer's experiment,
iv) Heisenberg's uncertainty principle
v) Illustrations of Heisenberg's uncertainty principle; electron diffraction at a single slit

Unit 5 Electrostatics **(6 hrs)**

i) Coulomb's law in integral form, the electric field intensity ,
ii) Continuous charge distribution (Line, Surface & Volume),
iii) Introduction to Gauss's law, integral form of Gauss's law,
iv) Applications of Gauss's Law to simple 2D-3D problems ,
v) Line integral of electric field, concept of electric potential (V),
vi) Potential (V) due to continuous charge distribution.

Unit 6 Magnetostatics **(6 hrs)**

i) Steady currents (line current ,surface current,volume current) & current densities,
ii) Magnetic field due to steady currents (Biot-Savert's law) and it's applications,
iii) Line integral of B over a closed loop,
iv) Ampere's Law and its applications to simple problems,
v) Closed surface integral of B (Non-existence of magnetic monopole).

References:

Unit 1: H. C. Verma & Halliday-Resnick (Sixth edition), B. B. Laud
Unit 2: Halliday-Resnick (Sixth edition)
Optics by Brij Lal (S. Chand Publication)
Unit 3: Classical Mechanics by P. V. Panat,
H. C. Verma, Halliday –Resnick (Sixth edition)
Unit 4: Halliday-Resnick (Sixth edition)
Unit 5 & 6: Classical Electrodynamics by David Griffith (Pearson India limited)

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