College of Engineering, Pune

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

Department of Computer Engineering and Information Technology

Curriculum Structure & Detailed Syllabus (UG Program)

Second Year B.Tech. Information Technology

(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.

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Program Education Objectives (PEOs):

The Undergraduate students will demonstrate..

I. Acquire sound knowledge in Information Technology to contribute effectively to the needs of IT industry and the society at large.

II. Gain sufficient capabilities in technologies used particularly in the sectors of communications, distributed computing and testing which are relevant to IT industry.

III. Formulate, analyze and solve real life problems face in industry.

IV. Able to learn the latest trends in Information Technology and ready for life-long learning process.

V. Have awareness about professional ethics of the Software Industry, basic soft skills essential for working in community and professional teams.

VI. Able to appear for competitive examinations, in order to reach higher echelons of excellence.

Program Outcomes (POs):

The Undergraduate Students will demonstrate...

1. Graduates will demonstrate basic knowledge in fundamentals of Information Technology and related programming technologies.
2. Graduates will demonstrate basic knowledge of networking with wireless technologies, multimedia technology and distributed computing, software testing and topics of current relevance to IT industry.
3. Graduates will have knowledge of the best practices in software development in industry.
4. Graduates will demonstrate the ability to design creative solutions to real life problems.
5. Graduates will demonstrate capability to work in teams and in professional work environments.
6. Graduates will be able to communicate technical topics in written and verbal forms.
7. Graduates will demonstrate an understanding of the problems of the IT industry.
8. Graduates will demonstrate their ability to use the state of the art technologies and tools including Free and Open Source Software (FOSS) tools in developing software.
9. Graduates will demonstrate good performance at the competitive examinations like GATE, GRE, CAT for higher education and / or seek employment.
10. Graduates will demonstrate their qualities of learning and demonstrating latest technology.
11. Graduates will have developed the capability for self-learning.

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			✓		✓	✓		✓			
VI									✓		✓

Note: The cells filled in with ✓ indicate the fulfilment/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 [Odd Term]

Sr. No.	Course Type	Course Name	Teaching Scheme			Credits
			L	T	P	
1	BSC	Ordinary Differential Equations and Multivariate Calculus	2	1	-	**3**
2	BSC	Science of Living Systems	3	0	0	**3**
3	MLC	Professional Ethics & Values	1	-	-	**0**
4	HSMC	Innovation	1	-	-	**1**
5	SBC	Programming Laboratory	0	0	2	**1**
6	PCC1	Data Structures and Algorithms	**3**	1	0	**4**
7	PCC2	Digital Logic Design	3	0	0	**3**
8	PCC3	Discrete Structures and Graph Theory	3	0	0	**3**
9	SBC	Data Structures and Algorithms Laboratory	0	0	4	**2**
10	LC2	Digital Logic Design Laboratory	0	0	2	**1**
			16	**2**	**8**	**21**
		Total Academic Engagement and Credits	**26**			**21**

Semester IV [Even Term]

Sr. No.	Course Type	Course Name	Teaching Scheme			Credits
			L	T	P	
1	BSC	Vector Calculus and Partial Differential Equations	2	1	-	**3**
2	ILOE	Information Systems [For Other Departments]	3	-	-	**3**
4	PCC1	Theory of Computation	3	-	-	**3**
5	PCC2	Microprocessor Techniques	3	-	-	**3**
6	PCC3	Principles of Programming Languages	3	-	-	**3**
7	PCC4	Data Communication	3	-	-	**3**
8	LC1	Microprocessor Techniques Laboratory	-	1	2	**2**
9	SBC	Principles of Programming Languages Laboratory	-	-	2	**1**
			17	**2**	**4**	**21**
		Total Academic Engagement and Credits	**23**			**21**

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	0	5
2	BSC	Science of Living Systems	3	0	0	3
3	BSC	Foundation of Physics	3	0	0	3
4	MLC	Professional Ethics & Values	1	0	0	0
5	HSMC	Innovation	1	0	0	1
6	SBC	Programming Laboratory	0	0	2	**1**
7	PCC1	Data Structures and Algorithms	**3**	1	0	**4**
8	PCC2	Digital Logic Design	3	0	0	**3**
9	PCC3	Discrete Structures and Graph Theory	3	0	0	**3**
10	SBC	Data Structures and Algorithms Laboratory	0	0	4	**2**
11	LC2	Digital Logic Design Laboratory	0	0	2	**1**
			18	**2**	**8**	**23**
		Total Academic Engagement and Credits	**31**			**26**

Sr. No.	Course Type	Course Name	Teaching Scheme			Credits
			L	T	P	
1	BSC	Multivariate Calculus and Differential Equations	4	1	-	5
2	ILOE	Information Systems [For Other Departments]	3	-	-	3
4	PCC1	Theory of Computation	3	-	-	**3**
5	PCC2	Microprocessor Techniques	3	-	-	**3**
6	PCC3	Principles of Programming Languages	3	-	-	**3**
7	PCC4	Data Communication	3	-	-	**3**
8	LC1	Microprocessor Techniques Laboratory	-	1	2	**2**
9	SBC	Principles of Programming Languages Laboratory	-	-	2	**1**
			19	**2**	**4**	**23**
		Total Academic Engagement and Credits	**27**			**23**

Semester-III

(MA 16001) Ordinary Differential Equations and Multivariate Calculus

Teaching Scheme:
Lectures : 2 Hrs/week
Tutorial: 1 Hr/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, substitutions in multiple integrals, Applications to Area, Volume, Moments and Center of Mass. **[11 Hrs]**

Text Books:

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

Reference Books:

- Author name, "Title of the book in double quotes", Publisher, Edition, Year
- 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.
- C.R. Wylie, " Advanced Engineering Mathematics" , McGraw Hill Publications, New Delhi
- Peter V. O' Neil, "Advanced Engineering Mathematics", Thomson Brooks / Cole, Singapore, 7th edition

(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, bioimaging, 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.

Selected 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.

(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 herself/himself.
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.

(CT 16003) Programming Laboratory

Teaching Scheme:
Laboratory : 2 hours per week

Examination Scheme:
Practical/Oral Exam: 50 marks
Term work: 50 marks

Course Outcomes:

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

1. Understand, analyze and create web page using HTML and file handling

2. Understand basic programming language concepts, particularly Java and object-oriented concepts
3. Implementation of various operations on Stack, Queue and List.
4. Implement various searching and sorting algorithms.
5. Acquire practical knowledge of android technology for project development

Suggested List of Assignments:

1. Design a student registration form using HTML and write the data to a file using CGI scripts

2. Implement stack and list data types using C++/Java.
3. Demonstrate the use of List, and Queue type using Standard template library of C++/Java

4. Implementing stack and list data types in C++/Java using Eclipse IDE.
5. Implement binary search and selection sort algorithm in C++/Java using Eclipse IDE.
6. Design a text based normal and scientific calculator using C++/Java in Eclipse with help of built in libraries for advanced math operation
7. Design any game in android using Eclipse or android studio. Student can use any library as per requirement. (Mini Project)

(CT 16004) Data Structures and Algorithms

Teaching Scheme:
Lectures : 3 Hrs/week
Tutorial: 1 Hr/week

Examination Scheme:
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes:

Students will be able to:

1. Write neat code by selecting appropriate data structure and demonstrate a working solution for a given problem.
2. Think of all possible inputs to an application and handle all possible errors properly.
3. Analyze clearly different possible solutions to a program and select the most efficient one.
4. Write an application requiring an effort of at least 1000 lines of code to demonstrate a good working solution.
5. Demonstrate the ability to write reusable code and abstract data types in C, using object-based way of thinking.

Unit I : Introduction: Data. Data types. Object, data structure and abstract data types (ADT). Characteristics of an algorithm. Analyzing programs. Frequency count. Time and space complexity. Big 'O' and Ω" notation. Best. average and worst cases. Dangling pointers and garbage memory.
[4 Hrs]

Unit II : Arrays. Files and Searching: Searching: linear and binary search algorithm. Hashing: hashing functions, chaining, overflow handling with and without chaining, open addressing: linear. quadratic

probing. Files handling: text and binary files, use of various libraries for handling files. **[6 Hrs]**

Unit III : Stacks and Queues: Stack and queue as ADT. Operations on stack and queue. Implementations using arrays and dynamic memory allocation. Application of stack for expression evaluation, expression conversion. Recursion and stacks. Problems like maze and knight's tour.
[6 Hrs]

Unit IV : Lists: List as ADT. Concept of linked organization of data against linked list. Singly linked list, doubly linked list, circular linked list. Representation & manipulations of polynomials/sets using linked lists. Dynamic memory management. Representation of sparse matrix. Addition and transpose of sparse matrix. **[8 Hrs]**

Unit V : Trees and Graphs: Basic terminology. Binary trees and its representation. Binary tree traversals (recursive and non recursive) and various operations. Insertion and deletion of nodes in binary search tree. Representation of graphs using adjacency matrix, adjacency list. Implementation of algorithms for traversals; implementing Kruskal's. Prim's algorithms. Single source shortest paths using Djkstra's algorithm. Applications of graphs and trees. **[8 Hrs]**

Unit VI : Time Complexity Analysis, Algorithm Design: Verification of programs, invariants, assertions, proof of termination. Best, Average and Worst case analysis of: binary search, quick sort, merge sort, insertion sort, hashing techniques, sparse matrix algorithms. Designing data structures for specific applications. **[8 Hrs]**

Text Books:

- E. Horowitz, S. Sahni, S.Anderson-freed, “Fundamentals of Data Structures in C”, Second Edition, University Press, ISBN 978-81-7371-605-8
- B. Kernighan, D. Ritchie, “The C Programming Language”, Prentice Hall of India, Second Edition, ISBN 81-203-0596-5
- Y. Langsam, M. Augenstin and A. Tannenbaum, “Data Structures using C”, Pearson Education Asia, First Edition, 2002, ISBN 978-81-317-0229-1

Reference Books:

- Ellis Horowitz, S. Sahni, D. Mehta “Fundamentals of Data Structures in C++”, Galgotia Book Source, New Delhi 1995 ISBN 16782928
- Jean-Paul Tremblay, Paul. G. Soresan, “An introduction to data structures with Applications”, Tata Mc-Graw Hill International Editions, 2nd edition 1984, ISBN-0-07-462471-7

(CT 16005) Digital Logic Design

Teaching Scheme:
Lectures : 3 Hrs/week

Examination Scheme:
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes:

Students will be able to:

1. Apply the knowledge of number systems and codes in problem solving related to code conversion and number system.
2. Learn and understand the basic concepts of combinational logic devices and apply the concepts in designing them.
3. Learn and understand the fundamentals of sequential logic devices and apply the concepts in designing them.
4. Apply and design the logical devices by using all these concepts along with implementation knowledge of hardware and peripheral design.

Unit I : Introduction to Number systems and codes : Binary number systems , Signed binary numbers, Binary arithmetic,1's and 2's complement, Octal number system, hexadecimal number system, Introduction to gates, Minimization of Boolean function using Karnaugh Map (up to four variable),SOP-POS, Quine - Mclusky methods, Code conversions- Binary code to gray code and gray to binary, BCD to Excess – 3,Excess – 3 to , BCD code etc. **[8 Hrs]**

Unit II : Design of Combinational Logic Circuits: Modular combinational logic elements, Overview & implementation of multiplexer/ demultiplexer, Implementation of Combinational Logic Circuits using mux / demux, Decoders, Encoders, Priority encoders. Design of Integer Arithmetic Circuits using Combinational Logic: Integer adders, Ripple carry adder and Carry look ahead adder, Integer subtractions using adders, Design of Combinational Circuits using Programmable Logic Devices (PLDs):Programmable Read Only Memories (PROMs), Programmable Logic Arrays (PLAs),Programmable Array Logic (PAL) devices **[8 Hrs]**

Unit III : Design of Sequential Logic Circuits: Latches: RS latch and JK latch, Flip-flops-RS, JK, T and D flip flops, Master-slave flip flops, Edge-triggered flip-flops. Analysis and Design of Synchronous Sequential Circuits: Introduction to sequential circuits, Characteristic table, Characteristic equation and Excitation table. **[8 Hrs]**

Unit IV: Modular sequential logic circuits: Registers, Design of Synchronous / Asynchronous using different flip-flops. Overview of Shift registers. Counters-Synchronous / Asynchronous, Up-down, Ring, Johnson counter. **[6 Hrs]**

Unit V : Algorithm State Machines: ASM charts, notation ,RTL notation and implementation design of simple controller, multiplexer controller method. **VHDL**: Introduction to HDL, VHDL- Library. **[5 Hrs]**

Unit VI Memories: Random access memory, TTL RAM cell, parameter read write cycles, ROMs EPROM,MOS-static RAM cell, dynamic RAM cell, refreshing, memory cycles. **[5 Hrs]**

Text Books:

- M Morris Mano "Digital Design" 3rd Edition Prentice Hall 2001 ISBN-10 / ASIN: 0130621218 ISBN-13 / EAN: 9780130621214
- R.P. Jain, "Modern Digital Electronics", 3rd Edition, Tata McGraw-Hill, 2003, ISBN 0 – 07 – 049492 – 4
- A.P. Malvino, D. P. Leach and G.Saha, "Digital Principles and Applications," 7/e, McGraw Hill, 2010.

Reference Books:

- Wakerly Pearon, "Digital Design: Principles and Practices", 3rd edition, 4th reprint, Pearson Education, 2004.
- A. Anand Kumar, "Fundamentals of digital circuits" 1st edition, PHI publication, 2001.
- Mark Bach, "Complete Digital Design", Tata MCGraw Hill, 2005.
- Stephen Brown, "Fundamentals of digital logic design with VHDL" 1st edition, TMH Publication 2002.

(CT 16006) Discrete Structures and Graph Theory

Teaching Scheme:
Lectures : 3 Hrs/week

Examination Scheme:
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes:

Students will be able to:

1. Explain basic terminology, formal logic, proofs, sets, relations, functions, recursion
2. Use formal logic proof and logical reasoning to solve problems
3. Relate the ideas of mathematical induction to recursion and recursively defined structures
4. Solve problems based on graphs, trees and related algorithms
5. Relate, interpret and apply the concepts to various areas of computer science

Unit I : Set Theory , Logic and Proofs : Propositions, Conditional Propositions, Logical Connectivity, Propositional calculus, Universal and Existential Quantifiers, First order logic, Proofs: Proof Techniques, Mathematical Induction. Set, Combination of sets, Finite and Infinite sets, Un-countably infinite sets, Principle of inclusion and exclusion , strong Induction **[6 Hrs]**

Unit II : Relations, Functions, Recurrence Relations: Definitions, Properties of Binary Relations, Equivalence Relations and partitions, Partial ordering relations and lattices, Chains and Anti chains. Theorem on chain, Warshall's Algorithm & transitive closure, Recurrence relations. **Functions:** Definition, Domain, Range, Image, etc. Types of functions: Surjection, Injection, Bijection, Inverse, Identity, Composition of Functions **[8 Hrs]**

Unit III : Number Theory: Basics of Modulo Arithmetic, Basic Prime Number Theory, GCD, LCM, Divisibility, Euclid's algorithm, Factorization, Chinese Remainder Theorem Fields: Naturals, Integers, Rationals, Reals, Complex Numbers Properties of operations: associative, commutative, distributive, identity, inverse **[6 Hrs]**

Unit IV : Counting Basic Counting Techniques (sum, product, subtraction, division, exponent), Pigeonhole and Generalized Pigeonhole Principle with many examples, Permutations and Combinations and numerical problems, Binomial Coefficients Pascal's, Identity and Triangle, Generating Permutations and Combinations **[6 Hrs]**

Unit V : Graphs & Trees Basic terminology, multi graphs and weighted graphs, paths and circuits, shortest path Problems, Euler and Hamiltonian paths and circuits, factors of a graph, planar graph and

Kuratowskis graph and theorem, independent sets, graph coloring. Trees, rooted trees, path length in rooted trees, binary search trees, spanning trees and cut set, theorems on spanning trees, cut sets , circuits, minimal spanning trees, Kruskal's and Prim's algorithms for minimal spanning tree.

[8 Hrs]

Unit VI : Algebraic Systems: Algebraic Systems, Groups, Semi Groups, Monoids, Subgroups, Permutation Groups, Codes and Group codes, Isomorphism and Automorphisms, Homomorphism and Normal Subgroups, Ring, Field. **[6 Hrs]**

Text Books:

- C. L. LIU, "Elements of Discrete Mathematics", 2nd Edition, Tata McGraw-Hill, 2002, ISBN: 0-07-043476-X.
- G. Shanker Rao, "Discrete Mathematical Structures", New Age International, 2002, ISBN: 81-224-1424-9

Reference Books:

- Lipschutz, Lipson, Discrete Mathematics, 2nd Edition, Tata McGraw-Hill, 1999, ISBN 0-07-463710--X.
- V. K. Balakrishnan, Graph Theory, TMH (Recommended for Graph), ISBN 0-07-058718-3
- B. Kolman, R. Busby and S. Ross, "Discrete Mathematical Structures", 4th Edition, Pearson Education, 2002, ISBN 81-7808-556-9
- J. Tremblay, R. Manohar, "Discrete Mathematical Structures with application to Computer Science", McGraw-Hill, 2002 ISBN 0-07-065142-6 (Recommended for prepositional Calculus)
- Kenneth H. Rosen: Discrete Mathematics and Its Applications, 5th Edition, Tata McGraw-Hill, 2003, ISBN 0-07-053047-5
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(CT 16007) Data Structures And Algorithms Laboratory

Teaching Scheme:
Laboratory : 4 hours per week

Examination Scheme:
Continuous evaluation: 50 Marks
Mini Project: 20 marks
End Semester Exam: 30 Marks

Course Outcomes:

Shared with the theory course: "Data Structures and Algorithms"

List of Assignments:

1. Write any 1 program showing your indentation and formatting skills. The program need not have any meaning, but it should have following constructs in C: if, while, for, switch, One nesting of 3 levels, = , * , scanf, printf, variables declaration
2. Create an account on typeracer.com. Participate in some race and show a speed of at least 40 words per minute.
3. Draw a diagram of data structures created by given code using a tool like xfig.
4. Write a program to compute x^y based on using base-3 presentation of a number. In the program, write a function which computes x^y

5. Write a program to remove duplicate doubles from an array of doubles. In the program, write a function which accepts an array of doubles and removes the duplicates from the array and has return type void.
6. Compare the time complexity of two sorting algorithms, by following the given steps. Create a set of data files with count of integers varying into thousands and millions. Sort the files using both the algorithms. Plot graph of the time taken by both the programs using tool like gnuplot. Compare the graphs and comment on the time complexity theoretically predicted and practically observed.
7. Write a function which evaluates an infix expression, without converting it to postfix. The input string can have spaces, (,) and precedence of operators should be handled.
8. Implement a queue (that is write queue.c and queue.h only) of characters, such that on an enqueue, the char is added at the end of queue, and on a dequeue the first element is taken out, but the queue uses only a 'head' pointer and not a 'tail pointer.
9. Write an data type called "Integer". The data type should represent integers of unlimited length.
10. Write a sorting program with the following features: Reads data from a text file and sorts it alphabetically by default. If the file has data in rows and columns (separated by space or tab) then allows sorting on a particular column. Allows any sort using numeric or alphbetical ordering.
11. Write the following functions for a binary search tree implementation: Searches the maximum value in the tree, preorder traversal without using recursion, Search the str in the tree and returns a pointer to the node, print the binary tree so that it lookks like a tree
12. Write a graph implementation, using adjacency lists.
13. Mini-project: Write an application of your own demonstration your skills in defining a problem, writing down the requirements carefully, designing a modular solution with clear separation of abstract data types and their use, design of proper function prototypes and division of work among functions. The application can be a unix command re-implemented (e.g. cut, find, tar, fdupes, bc, etc.), reimplementation of C library functions, memory allocator, a simple game using libraries like n-curses or SDL, games like sudoku or chess, or an application to manage institutions like hospitals, colleges, shops, etc.

(CT 16008) Digital Logic Design Laboratory

Teaching Scheme:
Laboratory : 2 hours per week

Examination Scheme:
Practical/Oral Exam: 50 marks
Term Work: 50 marks

List of Assignments:

1. Implementation of Boolean function using Gates
2. Code converters:
    - Binary to gray
    - Gray to binary

- Excess – 3 code to BCD
- BCD to Excess – 3 code.

3. Design of half adder, full adder.
4. Design of half subtract or , full subtract or.
5. K-map examples implementation
6. Quine-Mc'clusky examples implementation.
7. Design of :
    - 3 bit odd Parity Checker
    - 4 bit odd Parity Checker
    - 3 bit even Parity Checker
    - 4 bit even Parity Checker
8. Implementation of Multiplexer and Demultiplexer.
9. BCD adder using 4 bit adder IC.
10. Study of flip flops-
    - RS flip-flop
    - D flip-flop
    - T flip-flop
    - J-K flip-flop
11. Design of Synchronous Counter.
12. Design of Asynchronous counter.
13. Design of up / down counters.
14. Design of Sequence generator.
15. Design of Ring counter.
16. Design of Johnson Counter
17. Study Assignment on VHDL programming.

(MA) Vector Calculus and Partial Differential Equations

Teaching Scheme:
Lectures : 2+1 hrs/week
Credits: 2-1-0-3 (L-T-P-C)

Examination Scheme:
Internal Test 1 – 20 marks
Internal Test 2 – 20 marks
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. **[9 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.
[7 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:

- Lipschutz, Lipson, Discrete Mathematics, 2nd Edition, Tata McGraw-Hill, 1999, ISBN 0-07-463710--X.
- V. K. Balakrishnan, Graph Theory, TMH (Recommended for Graph), ISBN 0-07-058718-3
- B. Kolman, R. Busby and S. Ross, "Discrete Mathematical Structures", 4th Edition, Pearson Education, 2002, ISBN 81-7808-556-9
- J. Tremblay, R. Manohar, "Discrete Mathematical Structures with application to Computer Science", McGraw-Hill, 2002 ISBN 0-07-065142-6 (Recommended for prepositional Calculus)
- Kenneth H. Rosen: Discrete Mathematics and Its Applications, 5th Edition, Tata McGraw-Hill, 2003, ISBN 0-07-053047-5

(CT 16010) OPEN ELECTIVE - Information Systems

Teaching Scheme:
Lectures : 3 hrs/week

Examination Scheme:
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes:

After studying this course it will develop ability to:

1. Analyze functional and non-functional requirements to produce a system architecture that meets those requirements
2. Understand and apply process and methodology in building the application
3. Create design models using known design principles (e.g. layering) and from various view points (logical, physical etc.)
4. Explain and justify all the design choices and tradeoffs done during the application's development

Unit I : Introduction: Define and understand the term information systems (IS). Technology, people, and organizational components of an information system, various types of information systems, nature of information systems in the success and failure of modern organizations, Understand and plan for the future of managing IS. Information systems for automation, organizational learning and strategic support, Formulate and present the business case for a system.

[5 Hrs]

Unit II : Database Management and Internet: Importance of databases in modern organizations, Working of database management systems, Database design, Query Processing, how organizations are getting the most from their investment in database technologies. Role of telecommunications in organizations, Types of computer networks, Extranets, Intranets, Working of Internet, Basic Internet services, World Wide Web. **[6 Hrs]**

Unit III : Information Systems Development and Acquisition: Process used by organizations to manage the development of information Systems. Major phases of the systems development life cycle: systems identification, selection, and planning; system requirement specifications; system design; system implementation; and system maintenance. Software prototyping, rapid application development, object-oriented analysis and design methods of systems development and their strengths and weaknesses, Factors in building a system in-house, along with situations, three system development options: external acquisition, outsourcing, and end-user development.

[8 Hrs]

Unit IV : Organizational Information Systems: Characteristics of the operational, managerial, and executive levels of an organization, decision support systems, expert systems, office automation systems, collaboration technologies. **[7 Hrs]**

Unit V : Electronic Commerce: Business to Customer e-commerce, Business to Business e-commerce, Customer to Customer e-commerce, Advantages and disadvantages of e-commerce, E-Commerce System Architecture, Payment schemes in e-commerce, Cash transactions in e-commerce, e-commerce applications. **[6 Hrs]**

Unit VI : Information Systems Ethics, Computer Crime, and Security: Impact of computer ethics on information systems, Issues associated with information privacy, accuracy, property and accessibility, computer crime and list several types of computer crime, computer virus, worm, Trojan horse, and logic or time bomb, various methods for providing computer security, IT Act 2000.

[6 Hrs]

Text Books:

- "Information Systems Today, Managing in the Digital World" , Third Edition by Leonard M. Jessup; Joseph S. Valacich, Publisher: Prentice Hall
- "Introduction to Information Technology", V. Rajaraman, PHI

Reference Books:

- "Information Systems Management in Practice" Barbara C. McNurlin, Ralph H. Sprague, and Publisher: Pearson Education.

(CT 16011) Theory Of Computation

Teaching Scheme:
Lectures : 3 hrs/week

Examination Scheme:
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes:

Students will be able to:

1. Identify different formal language classes and their relationships
2. Design grammars and recognizers for different formal languages
3. Construct finite state machines and the equivalent regular expressions
4. Prove the equivalence of languages described by finite state machines and regular expressions.

Unit I : Introduction: Automata, Computability, and Complexity, Strings and languages: symbol, alphabet, string/ word. Language - Definition, language states, difference between natural and formal language. **[6 Hrs]**

Unit II : Finite Automata: Formal definition of a finite automaton, Examples of finite automata, Formal definition of computation, Designing finite automata, The regular operations. Non-determinism: Formal definition of a nondeterministic finite automaton, Equivalence of NFAs and DFAs, Closure under the regular operations. **[8 Hrs]**

Unit III : Regular Expressions and Pumping Lemma: Regular Expressions: Formal definition of a regular expression, Equivalence with finite automata. Nonregular Languages: The pumping lemma for regular languages. **[6 Hrs]**

Unit IV : Context-Free Languages: Context-free Grammars: Formal definition of a context-free grammar, Examples of context-free grammars, Designing context-free grammars, Ambiguity, Chomsky normal form. Pushdown Automata: Formal definition of a pushdown automaton, Examples of pushdown

automata, Equivalence with context-free grammars. Non-context-free Languages: The pumping lemma for context-free languages. **[8 Hrs]**

Unit V : The Church-Turing Thesis: Turing Machines: Formal definition of a Turing machine, Examples of Turing machines. Variants of Turing Machines: Multi-tape Turing machines, Nondeterministic Turing machines, Enumerators, Equivalence with other models. The Definition of Algorithm: Hilbert's problems, Terminology for describing Turing machines. **[6 Hrs]**

Unit VI : Decidability: Decidable Languages: Decidable problems concerning regular languages, Decidable problems concerning context-free languages, The Halting Problem: The diagonalization method, The halting problem is undecidable, A Turing-unrecognizable language.

[6 Hrs]

Text Books:

- Michael Sipser, "Introduction to the Theory of Computation", Cengage Learning Publications, 3rd Edition, 2013.
- John E Hopcroft, Rajeev Motwani, J D Ullman, "Introduction to Automata theory, Languages, and Computations", Pearson Education Publisher, 3rd Edition, 2009

Reference Books:

- E. V. Krishnamurthy, "Theory of computer science", Affiliated East Press Publications, 2004.
- Dexter C. Kozen, Automata and Computability, Springer Verlag Publications, 1997.
- Harry Lewis, Christos H. Papadimitriou, "Elements of the Theory of Computation," Prentice-Hall Publications, 2nd Edition, 1997.
- John Martin, "Introduction to Languages and Theory of Computations", McGraw-Hill Publications, 4th edition, 2010
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(CT 16012) Microprocessor Techniques

Teaching Scheme:
Lectures : 3 hrs/week

Examination Scheme:
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes:

Students will be able to:

1. Students will be able to explain concepts of memory organization and design
2. Students will be able to explain x86 architecture
3. Students will have developed skills to develop an assembly language programs for the X86 microprocessor
4. Students will be able to interface peripheral chips with respect to timer, interrupts, serial communication and DMA controller.

Unit I : Review of tri-state logic, buffers, decoders, memory and memory organization using typical RAM Chips. Evolution of microprocessor, Introduction to x86 microprocessor architecture, clock drivers and

buffers. Memory interfacing, Memory Map, Address decoding logic. **[6 Hrs]**

Unit II : x86 instruction encoding format, addressing modes and Instruction set, Assembly language programming, Assembler directives, Stacks and subroutines. Bus cycle, wait state, programming with string instructions, loop, rep, architecture-dependent implementations of various constructs and mechanisms of high level languages . **[8 Hrs]**

Unit III : I/0 programming, Memory mapped I/O, I/O mapped I/O, Polled I/O, PPI 8255, Various operating modes of 8255, interfacing, and programming, 4x4 key matrix interfacing, Seven Segment display interfacing. **[6 Hrs]**

Unit IV : 8086 Interrupt structure, ISR, PIC 8259 interfacing and programming, 8253 Timer. **[6 Hrs]**

Unit V : 8279 Keyboard Display Controller, interfacing and programming, HOLD state and DMA, DMAC 8237. **[6 Hrs]**

Unit VI : Serial I/0, Asynchronous and Synchronous serial I/0, 8251 USART programming and interfacing, RS232C interface, Introduction to Maximum mode of 8086. **[8 Hrs]**

Text Books:

- Douglas Hall, "Microprocessors and Interfacing", 2nd edition, 1992, McGraw-Hill, ISBN-0-07-100462-9
- John Uffenbeck, "The 8086/88 Family: Design, Programming & Interfacing", PHI, ISBN: 978-81-203-0933-3
- A.Ray, K.Bhurchandi,"Advanced Microprocessors and peripherals: Arch, Programming & Interfacing",Tata McGraw Hill, 2004,ISBN 0-07-463841-6

Reference Books:

- Liu, Gibson, "Microcomputer Systems: The 8086/88 Family", 2ndEdition, PHI, 2005, ISBN: 978-81-203-0409-3
- Ray Duncan, "Advanced MSDOS Programming", 2ndEdition, BPB Publication,ISBN 1-55615-157-8
- Kip Irvine,"Assembly language for IBM PC", PHI, 2ndEdition, 1993
- Peter Abel,"Assembly language programming", Pearson Education, 5thEdition, 2002, ISBN-10: 0137566107

(CT 16013) Principles of Programming Languages

Teaching Scheme:
Lectures : 3 hrs/week

Examination Scheme:
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes:

Students will be able to:

1. Draw the control flow of a program.
2. Understand the storage concepts in a simple program.
3. Program using basic concepts of OO languages i.e. objects, encapsulation, data hiding etc.
4. Program using advanced concepts of OO languages i.e. associations, packages, interfaces, exception handling etc.
5. Work with functional, Logic programming paradigms.

Unit I : Introduction: Role of programming languages, need to study programming languages, characteristics of good programming languages, Introduction to various programming paradigms: Procedural, object-oriented, logic and functional, concurrent programming.

Data Types: Properties of structured and non-structured data types and Objects, variables, constants, Derived and abstract data types, declaration, type checking. Binding and binding times, type conversion, scalar data type, composite data types, Implementation and Storage representation of data types and control flow statement. **[6 Hrs]**

Unit II : Procedures: Procedure call and return, recursive subprogram, Different parameter passing methods, Lifetime of variables, Scope rules: Static and Dynamic scope, Referencing environment: activation records (Local, Non local and Global), Storage management (static and Dynamic), Exceptions and exception handling. **[8 Hrs]**

Unit III : Object Oriented Programming: Design Principles: Objects, classes, Messages and methods, Implementation of Object-oriented Programming objective. **[6 Hrs]**

Unit IV : Object oriented programming with Java: Program structure, Object and class declarations, constructors, inheritance, polymorphism, access specification, interfaces, packages, exception handling, file I/O, GUI development, socket programming. **[8 Hrs]**

Unit V : Logic Programming: Logic programming language model, logical statements, resolution, unification, search structures: backward and forward, Applications of logic programming. Functional Programming: Introduction to functional programming, Lambda calculus: Ambiguity, free and bound identifiers, reductions, typed lambda calculus, application of functional programming.

[6 Hrs]

Unit VI : Concurrent programming and functional programming: Basic concepts of Concurrent Programming: processes, synchronization primitives, safety and live-ness properties, Parallelism in Hardware, streams, concurrency as interleaving, safe access to shared data. Functional Programming.

[6 Hrs]

Text Books:

- Roosta S., "Foundations of Programming Languages", Thomson, Brooke/Cole, ISBN 981 243-141-1
- Sethi R., "Programming Languages concepts & constructs", 2nd Edition, Pearson Education,ISBN 81 - 7808 - 104 – 0
- Herbert Schilt, “JAVA Complete Reference”, 7th Edition, Tata McGraw Hill, ISBN: 9780070636774
- Mark Lutz, “Learning Python”, 2nd Edition, O'reilly, ISBN: 978-0-596-00281-7

- Stanley B. Lippman, Josée Lajoie, Barbara E. Moo, “C++ Primer”, 3rd Edition, Addison Wesley Professional, ISBN-10: 0201824701

Reference Books:

- Scbesta R., "Concepts Of Programming Languages", 4th Edition, Pearson Education, ISBN- 81-7808-161-X
- Ghezzi C, Milano P., Jazayeri M., "Programming Languages Concepts", 3rd Edition, John Wiley and Sons Pvt. Ltd (WSE), ISBN - 0195113063
- M. Ben Ari, “Principles of Concurrent Programming, 1989
- Eckel B., "Thinking in Java", 3rd Edition, Pearson Education,
- T. W. Pratt , "Programming Languages", 2nd Edition ,Prentice-Hall Of India, ISBN 81 - 297 - 0524 - 9
- Michael L. Scott “Programming Language Pragmatics”, ELSEVIER Publication, ISBN: 81- 8147-370-1

(CT 16014) DATA COMMUNICATION

Teaching Scheme:
Lectures : 3 Hrs/week

Examination Scheme:
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Course Outcomes:

Students will be able to:

1. After completing this course the student must demonstrate the knowledge and ability to: Independently understand basic computer network technology.
2. Understand and explain Data Communications System and its components.
3. Identify the different types of network topologies and protocols.
4. Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.
5. Understand and building the skills of sub-netting and routing mechanisms.
6. Familiarity with the basic protocols of computer networks, and how they can be used to assist in network design and implementation.

Unit I : Introduction: Data Communication, Networks, Internet, Protocols and Standards, Network Models: OSI, TCP/IP, Analog and Digital data, Periodic Analog Signal, Digital Signal, Transmission Impairments, Data Rate Limits, Performance. Signal Conversion: digital-to-digital, Analog-to-Digital, Analog-to-Analog, Digital-to-Analog Conversion. **[8 Hrs]**

Unit II : Bandwidth Utilization and Transmission Media: Multiplexing, Spread Spectrum, Guided Media and Unguided media. **[5 Hrs]**

Unit III : Switching: Circuit Switched Networks, Datagram Networks, Virtual Circuit Networks, Structure of Switch. **[3 Hrs]**

Unit IV : Error Detection and Correction: Types of Errors, Redundancy, Detection Vs Correction, FEC Vs Retransmission, Coding, Modular Arithmetic, Block Coding, Linear Block Codes, Cyclic Codes, Checksum, Hamming Code. **[6 Hrs]**

Unit V : Data Link Control: Framing, Flow Control and Error Control Protocols, Protocols: stop-and-wait, Go-Back-N, Selective-Repeat, Piggybacking , HDLC,PPP. **[6 Hrs]**

Unit VI : Medium Access, Ethernet and LAN: Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA, Controlled Access, Channelization, IEEE standards, different Ethernets, Connecting devices, Backbone networks, VLAN. **[8 Hrs]**

Text Books:

- B. A. Forouzan, "Data Communications and Networking", 5th Edition, Tata McGraw-Hill, 2013, ISBN-10: 1-25-906475-1
- Alberto Leon Garcia and Indra Widjaja, "Communication Networks, Fundamental Concepts and Key Architectures", 2nd Edition, Tata McGraw-Hill. 2004, ISBN-10: 007246352X

Reference Books:

- William Stallings, "Data and computer Communication", 7th Edition, Pearson Education, ISBN-81-297-0206-1
- A S Tanenbaum, "Computer Networks", 4th Edition, Pearson Education, ISBN 9788177581652
- S. Keshav , "Engineering Approach to Computer Networks", Pearson Education, 1997, ISBN-13: 9780201634426
- J.F. Kurose and K. W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet" , 2nd Edition, Pearson, 2003, ISBN-13: 9780201976991

(CT 16015) Microprocessor Techniques Laboratory

Teaching Scheme
Credits: 0-1-2-3 (L-T-P-C)
Laboratory : 2 hours per week,
Tutorial 1 Hour per week

Examination Scheme :
Term work - 50 Marks
Practical Exam/Oral – 50 Marks

Laboratory Outcomes:

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

1. Students will demonstrate skill of developing assembly programs for the X86 microprocessor
2. Students willl demonstrate techniques for interfacing I/O devices to microprocessor.

List of Experiments/Assignments:

Assignments based on

X86 Assembly language Program development using

1. Data transfer, arithmetic and control instructions
2. Assembler directives
3. Stack and Subroutine
4. String instructions

Interfacing, programming of peripheral chips 8255/8259/8253/ 8251/8279/DAC.

Text Books:

- Carl Hamacher, Zvonko Vraesic and Safwat Zaky, Computer Organisation, 5thEdition, 2002, McGraw-Hill, ISBN 0-07-120411-3
- Douglas Hall, "Microprocessors and Interfacing", 2nd edition, 1992, McGraw-Hill, ISBN-0-07-100462-9
- John Uffenbeck, "The 8086/88 Family: Design, Programming & Interfacing", PHI, ISBN: 978-81-203-0933-3
- A.Ray, K.Bhurchandi,"Advanced Microprocessors and peripherals: Arch, Programming & Interfacing",Tata McGraw Hill, 2004,ISBN 0-07-463841-6

Reference Books:

- William Stallings, "Computer Organization And Architecture Designing For Performance", Pearson Education, 8thEdition, 2010, ISBN: 978-81-317-3245-8
- Liu, Gibson, "Microcomputer Systems: The 8086/88 Family", 2ndEdition, PHI, 2005, ISBN: 978-81-203-0409-3
- Ray Duncan, "Advanced MSDOS Programming", 2ndEdition, BPB Publication,ISBN 1-55615-157-8
- Kip Irvine,"Assembly language for IBM PC", PHI, 2ndEdition, 1993
- Peter Abel,"Assembly language programming", Pearson Education, 5thEdition, 2002, ISBN-10: 0137566107

(CT 16016) Principles of Programming Languages Laboratory

Teaching Scheme
Laboratory : 2 hours per week

Examination Scheme :
Continuous evaluation: 55 Marks
Mini Project: 15 marks
End Semester Exam: 30 Marks

Laboratory Outcomes:

Shared with the theory course: Principles of Programming Languages

List of Experiments/Assignments:

1. Assignment to understand creation of activation record.
2. Assignment to write program in OO language to understand concept of data abstraction and encapsulation.

3. Assignment to write program in OO language to understand concept of class inheritance and polymorphism.
4. Assignment to write program in OO language to understand concept of exception handling and file I/O.
5. Assignment to write an expert system using functional programming language.
6. Assignment to write a program to demonstrate use of logical programming language.
7. Assignment to write a program to demonstrate threads.
8. Assignment to write a program to demonstrate use of functional programming language.

(MA) Linear Algebra and Univariate Calculus

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

Examination Scheme:
Internal Test 1 – 20 marks
Internal Test 2 – 20 marks
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 (12th edition) by Maurice D. Weir, Joel Hass, Frank R. Giordano, Pearson Education.
- Advanced Engineering Mathematics (10th edition) by Erwin Kreyszig, Wiley eastern Ltd.

Reference Books:

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

(MA) Multivariate Calculus and Differential Equations

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

Examination Scheme:
Internal Test 1 – 20 marks
Internal Test 2 – 20 marks
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 : Functions of several variables, level curves and level surfaces, partial and directional derivatives, differentiability, chain rule, local extreme values and saddle points. **[6 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:

- 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:

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

(AS16002) 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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