MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY

SYLLABUS

BACHELOR OF SCIENCE IN
COMPUTER SCIENCE AND ENGINEERING (CSE)

REVISED & APPLICABLE FOR CSE – 16 and 17 BATCHES

REVISED ON January 2019

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (CSE)
MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY (MIST)
MIRPUR CANTONMENT, DHAKA-1216, BANGLADESH

PREFACE

Military Institute of Science and Technology (MIST) offers undergraduate and graduate programs in the field of science and engineering. This syllabus is for the undergraduate students in the Department of Computer Science and Engineering (CSE) of MIST. Although this syllabus has been written mainly for the students, student advisers and teachers will find it valuable as a reference document. Also, anybody who desires to know about the course contents of CSE Department will find this book helpful.

This syllabus provides general information about MIST, its historical background, faculties and departments. Different aspects of the course system, such as rules and regulations relating to admission, grading system, requirement for degrees have been elaborated. It describes the course requirements, course objectives, detailed course outline and courses offered in different terms.

The fields of Computer Science and Computer Engineering are changing rapidly. So the departmental as well as the non-departmental courses for CSE students have been revised to cater for recent advancements in these fields. The introduction of a basic course on computer systems for a gentle introduction of the field to the newcomers is among the worth mentionable changes. Number of subjects in some semesters has also been reduced keeping the total credit hour almost unchanged. Moreover, students now have more freedom in subject selection to specialize in a certain direction in their final years.

The CSE Program of MIST presently follows the OBE (Outcome Based Education) approach for conducting courses. Consequently, Integrated Design Project, which is one of OBE’s salient features, has been introduced from 2019 in all corresponding undergraduate batches. The revised curriculum as incorporated in this syllabus is approved by the committee of courses. It will be placed before the academic council, MIST for necessary approval. CSE undergraduate students of all running batches (CSE-16, CSE-17, CSE-18 and onwards) will be under the revised syllabus from January 2019.

According to the policy of MIST, the syllabus is revised minimum once in every three years. Some of the information recorded in this syllabus is likely to be modified from time to time. Everybody concerned is strongly advised to be in touch with the advisers or the undersigned regarding modifications to be introduced later. It is hoped that this syllabus will be of much use to everybody concerned.

Dhaka, Bangladesh
January 2019

Air Commodore Md Afzal Hossain, ndc, psc
Head (Dept of CSE)

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CHAPTER 1

GENERAL INFORMATION

1.1 Introduction

Military Institute of Science and Technology (MIST), the pioneer Technical Institute of Armed Forces, started its journey from 19 April 1998. It was the visionary leadership of the Honorable Prime Minister of People's Republic of Bangladesh Sheikh Hasina to establish a Technical Institute of Armed Forces. Accordingly, the Honorable Prime Minister, People's Republic of Bangladesh, Sheikh Hasina unveiled the Foundation Plaque on 19 April 1998. MIST is located at Mirpur Cantonment, which is on the northwest of Dhaka City. Mirpur Cantonment is well known to be as an Education Village of Bangladesh Armed Forces, a hub of knowledge for military and civil professionals. First Academic Program at MIST was launched on 31 January 1999 with the maiden batch of Civil Engineering (CE). The pioneer batch comprised of only military students. Computer Science & Engineering (CSE) Program got underway from academic session 2000-2001. Following those Programs, Electrical, Electronic & Communication Engineering (EECE) and Mechanical Engineering (ME) Programs including induction of Civil Students (both male and female) to various disciplines started from the session 2002-2003. Aeronautical Engineering (AE) program started at MIST from Academic Session 2008-2009. The department of Naval Architecture and Marine Engineering (NAME) began its journey from academic session 2012-2013 with 30 students. Number of students in this new dept has been increased to 50 with effect from academic year 2014. Each of CE, CSE, EECE and ME dept has started its 2nd section with 55 students with effect from academic year 2014. Foreign students from Sri Lanka were admitted for the first time in the same Academic Session. Presently students from Maldives, Palestine, Nepal and Ghambia are also studying different Engineering Programs. MIST enters into the domain of "Online Admission System" since 06 Sep 2010. MIST envisages creating facilities for military as well as civil students from home and abroad dedicated to pursue standard curriculum leading to Graduation Degree. As an Institution without any gender biasness, MIST is already on steady stride upholding its motto "Technology for Advancement". MIST remains committed to contributing to the wider spectrum of National Educational Arena and play a significant role in the development of Human Resources and ardently pursuing its goal to grow into a "Centre of Excellence".

MIST has well equipped class rooms with multimedia and web camera with internet facilities and Laboratories with modern equipment. The medium of instruction for all engineering programs is English. All academic programs of MIST are affiliated with the Bangladesh University of Professionals (BUP) and have close cooperation with Bangladesh University of Engineering and Technology (BUET) and Dhaka University (DU). Academic Session of MIST normally starts in the last week of January. Admission process starts in September/October and Admission Test held in November every year. Admission formalities are completed by December/January. The total number of intake in a year is 595. In general a maximum of 50% seats are allocated to Armed Forces Officers. MIST has other miscellaneous facilities such as Medical Centre, Fitness Centre, Cyber Café, Broadband Internet facilities, Library and Students' Accommodation (Male & Female). Out of six programs, so far four departments of MIST namely CE, EECE, ME and CSE have achieved accreditation from BAETE (IEB) which is certainly considered to be a pronounced achievement for its academic excellence in national and international arena.

1.2 Attributes of MIST

MIST is an educational entity where there is an opportunity of blending civil and military students with diversified skills, exposure, experience and outlook. Attributes those may be considered as strengths of MIST are:

- Rigorous admission and selection process for best possible screening.
- Interactive sessions in the classroom.
- Regular guest lectures and educational visits.
- Culture of timeliness, commitment and uninterrupted curriculum.
- Flexibility in choosing competent faculties through outsourcing.
- Well thought-out and continuous feedback and assessment system.
- Effective teaching through innovative method.
- Industrial attachment for on job training.
- Emphasis on code of conduct and dress code.
- Focus to develop students as a good human with all possible attributes of successful leader.
- Continuous effort to build strong industry-academia bondage.
- Tranquil, pollution free and secure campus life.

1.3 Objectives

- To establish a prestigious academic institute for studies in different fields of engineering and technology for military personnel and civil officials/ students from home and abroad at degree and post graduate levels.
- To organize courses on military science and technology in various areas of interest.
- To hold examinations and confer certificates of diplomas/ degrees, other academic distinctions, to and on persons who have persuaded a course of study and have passed examinations conducted by the institute.
- To confer research degrees, award fellowship, scholarship, exhibition, prizes, medals and honorary degrees to persons who have carried out research works under conditions as prescribed in the MIST regulations.
- To make provisions for advisory, research and consultation service including supervisions, material testing and to enter into suitable agreement with any persons/organizations for this purpose.
- To co-operate with Universities / Technical Institutions (both military and civil) including signing of Memoranda of Understanding (MOU) at home and abroad, in the manner and purpose as the institute may determine.
- To do such other acts, related to above-mentioned objectives, as may be required in order to expand the objectives of the institute.

1.4 Location

MIST is located at Mirpur Cantonment, northwest edge of the greater Dhaka city, a hub of knowledge for the armed forces. Mirpur Cantonment is a small, calm and quiet education village and free from all possible pollution of a city life. A garland like lake with migratory birds, three sides with extended green fields in the summer and water bodies in the rainy season, whistling birds on the tree branches and overall bounty of nature adds to the already existing splendid academic atmosphere. Other neighboring academic institutions are National Defense College (NDC) and Defense Services Command and Staff College (DSCSC) - two international standard education centers.

1.5 Capabilities

- To conduct under-graduate programs leading to B.Sc. Engineering Degrees in the following disciplines:
    - Civil Engineering (CE)
    - Computer Science and Engineering (CSE)
    - Electrical, Electronic and Communication Engineering (EECE)
    - Mechanical Engineering (ME)
    - Aeronautical Engineering (AE)
    - Navel Architecture and Marine Engineering (NAME)

- To conduct post graduate program.
- To conduct diploma courses in surveying & mapping.
- To conduct diploma and certificate courses in CSE.
- To conduct professional advanced courses.

1.6 Affiliation

All academic programs of MIST are affiliated with the Bangladesh University of Professionals (BUP). All examinations are conducted as per the schedule approved by the same university. BUP also approves the results and awards certificates amongst the qualified students.

1.7 Eligibility of Students for Admission in MIST (Subject to review each year)

The students must fulfill the following requirements (as per the academic year 2011-12):

For Bangladeshi Students

Minimum qualifications to take part in the admission test are as follows:

1. Applicants must have passed SSC/Dhakhil/equivalent examination from Board of Intermediate and Secondary Education/ Madrasa Education Board/ Technical Education Board in Science group with minimum GPA 4.00 in a 5-point scale.

2. Applicants must have passed HSC/Alim/equivalent examination from Board of Intermediate and Secondary Education/ Madrasa Education Board/ Technical Education Board in Science group with minimum GPA 4.00 in a 5-point scale.

3. In HSC/Alim/equivalent examination the applicant must have obtained minimum “A” grade in any two (02) subjects out of four (04) subjects including Mathematics,

Physics, Chemistry & English and minimum "A-" (A minus) grade in rest two (02) subjects.

4. Applicants with GCE "O" Level/equivalent background must have to qualify in minimum five (05) subjects including Mathematics, Physics, Chemistry and English with minimum "B" grade in average.

5. Applicants with GCE "A" Level/equivalent background must have to qualify in minimum three (03) subjects including Mathematics, Physics and Chemistry with minimum "B" grades separately.

6. Applicants who have passed HSC or equivalent examination in the current year or one year before the notification for admission can apply.

7. Sex: Male and female.

For Foreign Students

Maximum 3% of overall vacancies available will be kept reserved for the foreign students and will be offered to foreign countries through AFD of the Government of the People's Republic of Bangladesh. Applicants must fulfill the following requirements:

1. Educational qualifications as applicable for Bangladeshi civil students or equivalent.
2. Must have security clearance from respective Embassy/ High Commission in Bangladesh.
3. Sex: Male and female.

1.8 Admission Procedure

1.8.1 Syllabus for Admission Test

Admission test will be conducted on the basis of the syllabus of Mathematics, Physics, Chemistry and English (Comprehension and Functional) subjects of HSC examinations of all Boards of Secondary and Higher Secondary School Certificates. Admission test will be conducted out of 200 marks and the syllabus and distribution of marks is given below:

<table>
<tr><th>Serial</th><th>Subjects</th><th>Syllabus</th><th>Marks</th></tr>
<tr><td>1.</td><td>Mathematics</td><td rowspan="3">Syllabi of the current year of HSC Examinations of all Boards of Intermediate and Secondary Education</td><td>80</td></tr>
<tr><td>2.</td><td>Physics</td><td>60</td></tr>
<tr><td>3.</td><td>Chemistry</td><td>40</td></tr>
<tr><td>4.</td><td>English</td><td>Comprehension and functional</td><td>20</td></tr>
<tr><td></td><td>Total =</td><td></td><td>200</td></tr>
</table>

1.8.2 Final Selection

Minimum qualifying marks in the written admission test is 40%. But in special circumstances for fulfillment of specified number of seats, President Admission Committee with approval from Commandant, MIST, may consider relaxation of this condition. Merit list of candidates for final selection and admission to MIST will be prepared on the basis of the following:

Written Admission Test	75%.
GPA of SSC/ Dakhil (without 4th subject) / “O”level/ equivalent examination	10%.
Total GPA of Mathematics, Physics and Chemistry of HSC/ Alim/ “A” level/ equivalent examination	15%.
Total	**100%**

In case of tie, merit position will be determined on the basis of marks obtained in admission test in Mathematics, Physics, Chemistry and English respectively. Further dispute will be solved giving priority of result of HSC over SSC examination.

1.8.3 Medical Checkup

Civil candidates selected through admission test will go for medical checkup in MIST/CMH. If the medical authority considers any candidate unfit for study in MIST due to critical/contagious/mental diseases as shown in medical policy of MIST will be declared unsuitable for admission.

1.9 Withdrawal Policy

The MIST has been established with an aim of providing quality education in various disciplines of Engineering leading to B.Sc Engineering to be conferred by BUP. A definite standard of education and general discipline will be followed in every level of the program. The unsuccessful students will therefore be withdrawn from the institute.

1.9.1 Definition of Terms

Permanent Withdrawal

It will imply a complete/permanent discontinuity from any course/program of the institute.

Temporary Withdrawal

It means that the student has been allowed by the Academic Council, MIST to discontinue temporarily from any course/program for a definite period. The student, so withdrawn, may re-enter the course as per terms and conditions as set by the authority.

Permanent Expulsion

It means expulsion permanently from the institution on disciplinary ground. A student, if expelled permanently will never be allowed to re-enter the course or similar program in MIST and be subjected to other terms and conditions as set by the authority while approving the permanent expulsion order.

Temporary Expulsion

It means expulsion from an academic course/program for a certain period on disciplinary ground. A student, if expelled temporarily, may be allowed to re-enter the course/program on expiry of the punishment period and on fulfillment of other terms and conditions (if any) as set by the authority while approving the temporary expulsion order.

1.9.2 General Policy of Withdrawal

The under graduate (B.Sc) Engineering programs, in the disciplines of CE, EECE, ME, CSE and AE are planned for 04 regular levels, comprising of 08 regular terms. It is expected that all students will earn degree by clearing all the offered courses in the stipulated time. In case of failure the following policies will be adopted:

- Students failing in maximum two courses/subjects in any level, each comprising of two regular terms will be allowed to appear in the referred/re-examination on failed course(s)/subject(s) after a short term as per academic schedule.
- Referred/re-examination, after a short term is to be conducted within 02 (two) weeks of commencement of the next academic session at the latest.
- Students failing in maximum one course/subject in the referred/re-examination will be promoted to the next higher level. The failed course/subject will be termed as "Backlog" subject and the students have to pass the "Backlog" subject in the next scheduled referred/re-examination, but without any short term. Otherwise, he/she will be withdrawn permanently from the course/program.
- No student will be allowed to appear in the referred/re-examination in the same subject more than twice in the whole undergraduate program.
- Students in all levels will be allowed to appear in the referred/re-examination on two courses/subjects including the "Backlog" one.
- Students will be promoted to the second term of each level irrespective of their results in the first term of the level.
- Students failing in three or more courses/subjects in any level, comprising of two regular terms, will be allowed to repeat the level once. Students repeating a level will be granted exemption for that/those subject(s) in which they earned "B+" and above grade in the previous academic year. For a military student, repeating a level will be subject to the approval of the respective Services Headquarters.
- Students will be allowed to repeat a particular level only once in the whole undergraduate program.
- After level-4 referred/re-examination, if any military student fails in maximum one course/subject, but not the "Backlog"subject, then he/she will leave MIST and will be allowed to appear in the next scheduled referred/re-examination of the respective course. In that examination if he/she cannot pass the course/subject, or if he/she does not appear in the referred examination within 06 (six) years of registration will lose the scope of completing graduation. This failure will also be recorded in the dossier of military student officers.
- In case of sickness, which leads to missing of more than 40% classes or miss term final examination (supported by requisite medical documents), students may be allowed to withdraw temporarily from that term and repeat the whole level with the regular level in the next academic session, subject to the approval of Academic Council, MIST. However, he/she has to complete the whole undergraduate program within 06 (six) academic years from the date of his/her registration.
- Whatever may be the cases, students have to complete the whole undergraduate program within 06 (six) academic years from the date of registration.

- Failure to secure/achieve minimum CGPA of 2.20 in two consecutive levels will also lead to withdrawal of the student from the program.

1.9.3 Expulsion/Withdrawal on Disciplinary Ground

Unfair Means

Adoption of unfair means may result in expulsion of a student from the program and so from the institution. The Academic Council of MIST will authorize such expulsion on the basis of recommendation of the Disciplinary Committee, MIST and as per policy approved by the affiliating university. Following would be considered as unfair means adopted during examinations and other contexts:

- Communicating with fellow students for obtaining help in the examination.
- Copying from another student's script/report/paper.
- Copying from desk or palm of a hand or from other incriminating documents.
- Possession of any incriminating document whether used or not.

Influencing Grades

Academic council of MIST may expel/withdraw any student for approaching directly or indirectly in any form to influence a teacher or MIST authority for grades.

Other Indiscipline Behaviors

Academic council of MIST may withdraw/expel any student on disciplinary ground, if any form of indiscipline or unruly behavior is seen in him/her which may disrupt the academic environment/program or is considered detrimental to MIST's image.

Immediate Action by the Disciplinary Committee of MIST

The disciplinary committee, MIST may take immediate disciplinary action against any student of the institution. In case of withdrawal/expulsion, the matter will be referred to the academic council, MIST for post-facto approval.

1.9.4 Withdrawal on Own Accord

Permanent Withdrawal

A student who has already completed some courses and has not performed satisfactorily may apply for a permanent withdrawal.

Temporary Withdrawal

A student, if he/she applies, may be allowed to withdraw temporarily from the program, subject to the approval of academic council of MIST, but he/she has to complete the whole program within 06 (six) academic years from the date of his/her registration.

CHAPTER 2

THE DEPARTMENT OF COMPUTERSCIENCE AND ENGINEERING

2.1 Introduction

Computer plays vital and in fact indispensable role in all fields of modern human activities. Consequently, Computer Science and Engineering has established itself as one of' the most important branches of engineering. Recent development in computer has a considerable impact on society. It has already expanded to all fields of study starting from genetic engineering to space technology. Recent development in Artificial Intelligence has taken the human history a long way. That day is not very far when man can make machine like him.

The Department of Computer Science and Engineering is one of the pioneer Departments of this Institute providing top-quality education in Computer Science and Engineering (CSE) at its undergraduate program. ICT is the leading booming sector in present day. It is already declared as a thrust sector in Bangladesh. Keeping this in mind the department offers CSE course to produce computer specialist.

In addition to the above, Department of Computer Science and Engineering is going to begin M.Sc. (Engg)/M.Engg programs in October, 2014. In future there will be opportunity for postgraduate studies and research leading to higher degrees i.e. Ph.D. There are financial assistance program for the poor and meritorious students too.

2.2 Historical Background

Department of Computer Science and Engineering began its journey from the academic session in 2000-2001 as Department of CSIT with military students only. Later, civil students were inducted in the next session. The department was renamed as Department of CSE in January 2003. This year (2013), the 13th batch has begun their classes in Level-1. Over the years, this ever-flourishing department has been providing the technological foundation on ICT, scholarly guidance and leadership skills to the students that have contributed to produce 381 highly qualified and skilled CSE graduates. Our graduates are working proudly both at home and abroad. Besides, a good number of graduates are pursuing higher studies abroad with scholarship. Moreover, our CSE students actively participate in various events like national and international computer programming competition, Software development competitions, Gaming and Robotic contest, Mobile Apps development, Debate and English speaking competition, national and international seminar and workshops on ICT and exhibit brilliant performances. With the relentless effort of the qualified, sincere and enthusiastic faculty and able guidance of the respected Commandant and Dean of MIST, the department has become a unique one of its field. With its excellent professional competence, expert teaching viewpoints and capabilities of training, B.Sc. in Computer Science and Engineering (B.Sc. CSE) degree program has achieved accreditation from BAETE (IEB) on 10 July 2013 with a grade as "Good". The dept has started its 2nd section with 55 students with effect from academic session 2014.

2.3 Study Programs

The Department of Computer Science and Engineering offers the degree of B. Sc. Engg. The courses and syllabus followed by this department for the above degree is the most modern ones like that of advanced countries as well as appropriate to the local needs. The syllabus is designed as to contain all the necessary study materials so that a graduate can face the engineering problems readily after graduation. Also, the syllabus is reviewed and necessary changes are made in every three years by a "committee of courses" comprising the best academicians and experts of the field of Computer Science and Engineering coming from MIST and other leading Universities and Organizations.

2.4 Laboratory Facilities of the Department

The department endeavors to provide its faculty members and students adequate laboratory, library and other facilities. Departmental undergraduate courses are well supported by the following laboratories:

Software Engineering Lab: This department has a software engineering lab consisting of 60 computers as workstations. With co-located Artificial Intelligence and VLSI lab, class can be conducted for 70 students at a time providing each one PC.

Digital Lab: This department has a digital lab where sessional classes of different courses on digital electronics can be conducted. This lab is enriched with modern electronic equipment and facilities.

Multimedia Lab: This department has a multimedia lab with modern HP color laser printers, multimedia projector, scanner and document cameras. Student would be highly benefited through this lab in their project works.

Artificial Intelligence and VLSI Lab: There is an Artificial Intelligence and VLSI lab consisting of 70 computers as workstations in this department. With co-located software engineering lab, classes can be conducted for 70 students at a time providing each one PC and other equipment.

Network and Internet Lab: This department has a Network and Internet lab of 70 computers as workstations. All necessary network equipment and accessories are available in the lab for conducting sessional classes.

Microprocessor and Microcontroller Lab: This department has a Microprocessor and Microcontroller lab enriched with latest Micro kits.

Interfacing Lab: This department has an interfacing lab where sessional classes of different course on computer interfacing can be conducted. Moreover, students undertaking different interfacing project also are assisted by all required accessories and components. Regular project showcase are held in this lab.

Graphics and Multimedia Lab: This department has a Graphics and Multimedia lab where sessional classes of different course on computer graphics and multimedia theory can be conducted. This lab has 70 computers donated by Indian government in 2013. Moreover, students undertaking different graphics design project also are assisted by all required accessories and components. Regular project showcase are held in this lab.

Image Processing Lab: This department has an Image processing lab of 30 computers donated by Indian government in 2013 as workstations. All necessary image processing equipment and accessories are available in the lab for conducting sessional classes.

Teacher's PC Lab. This department has an additional lab for the teachers, who will be mostly helping the students for thesis and/or project work.

Other Computing Resources: This department has IBM and HP servers connecting all the PCs of MIST by Intranet, providing internet and other services. It has all the necessary equipment for multimedia lab. We have 24 hours Internet facilities including Wi-Fi.

Labs Planned for Future Expansion: This department will have following labs in future:

(1) Hardware Training Lab
(2) Hardware Maintenance Lab
(3) Mobile Computing lab

Note: The laboratories of CSE Department are also being utilized by the students of other departments for sessional classes and research work of relevant subject/courses.

2.5 Research Activities

The research work undertaken by the teachers and students of this department in the last few years is diversified in nature. The faculty members have a good number of publications in different national and international conferences and journals. MIST also regularly publishes an annual technical journal, MIST Journal, where faculties and students of CSE department put their contributions.

2.6 Co-curricular Activities

Students of this department have achieved remarkable success in co-curricular activities like programming contests, software and hardware project competitions, software fair etc. Besides, students take part and show significant performance in debate, sports and cultural programs.

2.6.1 Programming Contests

CSE department programming team has been participating and in various national and international programming contests regularly and performing well. The Department team has been regularly participating in the Dhaka Regional final of ACM (Association for Computing Machinery) International Collegiate Programming Contest (ACM-ICPC). In ACM-ICPC Dhaka Regional 2008, MIST team achieved 7th position and ACM-ICPC Dhaka Regional 2009, MIST team placed 8th position.

2.6.2 Software and Hardware Project Competitions

CSE department students regularly participate in different software and hardware project competitions and perform well. Notably, in 2011, software named "BANGLA TEXT TO BRAILLE TRANSLTOR" was developed by four CSE graduates from MIST (Md. Osman

Gani, F M Mahbub-ul-Islam, Samiul Azam and Ahmad Imtiaz Khan). This software came up as the winner of prestigious “BASIS IT Innovation Search Program 2011”and runner up of “National Digital Innovation Award 2011”.

2.6.3 Sports and Cultural Programs

CSE Department became champion in inter-departmental Programming Contest-2010, Inter-departmental Table Tennis Competition-2011, Inter-departmental Basketball Competition-2011, Inter-departmental Volleyball Competition-2011, Inter-departmental Cultural Competition 2012 and 2013 and runner up in Inter-departmental Sports Competition 2014**.**

CHAPTER 3

RULES AND REGULATIONS FOR UNDERGRADUATE PROGRAM

3.1. Overview

MIST has introduced course system for undergraduate studies from the academic session 2017 - 18. Therefore, the rules and regulations mentioned in this paper will be applicable to students for administering undergraduate curriculum through the Course System. This will be introduced with an aim of creating a continuous, even and consistent workload throughout the term for the students.

3.2. The Course System

The salient features of the Course System are as follows:

a. Number of theory courses will be generally 5 in each term. However, with the recommendation of course coordinator and Head of the Department, Commandant MIST may allow relaxation in this regard. This relaxation is to be reported to Academic Council of MIST.
b. Students will not face any level repeat for failing.
c. Students will get scope to improve their grading.
d. Introduction of more optional courses to enable the students to select courses according to their individual needs and preferences.
e. Continuous evaluation of students' performance.
f. Promotion of student-teacher interaction and contact.

Beside the professional courses pertaining to each discipline, the undergraduate curriculum gives a strong emphasis on acquiring thorough knowledge in the basic sciences of mathematics, physics and chemistry. Due importance is also given on the study of several subjects in humanities and social sciences.

The first two years of bachelor's degree programs generally consist of courses on basic engineering, general science and humanities subjects; while the third and subsequent years focus on specific disciplines.

3.3. Number of Terms in a Year

There will be two terms in an academic year.

1. Term I (Spring)
2. Term II (Fall)

In addition to these two regular terms there will be a short term after the Term II of each academic session. During the short term, students can take only failed courses to cover up the credit deficiencies.

Respective departments will take the decisions about courses to be offered during each short term depending upon the availability of course teachers and number of students willing to take a particular course.

3.4. Duration of Terms

The duration of each of Term I (Spring) and Term II (Fall) is maximum 22 weeks. Following table has the breakdown of a typical term.

Ser	Events	Durations
1.	Classes before Mid Term	7 weeks
2.	Mid Term Vacation	1 week
3.	Classes after Mid Term	7 weeks
4.	Makeup Classes and Preparatory leave	2/3 weeks
5.	Term Final Examination	2/3 weeks
6.	Term End Vacation	1/2 week

The duration of a Short Term will be around 7 weeks of which about 6 weeks will be spent for class lectures and one week for Term Final Examination. The duration for Short Term and Examination will be as under:

1.	Classes	6 weeks
2.	Final Examination	1 week
Total		**7 Weeks**

3.5. Course Pattern and Credit Structure

The undergraduate program is covered by a set of theoretical courses along with a set of laboratory (sessional) courses to support them.

3.6. Course Designation System

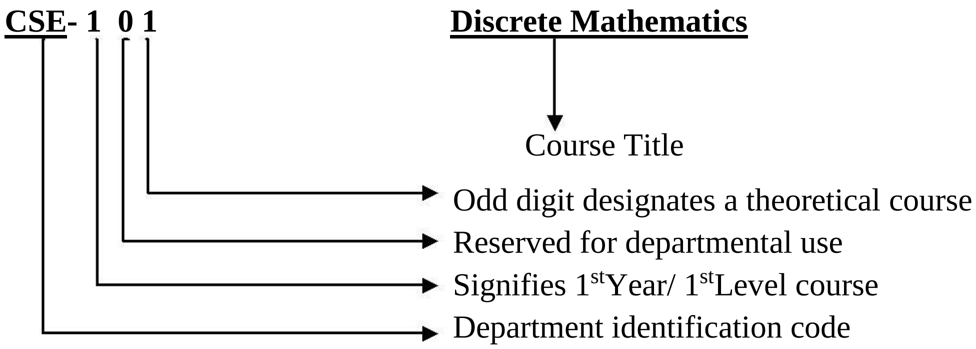
Each course is designated by a maximum of three/four letter code identifying the department offering the course followed by a three-digit number having the following interpretation:

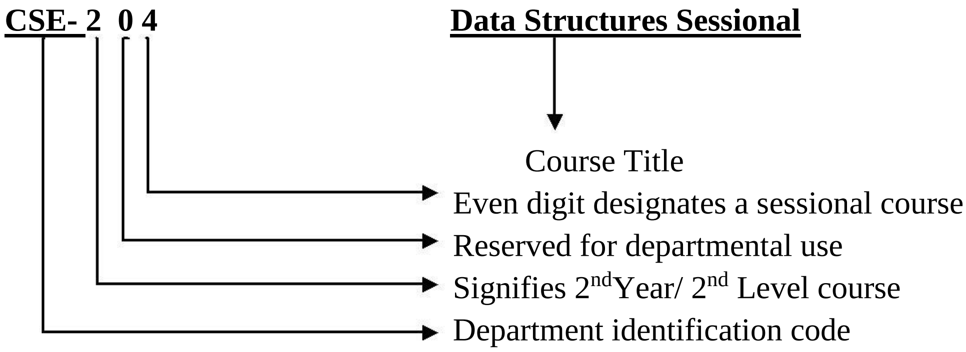
a. The first digit corresponds to the year/level in which the course is normally taken by the students.

b. The second digit is reserved for departmental use. It usually identifies a specific area/group of study within the department.

c. The last digit is an odd number for theoretical courses and an even number for sessional courses.

The course designation system is illustrated as follows:





3.7. Assignment of Credits

The assignment of credits to a theoretical course follows a different rule from that of a sessional course.

a. Theoretical Courses: One lecture per week per term is equivalent to one credit.

b. Sessional Courses: Credits for sessional courses is half of the class hours per week per term.

Credits are also assigned to project and thesis work taken by the students. The amount of credits assigned to such work varies from one discipline to another.

3.8. Types of Courses

The types of courses included in the undergraduate curricula are divided into the following groups:

a. Core Courses: In each discipline, a number of courses are identified as core courses, which form the nucleus of the respective bachelor's degree program. A student has to complete all the designated core courses of his/her discipline.

b. Prerequisite Courses: Some of the core courses are identified as prerequisite courses for a specific subject.

c. Optional Courses: Apart from the core courses, the students can choose from a set of optional courses. A required number of optional courses from a specified group have to be chosen.

3.9. Course Offering and Instruction

The courses to be offered in a particular term are announced and published in the Course Catalog along with the tentative Term Schedule before the end of the previous term. The courses to be offered in any term will be decided by Board of Undergraduate Studies (BUGS) of the respective department. The courses that have been eliminated in the reviewed syllabus may be offered as deemed necessary due to failed or not registered in these courses in previous terms by any student.

Each course is conducted by a course teacher who is responsible for maintaining the expected standard of the course and for the assessment of students' performance. Depending on the strength of registered students (i.e. on the number of students) enrolled for the course, the teacher concerned might have course associates and Teaching Assistants (TA) to aid in teaching and assessment.

3.10. Teacher-Student Interaction

The new course system encourages students to come in close contact with the teachers. For promotion of a high level of teacher-student interaction, each student is assigned to an adviser and the student is free to discuss all academic matters with his/her adviser. Students are also encouraged to meet any time with other teachers for help and guidance in academic matters. However, students are not allowed to interact with teachers after the moderation of questions.

3.11. Student Adviser

One adviser is normally appointed for a group of students by the BUGS of the concerned department. The adviser advises each student about the courses to be taken in each term by discussing the academic program of that particular term with the student.

However, it is also the student's responsibility to keep regular contact with his/her adviser who will review and eventually approve the student's specific plan of study and monitor subsequent progress of the student.

For a student of second and subsequent terms, the number and nature of courses for which he/she can register is decided on the basis of academic performance during the previous term. The adviser may permit the student to drop one or more courses based on previous academic performance.

3.12. Course Registration

Any student who uses classroom, laboratory facilities or faculty-time is required to register formally. Upon admission to the MIST, students are assigned to advisers. These advisers guide the students in choosing and registering courses.

3.12.1. Registration Procedure. At the commencement of each term, each student has to register for courses in consultation with and under the guidance of his/her adviser. The date, time and venue of registration are announced in advance by the Registrar's Office. Counseling and advising are accomplished at this time. It is absolutely essential that all the students be present for registration at the specified time.

3.12.2. **Pre-conditions for Registration**.

a. For first year students, department-wise enrollment/admission is mandatory prior to registration. At the beginning of the first term, an orientation program will be conducted for them where they are handed over with the registration package on submission of the enrolment slip.

b. Any student, other than the new batch, with outstanding dues to the MIST or a hall of residence is not permitted to register. Each student must clear their dues and obtain a clearance certificate, upon production of which, he/she will be given necessary Course Registration Forms to perform course registration.

c. A student is allowed to register in a particular course subject to the class capacity constraints and satisfaction of pre-requisite courses. However, even if a student fails in a pre-requisite course in any term, the concerned department (BUGS) may allow him/her to register for a course which depends upon the pre-requisite course provided that his/her attendance and performance in the continuous assessment of the mentioned pre- requisite course is found to be satisfactory.

3.12.3. **Registration Deadline**. Each student must register for the courses to be taken before the commencement of each term. Late registration is permitted only during the first week of classes. Late registration after this date will not be accepted unless the student submits a written application to the registrar through the concerned Head of the department explaining the reasons for delay. Acceptable reasons may be medical problems with supporting documents from the Medical Officer of MIST or some other academic commitments that prohibit enrollment prior to the last date of registration.

3.12.4. **Penalty for Late Registration**. Students who fail to register during the designated dates for registration are charged a late registration fee of Tk. 100.00 (One hundred only) per credit hours. Penalty for late registration will not be waived.

3.13. Limits on the Credit Hours to be taken

A student should be enrolled for at least 15 credit hours and is allowed to take a maximum of 24 credit hours. Relaxation on minimum credit hours may be allowed. A student must enroll for the sessional courses prescribed in a particular term within the allowable credit hour limits.

In special cases where it is not possible to allot the minimum required 15 credit hours to a student, the concerned department (BUGS) may permit with the approval of the Comdt, a lesser number of credit hours to suit individual requirements. Such cases are also applicable to students of Level 4 requiring less than 15 credit hours for graduation.

3.14. Course Add/Drop

A student has some limited options to add or drop courses from the registration list. Addition of courses is allowed only within the first two weeks of a regular term and only during the first week of a short term. Dropping a course is permitted within the first four weeks of a regular term and two weeks of a short term.

Any student willing to add or drop courses has to fill up a Course Adjustment Form. This also has to be done in consultation with and under the guidance of the student's respective adviser. The original copy of the Course Adjustment Form has to be submitted to the Registrar's Office, where the required numbers of photocopies are made for distribution to the concerned adviser, Head, Dean, Controller of Examinations and the student.

All changes must be approved by the adviser and the Head of the concerned department. The Course Adjustment Form has to be submitted after being signed by the concerned persons.

3.15. Withdrawal from a Term

If a student is unable to complete the Term Final Examination due to serious illness or serious accident, he/she may apply to the Head of the degree awarding department for total withdrawal from the term before commencement of term final examination. However application may be considered during term final examination in special case. The application must be supported by a medical certificate from the Medical Officer of MIST. The concerned student may opt for retaining the sessional courses of the term. The Academic Council will take the final decision about such applications. However, the total duration for graduation will not exceed 6 academic years.

3.16. The Grading System

The total performance of a student in a given course is based on a scheme of continuous assessment, for theory courses this continuous assessment is made through a set of quizzes, class tests, class evaluation, class participation, homework assignment and a term final examination. The assessments for sessional courses are made by evaluating performance of the student at work during the class, viva-voce during laboratory hours and quizzes. Besides that, at the end there will be a final lab test. Each course has a certain number of credits, which describes its corresponding weightages. A student's performance is measured by the number of credits completed satisfactorily and by the weighted average of the grade points earned. A minimum grade point average (GPA) is essential for satisfactory progress. A minimum number of earned credits also have to be acquired in order to qualify for the degree. Letter grades and corresponding grade points will be given as follows:

Numerical Markings	Grade	Grade Points
80% and above	A+	4.00
75% to below 80%	A	3.75
70% to below 75%	A-	3.50
65% to below 70%	B+	3.25
60% to below 65%	B	3.00
55% to below 60%	B-	2.75
50% to below 55%	C+	2.50
45% to below 50%	C	2.25
40% to below 45%	D	2.00

Numerical Markings	Grade	Grade Points
below 40%	F*	0.00
Incomplete	I	-
Withdrawal	W	-
Project/ Thesis continuation	X	-

* Subject in which the student gets F grade shall not be regarded as earned credit hours for the calculation of Grade Point Average (GPA).

3.17. Distribution of Marks

3.17.1. Theory. Marks distribution of Theory courses will be according to exam policy.

3.17.2. **Sessional/Practical Examinations**. Sessional courses are designed and conducted by the concerned departments. Examination on sessional/practical subjects will be conducted by the respective department before the commencement of term final examination. The date of practical examination will be fixed by the respective department. Students will be evaluated in the sessional courses on the basis of the followings (all or as decided by the Examination Sub-Committee):

a.	Class Participation	5
b.	Class performance/observation	5
c.	Lab Test/Report Writing/project work/Assignment	50
d.	Quiz Test	30
e.	Viva Voce	10
	Total	**100%**

For B.Sc. in CSE program, the marks distribution of sessional courses will be distributed according to the type of the sessional course. The distributions of marks for three types of sessional are given below:

Marks distribution of lab based sessionals

Category	Marks %
Lab test	40
Quiz	20
Viva	10
Class Performance	10
Report	10
Class Assessment	10
Total	**100**

Marks distribution of project based sessionals

Category	**Marks %**
Project	40
Quiz	20
Viva / Presentation	10
Class Participation	10
Report	10
Class Assessment	10
Total	**100**

Marks distribution of programming based sessionals

Category	**Marks %**
Online Test – 1	25
Online Test – 2	25
Viva	10
Class Participation	10
Class Assessment	30
Total	**100**

3.17.3. Sessional Course of Communicative English. The distribution will be as under:

a.	Class Participation	20
b.	Individual Presentation	20
c.	Quiz	20
d.	Group Presentation	20
e.	Viva Voce	20
Total		**100%**

3.17.4. Basis for awarding marks for Class Participation.

This will be as follows:

	Marks
90% and above	100%
85% to less than 90%	80%
80% to less than 85%	60%
75% to less than 80%	40%
Below 75%	0%

3.18. Collegiate and Non-collegiate

Students having Class Participation of 90% or above in individual subject will be treated as collegiate and less than 90% and up to 75% will be treated as non-collegiate in that subject. The non-collegiate student(s) may be allowed to appear in the examination subject to payment of non-collegiate fee/fine of an amount fixed by MIST/BUP. Students having Class

Participation below 75% will be treated as dis-collegiate and will not be allowed to appear in the examination and treated as fail. But in a special case such students may be allowed to appear in the examination with the permission of Commandant and it must be approved by the Academic Council.

3.19. Calculation of CGPA

Grade Point Average (GPA) is the weighted average of the grade points obtained of all the courses passed/completed by a student. For example, if a student passes/completes *n* courses in a term having credits of C1, C2, ..., Cn and his grade points in these courses are G1, G2, ...

Gn respectively, then

$$GPA = \frac{Grade\ points\ earned\ in\ the\ semester}{Credits\ completed\ in\ the\ semester}$$

$$= \frac{Summation\ of\ (Credit\ hours\ in\ a\ course *\ Grade\ point\ earned\ in\ that\ course)}{Total\ number\ of\ credit\ hours\ completed}$$

$$= \frac{\sum_{i=1}^{n} \boldsymbol{Ci * Gi}}{\sum_{i=1}^{n} \boldsymbol{Ci}}$$

The Cumulative Grade Point Average (CGPA) is the weighted average of the GPA obtained in all the terms passed/completed by a student. For example, if a student passes/ completes n terms having total credits of TC1, TC2, ... , TCn and his GPA in these terms are GPA1, GPA2,... , GPAn, respectively then

$$\boldsymbol{CGPA} = \frac{\sum_{i=1}^{n} \boldsymbol{TCi * GPAi}}{\sum_{i=1}^{n} \boldsymbol{TCi}}$$

Numerical Example

Suppose a student has completed eight courses in a term and obtained the following grades:

Course	Credit Ci	Grade Points	Gi	Ci*Gi
EECE-163	3.00	A	3.75	11.25
EECE-164	0.75	A+	4.00	3.00
MATH-141	3.00	A-	3.50	10.50
PHY-103	3.00	B+	3.25	9.75
HUM-101	3.00	A	3.75	11.25
HUM-102	1.50	A	3.75	5.625
CSE-101	3.00	A	3.75	11.25
CSE-103	3.00	A-	3.50	10.50
CSE-104	1.5	B+	3.25	4.875
Total	**21.75**			**78.00**

$$\boldsymbol{GPA = \frac{78.00}{21.75} = 3.59}$$

Suppose a student has completed four terms and obtained the following GPA:

Level	Term	Earned Credit Hours	Earned GPA	TC_i*GPA_i
		TC_i	GPA_i	
1	I	21.75	3.75	81.5625
1	II	20.75	3.61	74.9075
2	I	19.50	3.21	62.595
2	II	21.00	2.98	62.58
Total		83.00		281.645

$$CGPA = \frac{281.645}{83} = 3.39$$

3.20. Minimum Earned Credit and GPA Requirement for Obtaining Degree

Minimum credit hour requirements for the award of bachelor's degree in engineering (B.Sc. Engineering) and other discipline will be decided as per existing rules. The minimum GPA requirement for obtaining a Bachelor's degree in Engineering and Architecture is 2.20.

3.21. Impacts of Grade Earned

The courses in which a student has earned a 'D' or a higher grade will be counted as credits earned by him/her. Any course in which a student has obtained an 'F' grade will not be counted towards his/her earned credits or GPA calculation. However, the 'F' grade will remain permanently on the Grade Sheet and the Transcript.

A student who obtains an 'F' grade in a core course will have to repeat that particular course. However, if a student gets an 'F' in an optional course, he/she may choose to repeat that course or take a substitute course if available. When a student will repeat a course in which he/she has previously obtained an 'F', he/she will not be eligible to get a grade better than 'B+' in that repeated course.

If a student obtains a grade lower than 'B+' in a particular course he/she will be allowed to repeat the course only once for the purpose of grade improvement. However, he/she will not be eligible to get a grade better than 'B+' for an improvement course.

A student will be permitted to repeat for grade improvement purposes a maximum of 6 courses in BSc. Engineering programs and a maximum of 7 courses in B. Arch. program.

If a student obtains a 'B+' or a better grade in any course he/she will not be allowed to repeat the course for the purpose of grade improvement.

3.22. Classification of Students

At MIST, regular students are classified according to the number of credit hours completed/ earned towards a degree. The following classification applies to all the students:

Level	Credit Hours Earned	
	Engineering/URP	Architecture
Level 1	0.0 to 36.0	0.0 to 34.0
Level 2	More than 36.0 to 72.0	More than 34.0 to 72.0
Level 3	More than 72.0 to 108.0	More than 72.0 to 110.0
Level 4	More than 108.0	More than 110.0 to 147.0
Level 5		More than 147.0

However, before the commencement of each term all students other than new batch are classified into three categories:

a. **Category 1:** This category consists of students who have passed all the courses described for the term. A student belonging to this category will be eligible to register for all courses prescribed for the upcoming term.

b. **Category 2:** This category consists of students who have earned a minimum of 15 credits but do not belong to category 1. A student belonging to this category is advised to take at least one course less since he might have to register for one or more backlog courses as prescribed by his/her adviser.

c. **Category 3:** This category consists students who have failed to earn the minimum required 15 credits in the previous term. A student belonging to this category is advised to take at least two courses less than a category 1 student subject to the constraint of registering at least 15 credits. However, he will also be required to register for backlog courses as prescribed by the adviser.

Definition of Graduating Student. Graduating students are those students who will have $\leq$ 24 credit hour for completing the degree requirement.

3.23. Performance Evaluation

The performance of a student will be evaluated in terms of two indices, viz. Term Grade Point Average and Cumulative Grade Point Average which is the grade average for all the terms completed.

Students will be considered to be making normal progress toward a degree if their Cumulative Grade Point Average (CGPA) for all work attempted is 2.20 or higher. Students who regularly maintain a term GPA of 2.20 or better are making good progress toward the degrees and are in good standing with MIST. Students who fail to maintain this minimum rate of progress will not be in good standing. This can happen when any one of the following conditions exists.

a. The term GPA falls below 2.20.

b. The Cumulative Grade Point Average (CGPA) falls below 2.20.

c. The earned number of credits falls below 15 times the number of terms attended.

All such students can make up their deficiencies in GPA and credit requirements by completing courses in the subsequent term(s) and backlog courses, if there are any, with better grades. When the minimum GPA and credit requirements are achieved the student is again returned to good standing.

3.24. <u>Rules for Self-Study Courses</u>

A self-study course is among the regular courses listed in the course catalog. This type of course is offered only in exceptional cases. The following rules are applicable to all self study courses:

a. Whether a course is to be floated as a self study course will be decided by the Head of the concerned department in consultation with the teacher/course coordinator concerned. Such a decision also has to be reported to the Academic Council.

b. A self study course may be offered in a particular term only if the course is not running in that term as a regular course.

c. The self study course is offered to a student in his/her graduating term if it helps him/her to graduate in that term.

d. A student is allowed to register for a maximum of two theory courses on a self-study basis.

e. Students should have 75% Class Participation.

f. Normally no lecture will be delivered for a self study course but laboratory/design classes may be held if they form part of a course.

g. The course coordinator/course teacher will assign homework, administer quizzes, and final examination for giving assessments at the end of the term.

h. No Laboratory/Sessional Course can be taken as self study course.

3.25. Rules for Courses Offered in Short Term

A Short Term course will be conducted after one week of completion of Term II Final Examination in each year. The following rules are applicable to Short Term courses:

a. The courses to be run during the short term shall be decided on the recommendations of departments on the basis of essential deficiencies to be made up by a group of students. Once floated, other students could be allowed to register in those courses subject to the capacity constraints and satisfaction of prerequisites.

b. Student will be allowed to register in a maximum of three theory courses during the Short Term.

c. Graduating students may register for Short Term examinations after finalization of result of Term 2 final examination.

d. A certain fee for each credit hour to be registered to be borne by the students who enroll during Short Term.

3.26. Minimum Earned Credit and GPA Requirement for Obtaining Degree

Minimum credit hour requirements for the award of bachelor's degree in engineering (BSc. Engg) and architecture (B. Arch.) will be decided by the respective department (BUGS). However, at least 157 credit hours for engineering and 189 credit hours for architecture must be earned to be eligible for graduation, and this must include the specified core courses. The minimum GPA requirement for obtaining a Bachelor's degree in engineering and architecture is 2.20.

A student may take additional courses with the consent of his/her Adviser in order to raise GPA, but he/she may take a maximum of 15 such additional credits in engineering and 18 such additional credits in architecture beyond respective credit-hour requirements for Bachelor's degree during his/her entire period of study.

3.27. Application for Graduation and Award of Degree

A student who has fulfilled all the academic requirements for Bachelor's degree will have to apply to the Controller of Examinations through his/her Adviser for graduation. Provisional Degree will be awarded by BUP on completion of credit and GPA requirements.

3.28. Time Limits for Completion of Bachelor's Degree

A student must complete his studies within a maximum period of six years for engineering and seven years for architecture.

3.29. <u>Attendance, Conduct and Discipline</u>

MIST has strict rules regarding the issues of attendance in class and discipline.

3.29.1. **<u>Attendance</u>**. All students are expected to attend classes regularly. The university believes that attendance is necessary for effective learning. The first responsibility of a student is to attend classes regularly and one is required to attend the classes as per MIST rules.

3.29.2. **<u>Conduct and Discipline</u>**. During their stay in MIST all students are required to abide by the existing rules, regulations and code of conduct. Students are strictly forbidden to form or be members of student organization or political party, club, society etc., other than those set up by MIST authority in order to enhance student's physical, intellectual, moral and ethical development. Zero tolerance in regards of sexual abuse and harassment in any forms and drug abuse and addiction are strictly observed in the campus.

3.30. Teacher-Student Interaction

The academic system in MIST encourages students to come in close contact with the teachers. For promotion of high level of teacher-student's interaction, a course coordinator (CC) is assigned to each course. Students are free to discuss with CC about all academic matters. Students are also encouraged to meet other teachers any time for help and guidance for academic matters. Heads of the departments, Director of Administration, Director of Students Welfare (DSW), Dean and Commandant address the students at some intervals. More so, monthly Commandant's Parade is organized in MIST where all faculty members, staff and students are formed up, thereby increasing teacher-student interaction.

3.31. Absence during a Term

A student should not be absent from quizzes, tests, etc. during the term. Such absence will naturally lead to reduction in points/marks, which count towards the final grade. Absence in the Term Final Examination will result in an F grade in the corresponding course. A student who has been absent for short periods, up to a maximum of three weeks due to illness, should approach the course teacher(s) or the course coordinator(s) for make-up quizzes or assignments immediately upon return to classes. Such request has to be supported by medical certificate from competent authority (e.g. CMH/MIST Medical Officer).

3.32. Recognition of Performance

As recognition of performance and ensure continued studies MIST awards medals, scholarships and stipends will be given as per existing rules and practices.

3.33. Types of Different Examination

Following different types of final Examinations will be conducted in MIST to evaluate the students of Undergraduate Programs:

a. **Term Final Examination:** At the end of each normal term (after 22wk or so), Term Final Examination will be held. Students will appear in the Term Final Examination for all the theory courses they have taken in the Term.

b. **Short Term Examination:** Short Term may be conducted after one week completion of Term 2 final examination. Students will be allowed to take maximum three theoretical courses in the Short Term. Examination will be conducted at the end of Short Term (6^{th} week class). However, Head of concerned department with the approval of Commandant may decide to take Supplementary examination instead of Short Term. No Laboratory/Sessional Courses can be taken in short term.

c. **Supplementary Examination:** It will take place once in a year, after each term-I final break. It should be completed within first 3 weeks of a new term. Students will be allowed to appear this examination for maximum two subjects at a time. Graduating students will be allowed to appear maximum three subjects during supplementary examination in their last Term. However, Head of the concerned department with the approval of Commandant may decide to take another Supplementary Examination instead of Short Term. In that case, a student will be allowed to take maximum three failed courses or improvement courses in the particular Supplementary Examination. This examination will be conducted in the previous week of the beginning of Term I. Highest achieved grade for all courses of Supplementary Examination will be B+.

d. **Improvement Examination:** It will be taken during supplementary and short term examination. Questions will be same as the question of the regular examination of that Short Term Final Examination (if any). Student can take maximum three subjects at a time and maximum 6 subjects in the whole academic duration. If a student obtains a grade lower than 'B+' in a course, he/she will be allowed to repeat the course only once for grade improvement. However, he/she will not be eligible to get a grade better then 'B+' for an improvement course. Among the previous result and improvement examination result, best one will be considered as final result for an individual student. However, performance of all examination i,e previous to improvement examination, shall be reflected in the transcript.

e. **Self-Study Course Examination:** Only graduating students (level-4) will be allowed to appear at Self Study course examination. It will be taken with Term Final Examination. No regular class will be arranged for this, but teachers will be assigned for supervising and guiding the students for study, conducting class test/quiz and regular assessment for 30% marks. Maximum two theory courses may be taken as self-study course by a student. Highest achieved grade for these courses will be B+. In that case a student will be allowed to take maximum 24 credit instead of 15 in the last Term of his/her graduation.

3.34. Rules of Different Examinations

3.34.1. **Term Final Examination.** Following rules to be followed:

a. Registration to be completed before commencement of the class. A student has to register his desired courses paying registration, examination fee and other related fees.

b. Late registration will be allowed without penalty within first one week of the term.

c. Within 1st two weeks of a term a student can Add/Drop course/courses. To add a course, in the 3rd week, one has to register the course by paying additional fees. To drop a course, one has to apply within three weeks and paid fees will be adjusted/ refunded. If anyone wants to drop a course after three weeks and within 4 weeks, that will be permitted but paid fees will not be refunded in that case.

d. Registrar office will finalize registration of all courses within 7 (seven) weeks, issue registration slip and that will be followed by issuing Admit Card.

e. Term Final Examination to be conducted in the 18-20th week of the term as per approved Academic Calendar.

3.34.2. **Short Term Examination.** Following rules to be followed:

a. Short Term for period of 6 weeks may be offered by a department after one week of completion of Term II Final Examination.

b. Short Term Final Examination is to be conducted on 7th week of Short Term.

c. Only repeat course can be offered, not any fresh course.

d. Classes will be arranged for the students who register a failed course in the Short Term.

e. After 6 (six) weeks of class, in the 7th week short Term Examination will be held. Academic calendar for this Short Term will be declared by the Department during the Mid-Term break of Term-II.

f. One student can take only three (failed/improvement) courses at a time in the Short Term.

g. Students will have to complete registration of course for Short Term by paying all the fees, before starting of the Term-II final Exam.

h. Graduating students may register for Short Term examinations after finalization of result of T 2 final examination.

j. Maximum grading will be ‘B+’.

k. Question Setting, Moderation, Result Publication will be done following the same rules of Term Final Exam as per Exam Policy. Separate Tabulation sheet will be made for this examination.

l. However, Head of concerned department with the approval of Commandant may decide to take Supplementary Examination instead of Short Term. Students will be allowed to take maximum three failed courses/improvement courses in that supplementary examination.

3.34.3. **Supplementary Examination.**

Following rules to be followed:

a. After the final break of every Term-I, Supplementary Examination will be held (once in a year).

b. Examination will be taken on 70% marks like Term Final examination. Remaining 30% marks on continuous assessment earned previously in that particular course will be counted. If a student fails in a course more than once in regular terms, then best one of all continuous assessment marks will be counted.

c. A student will be allowed to take maximum two courses at a time for each supplementary examination, but in the graduating Term one student can take maximum three courses if required.

d. Highest grade of supplementary examination will be ‘B+’.

e. Registration for supplementary courses to be done during the mid-term break of Term 1, paying the required fees.

f. Examination will be completed after Term I End break within three weeks of Term II.

g. If any student fails in a course, he can clear the course retaking it 2nd time or, he can clear the examination appearing at the supplementary examination as well. But anyone fails twice in a course consecutively, he has to take approval of Academic Council of MIST for appearing third/last time in a course and need to pay extra financial penalty.

h. If anyone fails in the sessional course, that course cannot be cleared in the supplementary examination.

j. Question setting, Moderation, Result Publication will be done following the same rules of Term Final Examination as per Examination Policy.

k. However, Head of the concerned department with the approval of Commandant may decide to take another Supplementary Examination instead of Short Term. In that case, a student will be allowed to take maximum three failed courses or improvement courses in that particular Supplementary Examination. This examination will be conducted in the previous week of the beginning of Term 1. Registration of that Supplementary Examination should be completed during registration of Short Term course.

3.34.4. **Improvement Examination.** Following rules to be followed:

a. Any student gets a grading below 'B+' and desires to improve that course, he will be allowed to appear the improvement examination for that particular course.

b. Highest grade of Improvement examination will be 'B+'.

c. One student is allowed to appear at Improvement exam in 6 (six) courses in his whole graduation period taking maximum three courses at a time.

d. For Improvement examination, registration is to be done before Term 2 Final Examination with the Short Term Courses or, during the registration of Supplementary Courses by paying all the fees.

e. Improvement examination to be taken during the supplementary and short term examinations.

f. Choice of Improvement course is restricted within the offered courses of that Short Term by the Departments and in two courses at a time.

g. Question Setting, Moderation and Result Publication to be done with courses of regular Term Final Examination.

3.34.5. **Self-Study Course and Examination.** Following Rules to be followed:

a. An irregular student for completion of his graduation, can take maximum two repeat courses as self-study course in the graduating Term if he desires and is accepted by department.

b. One student can take maximum 24 credit hours course in the graduating Term to complete his graduation.

c. Registration for self-study course by paying all fees, must be completed with other course of regular Term.

d. To run the self-study course, concerned Department will assign one teacher each for every self-study course offered. No regular theory class will be held, but that assigned teacher will take necessary class Tests, Quiz Test and give attendance and observation marks to give 30% marks at the end of the Term. For remaining 70% marks written examination will be taken with the Term Final Examination.

e. Assigned teacher for self-study examination will be responsible for setting questions of 70% marks and other examination formalities.

f. Question Setting, Moderation, and Result Publication to be done with courses of Term Final Examination.

g. Grading of Self Study course and examination will be maximum 'B+'.

3.35. Irregular Graduation

If any graduating student clears his/her failed course in Term-1 and his graduation requirements are fulfilled, his graduation will be effective from the result publication date of Term-1 and that student will be allowed to apply for provisional certificate.

CHAPTER 4

COURSE REQUIREMENTS FOR UNDERGRADUATE COMPUTER SCIENCE AND ENGINEERING STUDENTS

Undergraduate students of the Department of Computer Science and Engineering (CSE) have to follow a particular course schedule, the term-wise distributions of which are given below:

LEVEL-1 TERM-I

	Course No	Course Title	Hours/Week		Credits	Pre-requisite	Page No
			Theory	Sessional			
1	CSE-100	Introduction to Computer Systems Sessional	-	3.00	1.50		
2	EECE-163	Electrical Circuit Analysis	3.00	-	3.00		
3	EECE-164	Electrical Circuit Analysis Sessional	-	3.00	1.50		
4	ME-181	Basic Mechanical Engineering	2.00	-	2.00		
5	MATH-141	Mathematics-I (Differential Calculus and Integral Calculus)	3.00	-	3.00		
6	PHY-103	Physics	3.00	-	3.00		
7	PHY-104	Physics Sessional	-	1.50	0.75		
8	HUM-101	English	2.00	-	2.00		
9	Shop-140	Workshop Practice Sessional	-	1.50	0.75		
	Total		**13.00**	**9.00**	**17.50**		

LEVEL-1 TERM-II

	Course No	Course Title	Hours/Week		Credits	Pre-requisite	Page No
			Theory	Sessional			
1	CSE-101	Discrete Mathematics	3.00	-	3.00		
2	CSE-105	Structured Programming Language	3.00	-	3.00	CSE-100	
3	CSE-106	Structured Programming Language Sessional	-	3.00	1.50		
4	EECE-169	Electronic Devices and Circuits	3.00	-	3.00	EECE-163	
5	EECE-170	Electronic Devices and Circuits Sessional	-	3.00	1.50		
6	CE-150	Engineering Drawing & CAD Sessional	-	3.00	1.50		
7	CHEM-101	Chemistry	3.00	-	3.00		
8	MATH-143	Mathematics-II (Ordinary and Partial Differential Equations and Coordinate Geometry)	3.00	-	3.00		
	Total		**15.00**	**9.00**	**19.50**		

LEVEL-2 TERM-I

	Course No	Course Title	Hours/Week		Credits	Pre-requisite	Page No
			Theory	Sessional			
1	CSE-201	Digital Logic Design	3.00	-	3.00		
2	CSE-202	Digital Logic Design Sessional	-	3.00	1.50		
3	CSE-203	Data Structures	3.00	-	3.00	CSE-105	
4	CSE-204	Data Structures Sessional	-	3.00	1.50		
5	CSE-205	Object Oriented Programming Language	3.00	-	3.00	CSE-105	
6	CSE-206	Object Oriented Programming Language Sessional	-	3.00	1.50		
7	EECE-269	Electrical Drives and Instrumentation	3.00	-	3.00	EECE-169	
8	EECE-270	Electrical Drives and Instrumentation Sessional	-	1.50	0.75		
9	MATH-245	Mathematics-III (Vector Analysis, Matrices and Fourier Analysis)	3.00	-	3.00		
	Total		**15.00**	**10.50**	**20.25**		

LEVEL-2 TERM-II

	Course No	Course Title	Hours/Week		Credits	Pre-requisite	Page No
			Theory	Sessional			
1	CSE-210	Assembly Language Programming Sessional	-	3.00	1.50		
2	CSE-211	Digital Electronics and Pulse Technique	3.00	-	3.00	EECE-169	
3	CSE-212	Digital Electronics and Pulse Technique Sessional	-	1.50	0.75		
4	CSE-213	Computer Architecture	3.00	-	3.00	CSE-201	
5	CSE-215	Algorithms	3.00	-	3.00	CSE-101, CSE-203	
6	CSE-216	Algorithms Sessional	-	3.00	1.50		
7	CSE-217	Theory of Computation	3.00	-	3.00		
8	CSE-220	Object Oriented Programming language Sessional-II	-	1.50	0.75		
9	MATH-247	Mathematics-IV (Complex Variable and Laplace Transform)	3.00	-	3.00		
10	HUM-215	Engineering Ethics	2.00	-	2.00		
	Total		**17.00**	**9.00**	**21.50**		

Rest of the chapter is different for batch CSE-16 and CSE-17.

APPLICABLE FOR CSE-17

CSE-17 has already completed up to Level-2, Term-II on the approved syllabus applicable for CSE - 15, 16 & 17 as on December 2018. From Level-3, Term-I onwards they will follow the rest of the syllabus according to the following outline.

LEVEL-3 TERM-I

	Course No	Course Title	Hours/Week		Credits	Pre-requisite
			Theory	Sessional		
1	CSE-301	Database Management Systems	3.00	-	3.00	
2	CSE-302	Database Management Systems Sessional	-	3.00	1.50	
3	CSE-303	Compiler	3.00	-	3.00	CSE-217
4	CSE-304	Compiler Sessional	-	1.50	0.75	
5	CSE-305	Microprocessors and Micro-controller	3.00	-	3.00	CSE-201
6	CSE-306	Microprocessors and Micro-controller Sessional	-	1.50	0.75	
7	CSE-307	Operating System	3.00	-	3.00	
8	CSE-308	Operating System Sessional	-	1.50	0.75	
9	CSE-309	Computer Network	3.00	-	3.00	
10	CSE-310	Computer Network Sessional	-	3.00	1.50	
	Total		**15.00**	**10.50**	**20.25**	

LEVEL-3 TERM-II

	Course No	Course Title	Hours/Week		Credits	Pre-requisite
			Theory	Sessional		
1	CSE-311	Numerical Analysis	3.00	-	3.00	
2	CSE-313	Mathematical Analysis for Computer Science	3.00	-	3.00	
3	CSE-315	Digital System Design	3.00	-	3.00	CSE-305
4	CSE-316	Digital System Design Sessional	-	1.50	0.75	
5	CSE-317	Data Communication	3.00	-	3.00	
6	CSE-318	Data Communication Sessional	-	1.50	0.75	
7	CSE-319	Software Engineering	3.00	-	3.00	
8	CSE-360	Integrated Design Project/Capstone Project 1 (IDP –I)	-	3.00	1.50	CSE 105, CSE 203, CSE 215, CSE 205 and their corresponding sessional, CSE 220.*
9	HUM-315	Engineering Economics	2.00	-	2.00	
10	HUM-312	English Sessional	-	3.00	1.50	
	Total		**17.00**	**9.00**	**21.50**	

*Note: In respect of prerequisite course(s) for taking IDP-1, HOD may allow waiver of maximum two courses.

*LEVEL-3 INDUSTRIAL TRAINING

	Course No	Course Title	Hours/Week		Credits	Pre-requisite
			Theory	Sessional		
	CSE-350	Industrial Training	-	4 Weeks	1.00	

***Note**: This course is mandatory. Evaluation report from industry is to be submitted at the end of the training and accordingly to be incorporated in the tabulation sheet.

LEVEL-4 TERM-I

	Course No	Course Title	Hours/Week		Credits	Pre-requisite
			Theory	Sessional		
1	CSE-400	Thesis	-	3.00	1.50	
2	CSE-401	System Analysis, Design and Development	3.00	-	3.00	
3	CSE-402	System Analysis, Design and Development Sessional	-	1.50	0.75	
4	CSE-403	Artificial Intelligence	3.00	-	3.00	
5	CSE-404	Artificial Intelligence Sessional	-	1.50	0.75	
6	CSE-405	Computer Interfacing	3.00	-	3.00	
7	HUM-415	Financial and managerial Accounting	2.00	-	2.00	
8	CSE-460	Integrated Design Project/Capstone Project 2 (IDP –II)	-	6.00	3.00	CSE-360
9	CSE-4XO	Option-I	3.00	-	3.00	
	Total		**14.00**	**12.00**	**20.00**	

Option-I

	Course No	Course Title	Hours/Week		Credits	Pre-requisite
1	CSE-419	Advanced Algorithms	3.00	-	3.00	
2	CSE-421	Basic Graph Theory	3.00	-	3.00	
3	CSE-423	Fault Tolerant System	3.00	-	3.00	
4	CSE-425	Basic Multimedia Theory	3.00	-	3.00	
5	CSE-427	Digital Image Processing	3.00	-	3.00	
6	CSE-429	Data and Network Security	3.00	-	3.00	
7	CSE-431	Object Oriented Software Engineering	3.00	-	3.00	
8	CSE-433	Artificial Neural Networks and Fuzzy Systems	3.00	-	3.00	
9	CSE-435	Distributed Algorithms	3.00	-	3.00	
10	CSE-437	Bioinformatics	3.00	-	3.00	
11	CSE-439	Robotics	3.00	-	3.00	
12	CSE-441	Machine Learning	3.00	-	3.00	

LEVEL-4 TERM-II

	Course No	Course Title	Hours/Week		Credits	Pre-requisite
			Theory	Sessional		
1	CSE-400	Thesis*	-	6.00	3.00	
2	CSE-407	Applied Statistics and Queuing Theory	3.00	-	3.00	
3	CSE-411	VLSI Design	3.00	-	3.00	
4	CSE-413	Computer Graphics	3.00	-	3.00	
5	CSE-414	Computer Graphics Sessional	-	1.50	0.75	
6	CSE-417	Engineering Management	3.00	-	3.00	
7	CSE-4XO	Option-II	3.00	-	3.00	
8	CSE-4XE	Option-II Sessional	-	1.50	0.75	
	Total		**15.00**	**9.00**	**19.50**	

Option-II

	Course No	Course Title	Hours/Week		Credits	Pre-requisite
			Theory	Sessional		
1	CSE-443	Pattern Recognition	3.00	-	3.00	
2	CSE-444	Pattern Recognition Sessional	-	1.50	0.75	
3	CSE-445	Digital Signal Processing	3.00	-	3.00	
4	CSE-446	Digital Signal Processing Sessional	-	1.50	0.75	
5	CSE- 447	Telecommunication Engineering	3.00	-	3.00	
6	CSE- 448	Telecommunication Engineering Sessional	-	1.50	0.75	
7	CSE-449	Mobile and Ubiquitous Computing	3.00	-	3.00	
8	CSE-450	Mobile and Ubiquitous Computing Sessional	-	1.50	0.75	
9	CSE- 451	Simulation and Modeling	3.00	-	3.00	
10	CSE- 452	Simulation and Modeling Sessional	-	1.50	0.75	
11	CSE-453	Data Ware-housing and Data Mining	3.00	-	3.00	
12	CSE-454	Data Ware-housing and Data Mining Sessional	-	1.50	0.75	

Note: The courses those have been eliminated in the reviewed syllabus may be offered as deemed necessary due to failed or not registered in these courses in previous terms by any student.

Summary

Level and Term	Hours/Week		Credits	No of Theory Courses
	Theory	Sessional		
Level-1 Term-I	13.00	9.00	17.50	5
Level-1 Term-II	15.00	9.00	19.50	5
Level-2 Term-I	15.00	10.50	20.25	5
Level-2 Term-II	17.00	9.00	21.50	6
Level-3 Term-I	15.00	10.50	20.25	5
Level-3 Term-II	17.00	9.00	22.50	6
Level-4 Term-I	15.00	10.50	20.00	5
Level-4 Term-II	14.00	10.50	19.50	5
Grand Total	**121.00**	**78.00**	**161.00**	**42**

APPLICABLE FOR CSE-16

CSE-16 has already completed up to Level-3, Term-II on the approved syllabus applicable for CSE - 15, 16 & 17 as on December 2018. From Level-4, Term-I onwards they will follow the rest of the syllabus according to the following outline.

LEVEL-4 TERM-I

	Course No	Course Title	Hours/Week		Credits	Pre-requisite
			Theory	Sessional		
1	CSE-400	Thesis	-	3.00	1.50	
2	CSE-401	System Analysis, Design and Development	3.00	-	3.00	
3	CSE-403	Artificial Intelligence	3.00	-	3.00	
4	CSE-404	Artificial Intelligence Sessional	-	1.50	0.75	
5	CSE-405	Computer Interfacing	3.00	-	3.00	
6	CSE-407	Applied Statistics and Queuing Theory	3.00	-	3.00	
7	CSE-460	Integrated Design Project/Capstone Project 1 (IDP –I)	-	4.50	2.25	CSE 105, CSE 106, CSE 203, CSE 204, CSE 215, CSE 216, CSE 205, CSE 206, and CSE 220.*
9	CSE-4XO	Option-I	3.00	-	3.00	
	Total		**15.00**	**9.00**	**19.50**	

*Note: In respect of prerequisite course(s) for taking IDP-1, HOD may allow waiver of maximum two courses.

Option-I

	Course No	Course Title	Hours/Week		Credits	Pre-requisite
			Theory	Sessional		
1	CSE-419	Advanced Algorithms	3.00	-	3.00	
2	CSE-421	Basic Graph Theory	3.00	-	3.00	
3	CSE-423	Fault Tolerant System	3.00	-	3.00	
4	CSE-425	Basic Multimedia Theory	3.00	-	3.00	
5	CSE-427	Digital Image Processing	3.00	-	3.00	
6	CSE-429	Data and Network Security	3.00	-	3.00	
7	CSE-431	Object Oriented Software Engineering	3.00	-	3.00	
8	CSE-433	Artificial Neural Networks and Fuzzy Systems	3.00	-	3.00	
9	CSE-435	Distributed Algorithms	3.00	-	3.00	
10	CSE-437	Bioinformatics	3.00	-	3.00	
11	CSE-439	Robotics	3.00	-	3.00	
12	CSE-441	Machine Learning	3.00	-	3.00	

LEVEL-4 TERM-II

	Course No	Course Title	Hours/Week		Credits	Pre-requisite
			Theory	Sessional		
1	CSE-400	Thesis*	-	6.00	3.00	
2	CSE-411	VLSI Design	3.00	-	3.00	
3	CSE-413	Computer Graphics	3.00	-	3.00	
4	CSE-414	Computer Graphics Sessional	-	1.50	0.75	
5	HUM-415	Financial and managerial Accounting	2.00	-	2.00	
6	CSE-417	Engineering Management	3.00	-	3.00	
7	CSE-4XO	Option-II	3.00	-	3.00	
8	CSE-462	Integrated Design Project/Capstone Project 2 (IDP –II)	**-**	**3.00**	**1.50**	CSE-460
9	CSE-4XE	Option-II Sessional	-	1.50	0.75	
	Total		**14.00**	**12.00**	**20.00**	

Option-II

	Course No	Course Title	Hours/Week		Credits	Pre-requisite
			Theory	Sessional		
1	CSE-443	Pattern Recognition	3.00	-	3.00	
2	CSE-444	Pattern Recognition Sessional	-	1.50	0.75	
3	CSE-445	Digital Signal Processing	3.00	-	3.00	
4	CSE-446	Digital Signal Processing Sessional	-	1.50	0.75	
5	CSE- 447	Telecommunication Engineering	3.00	-	3.00	
6	CSE- 448	Telecommunication Engineering Sessional	-	1.50	0.75	
7	CSE-449	Mobile and Ubiquitous Computing	3.00	-	3.00	
8	CSE-450	Mobile and Ubiquitous Computing Sessional	-	1.50	0.75	
9	CSE- 451	Simulation and Modeling	3.00	-	3.00	
10	CSE- 452	Simulation and Modeling Sessional	-	1.50	0.75	
11	CSE-453	Data Ware-housing and Data Mining	3.00	-	3.00	
12	CSE-454	Data Ware-housing and Data Mining Sessional	-	1.50	0.75	

Note: The courses those have been eliminated in the reviewed syllabus may be offered as deemed necessary due to failed or not registered in these courses in previous terms by any student.

Summary

Level and Term	Hours/Week		Credits	No of Theory Courses
	Theory	Sessional		
Level-1 Term-I	13.00	9.00	17.50	5
Level-1 Term-II	15.00	9.00	19.50	5
Level-2 Term-I	15.00	10.50	20.25	5
Level-2 Term-II	17.00	9.00	21.50	6
Level-3 Term-I	15.00	10.50	20.25	5
Level-3 Term-II	17.00	9.00	22.50	6
Level-4 Term-I	15.00	10.50	20.25	5
Level-4 Term-II	14.00	10.50	19.25	5
Grand Total	**121.00**	**78.00**	**161.00**	**42**

CHAPTER 5

DETAIL OUTLINE OF UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

LEVEL-1 TERM-I

CSE-100 — 3 hours in a week, 1.50 Cr.
Introduction to Computer Systems Sessional

Introduction to computations; history of computing devices; Computers; Major components of a computer; Hardware: processor, memory, I/O devices; Software: Operating system, application software; Report writing and Presentation; Basic architecture of a computer; Basic Information Technology; Number system: binary, octal, hexadecimal, binary arithmetic; Basic programming concepts; Program development stages: flow charts; Programming constructs: data types, operators, expressions, statements; Introduction to Object Oriented Programming.

Reference Book(s):

1. Computer Fundamentals – Peter Norton.
2. The Complete PC Upgrade and Maintenance Guide – Mark Minasi.

EECE-163 — 3 hours in a week, 3.00 Cr.
Electrical Circuit Analysis

Fundamental electrical concepts and measuring units; Direct current (dc): Current, voltage, resistance, power and energy; Series/Parallel Circuits; Methods of network analysis and Network Theorems; Capacitors, Inductors and introduction to magnetic circuits. Alternating current (ac): Instantaneous current, voltage and power for various combinations of R, L and C circuits; Effective current and voltage, average power; Phasor representation of sinusoidal quantities; Sinusoidal Single-Phase Circuit Analysis; Introduction to three phase circuits; Power factor and power equation (Δ and Y circuits).

Reference Book(s):

1. Introductory Circuit Analysis - Robert L. Boylestad.
2. Alternating Current Circuits - Russel M Kerchner and George F Corcoran.
3. Fundamentals of Electric Circuits - Charles K Alexander, Mathew N O Sadiku.
4. Introduction to Electric Circuits - Richard C. Dorf, James A. Svoboda.

EECE-164 — 3 hours in a week, 1.50 Cr.
Electrical Circuit Analysis Sessional

Laboratory works based on EECE-163

ME-181 — 2 hours in a week, 2.00 Cr.
Basic Mechanical Engineering

Sources of energy: conventional and renewable; Introduction to IC engines, Refrigeration and Air conditioning systems; Statics of particles and rigid bodies; Forces in trusses and frames; Relative motion; Kinematics of particles: Newton's Second Law of Motion; Kinematics of rigid bodies; Introduction to Robotics; Plane, rotational and spatial motion with applications to manipulators; Geometric configurations: structural elements, linkage, arms and grippers; Motion characteristics.

Reference Book(s):

1. A Textbook Of Thermal Enginering - R S Khurmi
2. Introduction to Thermal Engineering- J. P. Vasandani
3. Refrigeration And Air Conditioning- Ahmadul Ameen

3 hours in a week, 3.00 Cr.
MATH-141
Mathematics-I (Differential Calculus and Integral Calculus)

DIFFERENTIAL CALCULUS

Limit, continuity and differentiability, successive differentiation of various types of functions, Leibnit'z theorem, Rolle's theorem, Mean Value theorem, expansion in finite and infinite forms, Lagrange's form of remainder, Cauchy's form of remainder (expansion of remainder), expansions of functions differentiation and integration, indeterminate form, partial differentiation, Euler's theorem, tangent and normal, sub tangent and subnormal in Cartesian and polar coordinates, maxima and minima of functions of single variables, curvature, asymptotes.

INTEGRAL CALCULUS

Definition of integrations, integration by the method of substitution, integration by parts, standard integrals, integration by the method of successive reduction, definite integrals, definite integral properties and its use in summing series, Walli's formula, improper integrals, Beta function and Gamma function, multiple integral and its application, area, volume of solid of revolution, area under a plane curve in Cartesian and polar coordinates, area of the region enclosed by two curves in Cartesian and polar coordinate, arc lengths of curves in Cartesian and polar coordinates.

Reference Book(s):

1. A text Book of Differential Calculus – Rahman and Bhattachrjee.
2. Differential Calculus – Shanti Narayan.
3. Differential Calculus – Dr. B. D. Sharma.
4. Differential Calculus – Das and Mukhajee.
5. Integral Calculus – Rahman and Bhattacharjee.
6. Integral Calculus – Abu Eusuf.
7. Integral Calculus – Das and Mukhajee.

PHY-103 3 hours in a week, 3.00 Cr.
Physics

Waves-Oscillations & Wave mechanics

Oscillations: Differential equation of simple harmonic oscillator, total energy and average energy, Combination of simple harmonic oscillations, spring-mass system, damped oscillation, forced oscillation, resonance, stationary wave, phase velocity, group velocity. Wave mechanics: Fundamental postulates of wave mechanics, Schroding's equation (time dependent and time independent), Operators, Uncertainty principle, energy of a free particle.

Optics and Laser

Theories of light: Interference of light, Young's double slit experiment, Fresnel's bi-prism. Interference in thin films, Newton's rings, Interferometers, Diffraction of light: Fresnel and Fraunhofer diffractions, Diffraction by single slit, diffraction by double slits, diffraction gratings, Resolving power of optical instruments, Polarization of light: production and analysis of polarized light, polarization by double refraction, Brewster's law, Malus law, Nicole prism, , optical activity and polarimeter. Laser, spontaneous and stimulated emission, Helium-Neon laser, laser applications, Fiber optics.

Structure of Matter and Electricity: Crystalline & non-crystalline solids, single crystal and polycrystalline solids, crystal system, co-ordination number, packing factor, Miller indices, defects in solids, Bragg's law, Bonds in solids, Introduction to energy band, distinction between metal, insulator and semiconductor. Electricity: Coulomb's law, electric field, Gauss' law and its application, electric potential, capacitors and capacitance, dielectrics on atomic view, dielectric and Gauss's law, Ohm's law, resistivity -an atomic view, current density and drift velocity, Ampere's law, Faraday's law; Lenz's law, self-inductance and mutual inductance.

Reference Book(s):

1. A Text Book of Optics - Brijlal and Subramannyam
2. Fundamentals of optics - Francis and harvey
3. Waves and oscillation - Brijlal and Subramannyam
4. Physics part-I - Resnick and Haliday
5. Physics part-II - Resnick and Haliday
6. Fundamentals of Physcs - Haliday, Resnick and Walker
7. Electricity & Magnetism - K.K Tewari
8. Elementary Solid State Physics -M Ali Omar

PHY-104 3 hours in alternative week 0.75 Cr.
Physics Sessional

Laboratory works based on PHY-103

Reference Book(s):

1. Practical Physics –Dr. Giasuddin.
2. Practical Physics –C.L Arora.
3.

HUM-101 — 2 hours in a week, 2.00 Cr.
English

English Phonetics, Vocabulary, English Grammar-determiners, modifiers, affixes, root word, head word, types of verbs, different types of Clauses, Sentence construction and different types of sentences, synthesis of sentences, Grammatical Correction; Comprehension, Business Communication, Quotation and Tenders, Job Letters.
Paragraph writing, Precise writing, Amplification, Report writing, Situational writing- posters and advertisements, notice and memorandum, message writing, Communication Today; Short stories and Literary articles written by some prominent writers, Research Study, research methodology.

Reference Book(s):

1. Prose of Our Time – Ahsanul Haque, Sirajul Islam Chawdhury and M. Shamsuddoha.

Shop-140 — 3 hours in a week, 1.50 Cr.
Workshop Practice Sessional

Foundry: Introduction to foundry, tools and equipment; Patterns: function, pattern making; Molding: molding materials sand preparation, types of mold, procedure; Cores: types, core making materials; Metal melting and casting; Inspection of casting and casting defects.

Welding: Metal joints, riveting, grooving, soldering, welding; Welding practice: electric arc steel, aluminium; Types of electrode; Welding defects: visual, destructive and non-destructive tests of welding. Gas welding and equipment; Types of flame; Welding of different types of material; Gas welding defects; Test of gas welding.

Carpentry: Wood working tools, Wood working machine, Band Saw, Scroll Saw, Circular Saw, Jointer, Thickness Planner, Disc Sander, Wood Lathe, Types of Sawing, Common Cuts I Wood Works, Types of Joint, Defects of Timber, Natural Defects and Artificial Defects, Seasoning, Preservation, Substitute of Timber, Commercial Forms of Timber, Characteristics of Good Timber, Use of Fastening, Shop Practice, Practical Job, Planning and Estimating of a given Job.

Machine: Kinds of tools, Common bench and hand tools, Marking and layout tools, Measuring tools, Cutting tools, Bench work with job, Drilling, Sharper, Lathe and Milling Machines: Introduction, Type, size and capacity, uses and applications.

Reference Book(s):

1. Building Materials – Gurcharan Singh
2. Engineering Materials – M. A. Aziz
3. Machine Shop Practice – James Anderson, W. A. Chapman
4. Shop Theory – Anderson and Tatro.

LEVEL-1 TERM-II

CSE-101 — 3 hours in a week, 3.00 Cr.
Discrete Mathematics

Mathematical Logic: propositional calculus and predicate calculus;Set theory**:** sets, relations, partial ordered sets, functions; Mathematical reasoning and proof techniques; Counting: permutations, combinations, principles of inclusion and exclusion; Discrete Probability; Recurrence relations and recursive algorithms; Growth of functions; Graph theory: graphs, paths, trees, cycles; Algebraic structures: rings and groups.

Reference Book(s):

1. Discrete Mathematics & Its Applications- Kenneth H Rosen
2. Discrete Mathematics with Applications (Elsevier, 2004) -Thomas Koshy.

CSE-105 — 3 hours in a week, 3.00 Cr.
Structured Programming Language

Programming concepts; Program development stages; Flow charts; Structured programming language: data types, operators, expressions, control structures; Functions and program structure: Function basics, parameter passing conventions, scope rules and storage classes, recursion; Header files; Preprocessor; Pointers and arrays, Strings, Multidimensional array; User defined data types: structures, unions, enumerations; Input and Output: standard input and output, formatted input and output, file access; Variable length argument list; Pointer and it's uses; Command line parameters; Error Handling; Graphics; Linking; Library functions.

Reference Book(s):

1. Teach Yourself C - Herbert Schidlt
2. C: The Complete Reference - Herbert Schildt
3. C Programming Language – Dennis M. Ritche

CSE-106 — 3 hours in a week, 1.50 Cr.
Structured Programming Language Sessional

Laboratory works based on CSE-105

EECE-169 — 3 hours in a week, 3.00 Cr.
Electronic Devices and Circuits

Introduction to semiconductors, p-n junction diode, I–V characteristics; Diode applications: half and full wave rectifiers, clipping and clamping circuits, regulated power supply; Bipolar Junction Transistor (BJT): principle of operation, Transistor circuit configurations (CE, CB, CC), BJT biasing, BJT Transistor modeling, small-signal analysis of single and multi- stage amplifiers, frequency response of BJT amplifier.
Field Effect Transistors (FET): Principle of operation of JFET and MOSFET, Depletion and enhancement type MOSFETs, Switching circuits using FETs, CMOS, biasing of FETs, FET small signal analysis, Low and high frequency response of FETs; Operational amplifiers and its applications; Feedback and oscillators circuits; Operation, characteristics and application of SCR, TRIAC, DIAC and UJT; Introduction to IC fabrication processes.

Reference Book(s):

1. Electronic Devices and Circuit Theory -Robert L. Boylestad and Louis Nashelsky
2. Electronic Principles – Albert P. Malvino.

EECE-170 — 3 hours in a week, 1.50 Cr.
Electronic Devices and Circuits Sessional

Laboratory works based on EECE-169

CE-150 — 3 hours in a week, 1.50 Cr.
Engineering Drawing & CAD Sessional

Introduction: Lettering, numbering and heading, instrument and their use, sectional views and isometric views of solid geometrical figures; Plan, elevation and section of multistoried buildings; Building services drawings, detailed drawing of lattice towers; Use of AutoCAD software.

CHEM-101 — 3 hours in a week, 3.00 Cr.
CHEMISTRY

Atomic structure, quantum numbers, electronic configuration, periodic table; Properties and uses of noble gases; Different types of chemical bonds and their properties: Molecular structure of compounds: Selective organic reactions; Different types of solutions and their compositions; Phase rule. Phase diagram of mono component system; Properties of dilute solution; Thermo chemistry, chemical kinetics, chemical equilibrium; ionization of water and pi concept; Electrical properties of Solution.

Reference Book(s):

1. Chemistry of Engineering Material - Mominul Haque

MATH-143 3 hours in a week, 3.00 Cr.
Mathematics-II (Ordinary and Partial Differential Equations and Coordinate Geometry)

ORDINARY DIFFERENTIAL EQUATIONS:
Formulation of Differential Equations; Solution of first order differential equations by various methods, Solution of differential equation of first order but higher degrees; Solution of general linear equations of second and higher orders with constant co-efficient, Solution of Eular's Homogeneous linear differential equations.

PARTIAL DIFFERENTIAL EQUATIONS:
Introduction, Linear and non linear first order differential equations; Standard forms; linear equations of higher order; Equation of second order with variable coefficients;

COORDINATE GEOMETRY:
Transformation of coordinates, axes and its uses; Equation of conies and its reduction to standard forms; Pair of straight lines; Homogeneous equations of second degree; Angle between the pair of straight lines; Pair of lines joining the origin lo the point of intersection of two given curves, circles; System of circles; Orthogonal circles: Radical axis, radical center, properties of radical axes; Coaxial circles and limiting points: Equations of parabola, ellipse and hyperbola in cartesian and polar co-ordinates; Tangents and formals; pair of tangents; Chord of contact; Chord In terms of Its middle points; Pole and polar parametric co-ordinates; Diameters; Conjugate diameters and then- properties; Director circles and asymptotes.

Reference Book(s):

1. Ordinary and Partial differential Equations – M. D. Raisenghania.
2. Differential Equations – M. L. Khanna.
3. Differential Equations – B. D. Sharma.
4. Differential Equations – P. N. Chatterjee.
5. A text book on of coordinate geometry with vector analysis-Rahman and Bhattachrjee

LEVEL-2 TERM-I

CSE-201 3 hours in a week, 3.00 Cr.
Digital Logic Design

Number systems and codes; Digital logic: Boolean algebra, De-Morgan`s theorems, logic gates and their truth tables, canonical forms, combinational logic circuits, minimization techniques; Arithmetic and data handling logic circuits, decoders and encoders, multiplexers and de-mulitplexers; Flip-flops, race around problems; Counters; asynchronous counters, synchronous counters and their applications; Registers and basic memory unit; Synchronous and asynchronous logic design; Design of sequential circuit: State diagram; State minimizations and assignments; Pulse mode logic; Fundamental mode design; PLA design.

Reference Book(s):

1. Digital Logic and Computer Design-M. Morris Manno.
2. Digital Computer Electronics - Albert P. Malvino, Jerald A Brown

CSE-202 3 hours in a week, 1.50 Cr.
Digital Logic Design Sessional

Laboratory works based on CSE-201

CSE-203 3 hours in a week, 3.00 Cr.
Data Structures

Internal data representation; Abstract data types; Algorithm performance and elementary asymptotic analysis (Introduction to Big-O notation); Elementary data structures: array, linked list, stack, queue, tree and tree traversal, graphs and graph representation , heap, binary search tree; Sorting algorithms; Searching: linear search and binary search; Advanced data Structures: balanced binary search trees, skip list, advanced heaps; Hashing.

Reference Book(s):

1. Introduction to Algorithms – Thomas H Cormen
2. Data Structures - Reingold and Hansen
3. Data structures and algorithm – Hopcroft, Ullman
4. Michael T. Goodrich, Roberto Tamassia, Data Structures and Algorithms in Java 5th Edition, Wiley, 2010
5. Classic Data Structures –DebasisSamanta

CSE-204 3 hours in a week, 1.50 Cr.
Data Structures Sessional

Laboratory works based on CSE-203

CSE-205 3 hours in a week, 3.00 Cr.
Object Oriented Programming Language

Philosophy of Object Oriented Programming (OOP); Advantages of OOP over structured programming; Encapsulation, classes and objects, access specifiers, static and non-static members; Constructors, destructors and copy constructors; Array of objects, object pointers, and object references, In-line functions, friend functions, reference; Inheritance: single and multiple inheritance; Polymorphism: overloading, abstract classes, virtual functions and overriding; Exceptions; Object Oriented I/O, inserter, extractor; Template functions and classes; namespaces, overview of Standard Template Library; Multi-threaded Programming.

Reference Book(s):

1. Teach Yourself C++ - Herbert Schildt
2. Turbo C/C++ Complete Reference - Herbert Schildt
3. JAVA – How to Program – Deitel&Deitel
4. The Complete Reference Java – Herbert Schildt

CSE-206 3 hours in a week, 1.50 Cr.
Object Oriented Programming Language Sessional

Laboratory works based on CSE-205 (C++)

EECE-269 3 hours in a week, 3.00 Cr.
Electrical Drives and Instrumentation

Transformers: Transformation ratio equations, Losses, Ideal Transformer, Voltage regulation, Matching Transformer; Alternators: Faradays Law, Dynamo, Generated voltage equation, Voltage regulation, DC Generator; Synchronous motor and Induction motor; DC motor; Stepper motors; Thyristor and Microprocessor based speed control of motors. Instrumentation amplifiers: Differential, logarithmic and chopper amplifiers; Frequency and voltage measurements using digital techniques; Recorders and display devices; Spectrum analyzers and Logic analyzers; Data acquisition and Interfacing Io microprocessor based systems; Transducers: Types, principles and application of photovoltaic, piezoelectric, thermoelectric, variable reactance and opto-electronic transducers; Noise reduction in instrumentation.

Reference Book(s):

1. A Text Book of Electrical technology - B.L Theraja
2. Electrical Machinery and Transformers - Irving L. Kossow
3. A Course in Electrical and Electronic Measurements and Instrumentation - A.K. Sawhney
4. Electronic Instrumentation and Measurements - David A. Bell

EECE-270 3 hours in alternative week, 0.75 Cr.
Electrical Drives and Instrumentation Sessional

Laboratory works based on EECE-269

MATH-245 3 hours in a week, 3.00 Cr.
Mathematics-III (Vector Analysis, Matrices and Fourier Analysis)

VECTOR ANALYSIS

Scalars and vectors, equality of vectors; Addition and subtraction of vectors; Multiplication of vectors by scalars; Scalar and vector product of two vectors and their geometrical interpretation: Triple products and multiple products; Linear dependence and independence of vectors. Differentiation and integration of vectors together with elementary applications; Definition of line, surface and volume integrals; Gradient, divergence and curl of point functions, various formulae, Gauss's theorem, Stoke's theorem, Green's theorem.

MATRICES AND FOURIER ANALYSIS

a. **Matrices:** Definition of matrix; Algebra of matrices; multiplication of matrices, transpose of a matrix, inverse of matrix; rank and elementary transformations of matrices; Solution of linear equations; linear dependence and independence of vectors. quadratic forms, matrix polynomials, determination of characteristic root and vectors, null space and nullity of matrix, characteristic subspace of matrix.

b. **Fourier Analysis:** Real and complex form of Fourier series; Finite transform; Fourier Integral; Fourier transforms and their uses in solving boundary value problems of wave equations.

Reference Book(s):

1. Vector Analysis – Dr. Muhammad Abdus Sattar.
2. Vector Analysis – M. D. Raisinghania.
3. Martices and Linear Transformations – Mohammad Iman Ali.
4. An Introduction to Matrices – S. C. Gupta.
5. Matrics – Frand Asyres, JR.

LEVEL-2 TERM-II

CSE-210 — 3 hours in a week, 1.50 Cr.
Assembly Language Programming Sessional

System Architecture for Assembly language; Assembly programming basics; Assembly instruction types and their formats: Arithmetic, Logical, Transfer control and conditional processing, Stacks, branches, String processing, subroutine and parameter passing, macros, Input/Output; Interrupts; Procedures, file system and file I/O handling.

CSE-211 — 3 hours in a week, 3.00 Cr.
Digital Electronics and Pulse Technique

Diode Logic Gates, Transistor Switches, Transistor Gates, Open Collector and High Impedance Gates, MOS Gates; Digital Logic Families: TTL, ECL, IIL and CMOS Logic with Operation Details; Characteristics of Digital ICs: Propagation delay, Power dissipation, Figure of Merit, Fan out, and Noise immunity; Electronic Circuits for Flip Flops, Counters and Register, Memory Systems, PLAs; S/H circuits, A/D and D/A Converters with Applications; Linear Wave Shaping, Diode Wave Shaping Techniques, Comparator Circuits, Switching Circuits; Pulse Transformers, Pulse Transmission, Pulse Generation; Monostable, Bi-stable and Astable Multivibrator; Schmitt Trigger; Optically Coupled Oscillators; Blocking Oscillators and Time-base Circuit; Timing circuits; Simple voltage sweeps, linear current sweeps.

Reference Book(s):

1. Pulse, Digital and Switching waveforms- Jacob Millman and Herbert Taub.
2. Microelectronics: Digital and Analog Circuits and Systems- Jacob Millman.
3. Operational Amplifier and Linear Integrated Circuits- Robert Coughlin

CSE-212 3 hours in alternative week, 0.75 Cr.
Digital Electronics and Pulse Technique Sessional

Laboratory works based on CSE-211

CSE-213 3 hours in a week, 3.00 Cr.
Computer Architecture

Fundamentals of computer Design; Processor Design; Datapaths Design : single cycle and multi cycle implementations; Control Unit design : hardware and micro programmed; Hazards; Exceptions; Fixed Point Arithmetic; Arithmetic Logic Unit (ALU) Design; System organization; Parallel Processing; Pipeline: pipelined datapath and control, superscalar and dynamic pipelining, Pipeline structure vector supercomputers; RISC Processor; Memory organization.

Reference Book(s):

1. Computer Organization and Design- David A Patterson
2. Computer Organization and Architecture- William Stalling

CSE-215 3 hours in a week, 3.00 Cr.
Algorithms

Introduction to algorithms; Correctness proof and techniques for analysis of algorithms; Master Theorem; Methods for the design of efficient algorithms: divide and conquer, greedy method, dynamic programming; Graph algorithms: Basic search and traversal techniques, Topological sorting, Connected components, Spanning trees, Shortest paths, Flow algorithms; Lower bound theory; NP-completeness, NP-hard and NP-complete problems; Coping with Hardness: backtracking, branch and bound, approximation algorithms.

Reference Book(s):

1. Algorithm Design, Wiley, 2002 - Michael T. Goodrich and Roberto Tamassia
2. Algorithms, McGraw-Hill, 2006 - Sanjoy Dasgupta, Christos H. Papadimitriou, Umesh Vazirani.
3. Algorithm Design, Addison-Wesley, 2005 - Jon Kleinberg and Éva Tardos.
4. Introduction to Algorithms – Thomas H Corman

CSE-216 3 hours in a week, 1.50 Cr.
Algorithms Sessional

Laboratory works based on CSE-215

CSE-217 3 hours in a week, 3.00 Cr.
Theory of Computation

Finite automata: deterministic finite automata, nondeterministic finite automata, equivalence and conversion of deterministic and nondeterministic finite automata, pushdown automata; Context free languages; Context free grammars; Pushdown automata; Regualar languages: regular expressions, nonregular languages, the pumping lemma; Turing Machines: basic machines, configuration, computing with Turing machines, combining Turing machines; Undecidability.

Reference Book(s):

1. Introduction to the Theory of Computation. CENGAGE Learning, 3rd ed., 2012 - M. Sipser.
2. Introduction to Automata Theory, Languages, and Computation. Addison-Wesley Longman Publishing Co., Inc., 3rd ed., 2006 - J. E. Hopcroft, R. Motwani, and J. D. Ullman.
3. Elements of the Theory of Computation. Upper Saddle River, NJ, USA: Prentice Hall PTR, 2nd ed., 1997 - H. R. Lewis and C. H. Papadimitriou.

CSE-220 3 hours in alternative week, 0.75 Cr.
Object Oriented Programming Language Sessional-II

Laboratory works based on CSE-205 (JAVA)

MATH-247 3 hours in a week, 3.00 Cr.
Mathematics-IV (Complex Variable and Laplace Transform)

COMPLEX VARIABLE

Complex number system, General functions of a complex variable, Limits and continuity of a function of complex variable and related theorems, Complex function, differentiation and the Cauchy-Riemann Equations. Line integral of a complex function, Cauchy's Integral Formula, Liouville's Theorem, Taylor's and Laurent's Theorem, Singular Residues, Cauchy's Residue Theorem.

LAPLACE TRANSFORM

Definition. Laplace transforms of some elementary functions. Sufficient conditions for existence of Laplace transform. Inverse Laplace transforms. Laplace transforms of derivatives. The unit step function. Periodic function, some special theorems on Laplace transform, Partial fraction. Solutions of differential equations by Laplace transform. Evaluation of improper integral.

Reference Book(s):

1. Theory and Problems of Complex Variables – Marray R Sprigel.
2. Theory and functions of Complex Variables – Shanti Narayan.

HUM-215 2 hours in a week, 2.00 Cr.
Engineering Ethics

Historical and philosophical background of patents and other intellectual property, The U.S. Patent System: the Constitution, Congress, Patent Office (PTO), and courts, Analyzing and understanding judicial opinions, Legal fundamentals of patent protection for useful inventions, Design and plant patents, Legal fundamentals of copyright protection, Similarity and access, Expression vs. ideas and information, merger, Fair use of copyrighted works, Contributory copyright infringement, Critical differences between patent and copyright protection, Copyright infringement distinguished from plagiarism, Legal fundamentals of trade-secret and trademark protection, Requirements and limitations of patentability, The process of applying for a patent, Actions for patent infringement, Patent licensing, Non-competition agreements, Rights and obligations among co-inventors, co-authors, employers, and licensees.

Definition and scopes of Ethics. Different branches of ethics. Social change and the emergence of new technologies. History and development of engineering ethics. Science and technology necessity and application. Study of ethics in engineering. Applied ethics in engineering. Human qualities of an engineer. Obligation of an engineer to the clients .Attitude of an engineer to other engineers. Measures to be taken in order to improve the quality of engineering profession. Ethical expectation: Employers and employees, inter-professional relationship, Professional Organization – maintaining a commitment of ethical standards. Desired characteristics of a professional code. Institutionalization of ethical conduct. Case studies.

Reference Book(s):

1. Create or Perish: The Case for Inventions and Patents - Robert HRines
2. Engineering Ethics – Carles E Haris

Rest of the chapter is different for batch CSE-16 and CSE-17.

APPLICABLE FOR CSE-17

CSE-17 has already completed up to Level-2, Term-II on the approved syllabus applicable for CSE - 15, 16 & 17 as on December 2018. From Level-3, Term-I onwards they will follow the rest of the syllabus according to the following outline.

LEVEL-3 TERM-I

CSE-301 3 hours in a week, 3.00 Cr.

Database Management Systems

Pre-requisite: None

Rationale:
This course is designed to introduce the basic concepts of database, learn the foundations of database systems, focusing on basics such as the relational algebra and data model, schema normalization, query optimization, and transactions.

Objective:

1. Understand the basic concepts and appreciate the applications of database systems.
2. Know the basics of SQL and construct queries using SQL.
3. Be familiar with a commercial relational database system (Oracle) by writing SQL using the system.
4. Be familiar with the relational database theory, and be able to write relational algebra expressions for queries.

Course Outcomes (CO):

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

1. Describe the basic concepts and appreciate the applications of database systems.
2. Illustrate the basics of SQL and construct queries using SQL.
3. Be familiar with a commercial relational database system (Oracle) by writing SQL using the system.
4. Be familiar with the relational database theory and be able to write relational algebra expressions for queries.

Course Content:
Introduction of database systems; Models: Entity-Relationship model, Relational model; Relational algebra; SQL; Advanced SQL; Some applications using SQL. Integrity constraint; Relational database design; File organization and retrieval, file indexing and hashing; Transaction manager; Concurrency controller; Recovery manager; Security system; Database administration; Introduction to advanced database management systems: distributed database,

parallel database, data mining and warehousing, multimedia, object-oriented, object-relational, real-time database.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
Describe the basic concepts and appreciate the applications of database systems.	√											
Illustrate the basics of SQL and construct queries using SQL.	√											
Be familiar with a commercial relational database system (Oracle) by writing SQL using the system.	√											
Be familiar with the relational database theory and be able to write relational algebra expressions for queries.	√											

Lecture Schedule

Week	**Lecture**	**Topics**	**Class Test**
1	Lec 1 Lec 2 Lec 3	Introduction of database systems	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Models: Entity-Relationship model, Relational model	
3	Lec 7 Lec 8 Lec 9	Relational algebra	
4	Lec 10 Lec 11 Lec 12	SQL	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Advanced SQL, Some applications using SQL	
6	Lec 16 Lec 17 Lec 18	Integrity constraint	
7	Lec 19 Lec 20 Lec 21	Relational database design	
8	Lec 22 Lec 23	File organization and retrieval, file	**Class Test 3**

Week	Lecture	Topics	Class Test
	Lec 24	indexing and hashing	
9	Lec 25 Lec 26 Lec 27	Transaction manager	
10	Lec 31 Lec 32 Lec 33	Concurrency controller, Recovery manager	
11	Lec 28 Lec 29 Lec 30	Security system, Database administration	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Introduction to advanced database management systems: distributed database, parallel database	
13	Lec 37 Lec 38 Lec 39	Data mining and warehousing, multimedia	
14	Lec 40 Lec 41 Lec 42	Object-oriented, object-relational, real-time database	

Text and Ref Books:

1. Database System Concept, Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Fourth edition
2. Files and Databases- An Introduction, Peter D. Smith and G.M. Barnes, Addison-Wesley
3. Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke, Third edition

CSE-302 — 3 hours in a week, 1.50 Cr.

Database Management Systems Sessional

Pre-requisite: None

Rationale:
This course is designed to introduce the basic concepts of database, learn how to design database and gain first-hand experience through developing a real world e- commerce database application in a term project. Also, to learn the design of a database starting from the conceptual design to the implementation of database schemas and user interfaces to a database..

Objective:

1. To introduce the basic concepts of database.
2. Developing a real world database application.

3. To learn the design of a database starting from the conceptual design to the implementation of database schemas and user interfaces to a database.

Course Outcomes (CO):

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

1. Demonstrate the knowledge in projects with a commercial relational database system (Oracle) and design a team-based project.
2. Utilize the database design principles, SQL and PL SQL.
3. Demonstrate the relational database theory and be able to write relational algebra expressions for queries.

Course Content:

Introduction, Oracle Installation, Authentication, Security, Table Creation, SQL, Simple Query, Data Expressions, Join, Constraints, Advanced Query (GROUP Function etc.), Sub-queries, Single-row function, Numeric function, Manipulation function, Conversion function, Nesting of function, Abstract data type, Database Trigger/ Procedure, PL/SQL Packages, Indexing, View, Introduction to PL/SQL

Teaching-learning and Assessment Strategy:

Lectures, Class Performance, Project, Quiz, Viva, Lab Exam

Assessment Methods & their Weights:

Category	**Marks %**
Online Test – 1	25
Online Test – 2	25
Viva	10
Class Participation	10
Class Assessment	30
Total	**100**

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
Demonstrate the knowledge in projects with a commercial relational database system (Oracle) and design a team-based project.									√			
Utilize the database design principles, SQL and PL SQL.									√			
Demonstrate the relational database theory and be able to write relational algebra expressions for queries.									√			

Lecture Schedule

Week	Lecture	Topics	Project
1	Lec 1	Introduction, Oracle Installation, Authentication, Security	Project group distribution Project assignment
2	Lec 2	Table Creation, SQL	Presentation on the project proposal with submission of a report
3	Lec 3	Simple Query, Data Expressions etc.	Submission of the E- R diagram, Schema diagram
4	Lec 4	JOIN	
5	Lec 5		Project Update - 01
6	Lec 6	Online Exam – 1	
7	Lec 7	Constraints	
8	Lec 8	Advanced Query (GROUP Function etc.), Sub-queries	
9	Lec 9	Single-row function, Numeric function, Manipulation function, Conversion function, Nesting of function, Abstract data type etc.	Project Update - 02
10	Lec 10	Online Exam – 2	
11	Lec 11	Database Trigger/ Procedure	
12	Lec 12	PL/SQL Packages, Indexing, View	
13	Lec 13	Introduction to PL/SQL	
14	Lec 14	Online Exam – 3	

Text and Ref Books:

1. Database System Concept, Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Fourth edition

2. The Complete Reference JAVA2, Herbert Schildt

3. Microsoft C# Professional Projects,Geetanjali Arora, B. Aiaswamy, Nitin Pandey

4. The Complete Reference PHP 5.2 Steven Holzner

CSE-303 **3 hours in a week, 3.00 Cr.**

Compiler

Pre-requisite: CSE-217

Rationale:
To teach the students the basic techniques that underlie the practice of various phases of Compiler construction.

Objective:
1. To introduce the theory and tools that can be employed in order to perform syntax-directed translation of a high-level programming language into an executable code.
2. To understand the role of compilers in programming languages.
3. To understand various stages in compilation process.
4. To provide knowledge on designing scanners and parsers using tools.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Describe the role and purpose of compilers in programming languages.
2. Discuss the stages in compilation process.
3. Separate the lexical, syntactic and semantic analysis into meaningful phases for a compiler to undertake language translation and specify and analyze the lexical, syntactic and semantic structures of advanced language features.
4. Design scanners and parsers using tools, and build abstract syntax trees in connection with this.

Course Content:
Introduction to compiling; Basic issues; Lexical analysis and Scanning; Syntax analysis; Syntax-directed translation; Attribute Grammars and Semantic Analysis Semantic analysis; type-checking; issues with run-time environments – source language issues; Issues in the design of code generation, Intermediate code generation; Error management; Storage organization-storage allocation strategies, target machine run-time storage management; Code optimization: The principle sources of optimization, Peephole optimization, Optimization of basic blocks-Loops in flow graphs; Introduction to global data-flow analysis, Code improving transformations.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Describe the role and purpose of compilers in programming languages.	√											
Discuss the stages in compilation process.	√											
Separate the lexical, syntactic and semantic analysis into meaningful phases for a compiler to undertake language translation and specify and analyze the lexical, syntactic and semantic structures of advanced language features.		√										
Design scanners and parsers using tools, and build abstract syntax trees in connection with this.			√									

Lecture Schedule:

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction, Language Processors, The Structure of a Compiler	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	The Role of the Lexical Analyzer, Input Buffering, Recognition of Tokens, Transition Diagram	
3	Lec 7 Lec 8 Lec 9	Recognition of Reserved Words and Identifiers, Architecture of a Transition-Diagram-Based Lexical Analyzer, The Lexical-Analyzer Generator Lex	
4	Lec 10 Lec 11 Lec 12	Top-Down Parsing, Predictive Parsing	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Designing a Predictive Parser, Left Recursion, The Role of the Parser, Representative Grammars, Syntax Error Handling, Writing a Grammar	
6	Lec 16 Lec 17 Lec 18	Elimination of Left Recursion, Left Factoring, Top-Down Parsing, First and Follow	
7	Lec 19 Lec 20	LL (1) Grammars, Construction of Predictive Parsing Table, Nonrecursive	

	Lec 21	Predictive Parsing, Parsers Generators	
8	Lec 22 Lec 23 Lec 24	Syntax-Directed Definitions, Inherited and Synthesized Attribute, Evaluating an SDD at the Nodes of a Parse Tree, Dependency Graph	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Ordering the Evaluation of Attributes, S-Attributed Definitions, L-Attributed Definitions, Semantic Rules with Controlled Side Effect, Applications of Syntax Directed Translation	
10	Lec 31 Lec 32 Lec 33	Variants of Syntax Tree, Directed Acyclic Graphs for Expressions, The Value Number Method for Constructing DAG's, Three-Address Code, Addresses and Instructions	
11	Lec 28 Lec 29 Lec 30	Quadruples, Triples, Static Single-Assignment Form, Types and Declarations,	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Storage Organization, Static VS Dynamic Storage Allocation, Stack Allocation of Space, Activation Trees, Activation Records	
13	Lec 37 Lec 38 Lec 39	Issues in the Design of a Code Generator, The Target Language, Addresses in the Target Code, Static Allocation, Optimization of Basic Blocks	
14	Lec 40 Lec 41 Lec 42	Peephole Optimization, Optimization of basic blocks-Loops in flow graphs; Introduction to global data-flow analysis, Code improving transformations	

Text and Ref Books:

1. Compilers: Principles, Techniques & Tools (2nd ed)- Alfred V Aho, Monica S Lam, Ravi Sethi, and Jeffrey D Ullman, Pearson/Addison Wesley (2006).

2. Engineering A Compiler (2nd Ed)- Linda Torczon and Keith Cooper, Morgan Kaufmann Publishers Inc (2011).

CSE-304 3 hours in alternate week, 0.75 Cr.

Compiler Sessional

Pre-requisite: None

Rationale:
To implement tokenizer, arithmetic calculator and to able to write the code by using Flex and Bison.

Objective:
1. To learn to implement different phases of a compiler.
2. To learn the use of Flex and Bison tools used for designing a compiler.
3. To understand the different types of parsing techniques and to solve the problem.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Use the basic techniques of compiler construction and tools that can used to perform syntax-directed translation of a high-level programming language into an executable code.
2. Describe the working of lex and yacc compiler for debugging of programs.
3. Discuss the new tools and technologies used for designing a compiler.

Course Content:
Symbol Table, Tokenizer, Tokenizer Using Flex, Arithmetic Calculator using Bison, Intermediate Code Generator (Flex + Bison).

Teaching-learning and Assessment Strategy:
Lab performances, Lab Report/Assignment/Presentation, Lab Test/ Quiz.
Assessment Methods & their Weights:

Category	**Marks %**
Online Test – 1	25
Online Test – 2	25
Viva	10
Class Participation	10
Class Assessment	30
Total	**100**

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Use the basic techniques of compiler construction and tools that can used to perform syntax-directed translation of a high-level programming language into an executable code.						√						
Describe the working of lex and yacc compiler for debugging of programs.									√			
Discuss the new tools and technologies used for designing a compiler.											√	

Lecture Schedule:

Week	Lecture	Topics
1+ 2	Lab 1+2	Symbol Table
3+ 4	Lab 3+ 4	Tokenizer
5+ 6	Lab 5+6	Tokenizer Using Flex
7+ 8	Lab 7+ 8	Arithmetic Calculator using Bison
9+ 10	Lab 9+ 10	Intermediate Code Generator (Flex + Bison)
11+ 12	Lab 11+ 12	Online
13	Lab 13	Quiz
14	Lab 14	Viva

Text and Ref Books:

1. Compilers: Principles, Techniques & Tools (2nd ed)- Alfred V Aho, Monica S Lam, Ravi Sethi, and Jeffrey D Ullman, Pearson/Addison Wesley (2006).

2. Engineering A Compiler (2nd Ed)- Linda Torczon and Keith Cooper, Morgan Kaufmann Publishers Inc (2011).

CSE-305 — 3 hours in a week, 3.00 Cr.

Microprocessors and Micro-controllers

Pre-requisite: CSE-201

Rationale:
This course introduces basics of assembly language, microprocessor architecture, and discusses different interfaces and the design of systems based on microprocessors and microcontrollers.

Objective:

1. To achieve knowledge on the low level language of microprocessor
2. To provide an understanding of microprocessor-based systems and their use in instrumentation, control and communication systems.
3. To Investigate microprocessor-based systems, produce software for a microprocessor-based system, interface microprocessor-based systems and understand usage of programmable logic controllers

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Understand how the high level language is converted to low level languages and how a processor executes a program line by line.
2. Work with basic microprocessors using assembly language.
3. Understand the basic method of how a microcomputer works with its associate components.
4. Design 8051 microcontroller based system.

Course Content:
Microprocessors and Micro-controllers: Introduction to Microprocessor and Microcontroller. Architectural overview of Microprocessor and its operation, Common instruction types, addressing modes. Intel 8086 Microprocessor : Internal architecture, register structure, programming model, addressing modes, instruction set; I/O Pin diagram and Control signals; I/O port organization and accessing; Cache Memory, TLB Structure; Memory Management in Intel 80X86 Family; segmentation and Real Mode Memory Management. Intel 80186, 80386 and 80486 segments register formats, Paged memory operation. Linear to physical address translation; Arithmetic co-processor; Interrupts and Exception in Intel 80X86 families of processors, type of Interrupts, Interrupts in real mode and protected mode, Interrupt descriptor tables, Interrupts Priorities; Input and Output : IO address spaces, Port organization, Memory mapped IO, Hand-shaking IO instruction, Keyboard-Display interface Timer handler, Microcontrollers: Architecture of 8051, memory organization, special function register,I/O ports, Special function registers.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Demonstrate how the high level language is converted to low level languages and how a processor executes a program line by line.	√											
Develop using basic microprocessors using assembly language.	√											
Describe the basic method of how a microcomputer works with its associate components.		√										
Develop 8051 microcontroller based system.			√									

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	System Architecture for Assembly language; Assembly programming basics; Assembly Addressing modes	
2	Lec 4 Lec 5 Lec 6	Assembly instruction types and their formats: Arithmetic, Logical, Transfer control and conditional processing,	**Class Test 1**
3	Lec 7 Lec 8 Lec 9	Stacks, branches, String processing, subroutine and parameter passing	
4	Lec 10 Lec 11 Lec 12	Macros, Input/output; Interrupts, Procedures, file system and file I/O handling.	
5	Lec 13 Lec 14 Lec 15	Introduction to Microprocessor and Microcontroller. Architectural overview of Microprocessor and its operation, Common instruction types, addressing modes.	**Class Test 2**
6	Lec 16 Lec 17 Lec 18	Intel 8086 Microprocessor : Internal architecture, register structure, programming model,	
7	Lec 19 Lec 20 Lec 21	Addressing modes, instruction set; I/O Pin diagram and Control signals; I/O port organization and accessing;	

8	Lec 22 Lec 23 Lec 24	Cache Memory, TLB Structure; Memory Management in Intel 80X86 Family; segmentation and Real Mode Memory Management.	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Intel 80186, 80386 and 80486 segments register formats, Paged memory operation	**Class Test 4**
10	Lec 28 Lec 29 Lec 30	Paged memory operation. Linear to physical address translation; Arithmetic co-processor;	
11	Lec 31 Lec 32 Lec 33	Interrupts and Exception in Intel 80X86 families of processors, type of Interrupts, Interrupts in real mode and protected mode, Interrupt descriptor tables, Interrupts Priorities;	
12	Lec 34 Lec 35 Lec 36	Interrupts Priorities; Input and Output : IO address spaces, Port organization, Memory mapped IO, Hand-shaking IO instruction,	
13	Lec 37 Lec 38 Lec 39	Keyboard-Display interface Timer handler, Microcontrollers:	**Class Test 5**
14	Lec 40 Lec 41 Lec 42	Architecture of 8051, memory organization, special function register,I/O ports, Special function registers.	

Text and Ref Books:

1. Assembly Language Programming and Organization of the IBM PC--Ytha Yu, Charles Marut

2. The Intel Microprocessors - Barry B Brey

3. Microprocessors and Interfacing - Douglas V. Hall

4. Microprocessors and Microcomputer- based system design -Mohamed Rafiquzzaman.

5. 8051 Microcontroller-Internals, Instructions, Programming& Interfacing by Subrata Ghoshal

CSE-306 3 hours in a week, 1.50 Cr.

Microprocessors and Micro-controllers Sessional

Pre-requisite: None

Rationale:
This course introduces basics of assembly language, microprocessor architecture, and discusses different interfaces and the design of systems based on microprocessors and microcontrollers.

Objective:

1. To achieve knowledge on the low level language of microprocessor
2. To provide an understanding of microprocessor-based systems and their use in instrumentation, control and communication systems.
3. To Investigate microprocessor-based systems, produce software for a microprocessor-based system, interface microprocessor-based systems and understand usage of programmable logic controllers

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Understand how the high level language is converted to low level languages and how a processor executes a program line by line.
2. Work with basic microprocessors using assembly language.
3. Understand the basic method of how a microcomputer works with its associate components.
4. Design 8051 microcontroller based system.
5. Know about different family and generation of microprocessors and microcontrollers.

Course Content:

Basic of Assembly Language - Compilation, input, output, variables, basic instructions, memory model, data segment, stack segment, code segment, Input Output Instruction. Basic Idea of MDA 8086; LED, Seven Segment display, LCD, Keyboard, Motor, Dot matrix Interface with 8086; Basic idea of ATMEGA 16 microcontroller and simulation

Teaching-learning and Assessment Strategy:
Lectures, Class Performance, Project, Quiz, Viva, Lab Exam

Assessment Methods & their Weights:

Category	Marks %
Online Test – 1	25
Online Test – 2	25
Viva	10
Class Participation	10
Class Assessment	30
Total	**100**

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Describe how the high level language is converted to low level languages and how a processor executes a program line by line and solve problems using to low level languages.										√		
Work with basic microprocessors using assembly language.						√						
Work on Group Project based on basic micro-controllers with presentation.								√				

Lecture Schedule

Week	Lecture	Topics
1	Lec 1	**Basic of Assembly Language** - Compilation, input, output, variables, basic instructions, memory model, data segment, stack segment, code segment, Input Output Instruction
2	Lec 2	Online Exam
3	Lec 3	Basic idea of ATMEGA 16 microcontroller and simulation.
4	Lec 4	Project Idea
5	Lec 5	Basic Idea of MDA 8086
6	Lec 6	LED and Seven Segment display interface
7	Lec 7	Operation of DOT matrix using 8086 kit
8	Lec 8	LCD interface with 8086
9	Lec 9	Keyboard interface with 8086

10	Lec 10	Motor interface with 8086
11	Lec 11	Project Update
12	Lec 12	Viva
13	Lec 13	Final Project Submission
14	Lec 14	Quiz

Text and Ref Books:

1. Assembly Language Programming and Organization of the IBM PC--Ytha Yu, Charles Marut
2. The Intel Microprocessors - Barry B Brey
3. Microprocessors and Interfacing - Douglas V. Hall

CSE-307 — 3 hours in a week, 3.00 Cr.

Operating System

Pre-requisite: None

Rationale:

The Operating System course provides a comprehensive understanding to the modern Operating System. The course begins with the history of operating system and the review of computer hardware and concentrates on operating system concepts, system structure, process and threads, memory management, file system and related security aspects. It also deals with multiprocessor systems, virtualizations and cloud.

Objective:

1. Developing the basic idea about Internals and design principles of OS.
2. Learning the techniques for achieving protection and security in multi-level complex environment.

Course Outcomes (CO):

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

1. Classify, identify and analyse modern operating systems; concept for virtualization, cloud and multiple processor systems. Discuss and apply internal design principles of Operating System.
2. Understanding and analysing process, threads, memory and file management system;
3. Able to develop and design algorithms for deadlock and memory management.

Course Content :

OS Introduction of Operating System, Types of OS; Process: process managements, process states, job and process scheduling, CPU scheduling algorithms, process coordination, critical section problems, semaphores, Inter-Process Communication (IPC), classical IPC problems, multiprocessing and time sharing,; Memory management: swapping, memory allocation schemes, Paging and segmentation, virtual memory, page replacement strategies, working sets, demand paging; Input/output: hardware/software, disk, disk scheduling algorithms, Secondary storage management, terminals, clocks; Deadlock: resource allocation, detection, prevention, avoidance and recovery; File management; Virtualization : Types and techniques for efficient virtualization, memory and i/o virtualizations, virtual appliances, Cloud :clouds as a service, virtual machine migration, Check pointing; Multiple Processor Systems:Multiprocessor, Multicomputer, Distributed Systems, Research on Multiple Processor Systems; Operating system security and protection; case study of some operating systems.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, class tests, final exam.

Assessment Methods & their Weights:

Assessment Method	(100%)
Lab Test	40
Quiz	20
Viva	10
Class Participation	10
Report	10
Class Assessment	10

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Classify, identify and analyse modern operating systems; concept for virtualization, cloud and multiple processor systems.	√											
Understanding and analysing process, threads, memory and file management system;		√										
Able to develop and design algorithms for deadlock and memory management.			√									

Lecture Schedule:

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction evolution, goals and Components of OS, types of OS	Class Test 1
2	Lec 4	Process managements, process states and	

	Lec 5 Lec 6	state transition, process control blocks	
3	Lec 7 Lec 8 Lec 9	Job and process scheduling, scheduling levels, objective and criteria CPU scheduling algorithms	
4	Lec 10 Lec 11 Lec 12	Process coordination, critical section problems, semaphores,	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Language constructs, classical problems of process coordination, Inter-process communication, message and mailbox etc.	
6	Lec 16 Lec 17 Lec 18	Memory management memory allocation schemes, Paging and segmentation, virtual memory	
7	Lec 19 Lec 20 Lec 21	Page replacement strategies, working sets, demand paging	
8	Lec 22 Lec 23 Lec 24	File system functions file organization logical and physical file maps, tree structure file systems,	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	I/O programming Device management techniques. Interrupts processing parallel processing.	
10	Lec 31 Lec 32 Lec 33	Secondary storage management, disk scheduling algorithms	
11	Lec 28 Lec 29 Lec 30	Space allocation, catalogs, file access control mechanism	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Deadlock, deadlock prevention. avoidance direction and recovery	
13	Lec 37 Lec 38 Lec 39	Operating system security, timesharing, Types and techniques for efficient virtualization, memory and i/o virtualizations, virtual appliances	
14	Lec 40 Lec 41 Lec 42	Clouds as a service, virtual machine migration, Check pointing; Multiple Processor Systems: Multiprocessor, Multicomputer, Distributed Systems, Research on Multiple Processor Systems; Operating system security and protection; case study of some operating systems	

CSE-308 3 hours in alternate week, 0.75 Cr.

Operating System Sessional

Pre-requisite: None

Rationale:

Understand the basic components of a computer operating system, and the interactions among the various components on the policies for scheduling, deadlocks, memory management, synchronization, system calls, and file systems.

Objective:

1. To learn basic OS concepts and to be familiar with the design principles of Operating System
2. Developing Internal and design principles of Operating System.
3. Be Familiar with the boot loader, kernel and how they works

Course Outcomes (CO):

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

1. Learn basic OS concepts and to be familiar with the design principles of Operating System.
2. Discuss and apply internal design principles of Operating System.
3. Be Familiar with the boot loader, kernel and how they works
4. Design a team-based project on tiny OS with a presentation.

Course Content :

Introduction of Linux Operating System, Installation of Linux in various modes, Installation of windows application programs on Linux, Installation of Linux application programs on Windows, Basic Command Line commands, Linux Kernels and Office Environments, Orientation with Shell Programing, Making own kernel, Harding Windows, Harding Linux.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, class tests, final exam.

Assessment Methods & their Weights:

Assessment Method	(100%)
Lab Test	40
Quiz	20
Viva	10
Class Participation	10
Report	10
Class Assessment	10

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Learn basic OS concepts and to be familiar with the design principles of Operating System.											√	
Discuss and apply internal design principles of Operating System.										√		
Be Familiar with the boot loader, kernel and how they works.							√					
Design a team-based project on tiny OS with a presentation.									√			

Lecture Schedule:

Week	Topics
1-2	Introduction of Linux Operating System Installation of Linux in various modes Installation of windows application programs on Linux Installation of Linux application programs on Windows Basic Command Line commands
3-4	Playing with Linux Kernels and Office Environments Assigning related Project
5-6	Orientation with Shell Programing
7-8	Introduction with a lightweight open source OS (For e.g., NACHOS) Implementation of Process & Thread Synchronization
9-10	Evaluation on Synchronization Implementation of Memory management
11-12	Evaluation on Memory management
13-14	Quiz & Final Report Submission

Text and Ref Books:

1. Modern Operating Systems (4th ed) - Andrew S. Tanenbaum; Prentice Hall (2014)
2. **UNIX Shell Programming** - Kanetkar

CSE-309 3 hours in a week, 3.00 Cr.

Computer Network

Pre-requisite: None

Rationale:
Resource sharing, high Reliability, increase in system performance, and security are the main objective.

Objective:

1. Understand the organization of computer networks, factors influencing computer network development and the reasons for having variety of different types of networks.
2. Apply knowledge of different techniques of error detection and correction to detect and solve error bit during data transmission.
3. Design a network routing for IP networks.
4. Demonstrate proper placement of different layers of ISO model and illuminate its function.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Discuss the understanding of the organization of computer networks, factors influencing computer network development and the reasons for having variety of different types of networks.
2. Illustrate knowledge of different techniques of error detection and correction to detect and solve error bit during data transmission.
3. Design network routing for IP networks.
4. Demonstrate proper placement of different layers of ISO model and illuminate its function.

Course Content:
Protocol hierarchies; Data link control: HLDC; DLL in Internet; DLL of ATM; LAN Protocols: Standards IEEE 802; Hubs, Bridges, and Switches, FDDI, Fast Ethernet; Routing Algorithm; Internetworking, WAN; Fragmentation; Firewalls; IPV4, IPV6, ARP, RARP, Mobile IP, Network layer of ATM; Transport Protocols; Transmission Control Protocol: Connection Management, Transmission Policy, Congestion Control, Timer Management; UDP; AAL of ATM; wireless networks, mobile computing, and high speed networks; Gigabit Ethernet; Domain Name System: Name servers; Email and Its privacy; SNMP; HTTP; World Wide Web; Network security: Cryptography, DES, IDEA, public key algorithm; Authentication; Digital signatures, Principles of Reliable Data Transfer, FTP.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
Discuss the understanding of the organization of computer networks, factors influencing computer network development and the reasons for having variety of different types of networks.	√											

Illustrate knowledge of different techniques of error detection and correction to detect and solve error bit during data transmission.	√											
Design network routing for IP networks.			√									
Demonstrate proper placement of different layers of ISO model and illuminate its function.	√											

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction What Is the Internet, Network Edge, Network Core, Delay, Loss, and Throughput in Packet-Switched Networks, Protocol Layers and Their Service Models, Networks Under Attack, History of Computer Networking and the Internet	
2	Lec 4 Lec 5 Lec 6	Application Layer Principles of Network Applications, The Web and HTTP, File Transfer	**Class Test 1**
3	Lec 7 Lec 8 Lec 9	Electronic Mail in the Internet, DNS, Peer-to-Peer Applications, Socket Programming	
4	Lec 10 Lec 11 Lec 12	Transport Layer Process to Process Delivery,	
5	Lec 13 Lec 14 Lec 15	UDP, TCP, SCTP	**Class Test 2**
6	Lec 16 Lec 17 Lec 18	Network Layer IPv4 Addresses, Internet Protocol, Internetworking, IPv4	
7	Lec 19 Lec 20 Lec 21	IPv6 Address, Transition from IPv4 to IPv6, Address Mapping, ICMP	
8	Lec 22 Lec 23 Lec 24	Data Link Layer Services Provided by the Link Layer , Link Layer Implementation, Error-Detection and Correction, Parity Checks, Check summing Methods, CRC	
9	Lec 25 Lec 26 Lec 27	Multiple Access Links and Protocols, Switched Local Area Network, Link Virtualization, Data Center Networking, Retrospective	**Class Test 3**
10	Lec 31 Lec 32 Lec 33	Wireless and Mobile Networks Wireless Links and Network Characteristics, Cellular Internet Access, Mobility Management: Principles, Mobile	

		IP, Managing Mobility in Cellular Networks, Wireless and Mobility: Impact on Higher-Layer Protocols	
11	Lec 28 Lec 29 Lec 30	Network Security Cryptography, Message Integrity and Digital Signatures, End-Point Authentication, Securing E-Mail, Securing TCP Connections: SSL, Network-Layer Security: IPsec and Virtual Private Networks, Firewalls and Intrusion Detection Systems	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Network Layer IGMP, ICMPV6, Delivering, Forwarding and Routing Delivery, Forwarding	
13	Lec 37 Lec 38 Lec 39	Unicast Routing Protocols Multicast Routing Protocols	
14	Lec 40 Lec 41 Lec 42	Multimedia Digitizing Audio And Video, Audio And Video Compression, Streaming Stored Audio/Video, Streaming Live Audioivideo, Real-Time Interactive Audioivideo, RTP, RTCP, Voice Over IP Review Class	

Text and Ref Books:

1. Computer Networks - Andrew S. Tanenbaum
2. Computer Networks: Protocols, Standards, and Interfaces - Uyless Black Internetworking with TCP/IP: Principles, Protocols, Architecture - D. E. Comer
3. TCP/IP Illustrated Vol. I - W. R. Stevens
4. Complete Networking : A Top Down Approach Featuring the Internet – James F. Kurose, Keith W. Ross

CSE-310 — 3 hours in a week, 1.50 Cr.

Computer Network Sessional

Pre-requisite: None

Rationale:

Apply, discuss, analyze, simulate, and present architectures, applications of different types of computer networks to facilitate communication and resource-sharing among a wide range of users.

Objective:

1. Understand, analyze, simulate, and present architectures of different types of computer networks &

develop, and present contemporary and new protocols of computer networks.
2. Understand, Design, analyze different types of Network Layers.
3. Identify applications of computer networks with determining suitable alternatives of the networks.
4. Achieve a basic idea about Cisco Packet tracer, WireShark,Ns2

Course Outcomes (CO):

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

1. Discuss, analyze, simulate, and present architectures of different types of computer networks; develop, and present contemporary and new protocols of computer networks.
2. Describe, design, analyze different types of network layers.
3. Identify applications of computer networks with determining suitable alternatives of the networks.
4. Apply the basic functionalities of Cisco Packet Tracer, WireShark,Ns2.

Course Content:

IP Addressing, Basic Configuration of Cisco Packet Tracer, Socket Programing, Basic Network Configuration (Static) Data, Variable Length Subnet Mask (VLSM), RIP, EIGRP, Dynamic Host Configuration Protocol (DHCP) , Open Shortest Path First (OSPF), Physical Network Interface Connection/ Router & Switch Configuration, Access Control List (ACL), VLAN, InterVLAN, VTP, Information Gathering using Wireshark, Introduction to NS2.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, class tests, final exam.

Assessment Methods & their Weights:

Category	**Marks %**
Online Test – 1	25
Online Test – 2	25
Viva	10
Class Participation	10
Class Assessment	30
Total	**100**

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
Discuss, analyze, simulate, and present architectures of different types of computer networks; develop, and present contemporary and new protocols of computer networks.									√			
Describe, design and analyze different types of network layers.											√	
Identify applications of computer networks with determining suitable alternatives of the networks.									√			
Apply the basic functionalities of Cisco Packet Tracer, WireShark,Ns2.											√	

Lecture Schedule

Week	Topics
1	IP Addressing, Basic Configuration of Cisco Packet Tracer
2	Socket Programing
3	Basic Network Configuration (Static) Data
4	Variable Length Subnet Mask (VLSM)
5	RIP, EIGRP
6	Dynamic Host Configuration Protocol (DHCP) , Open Shortest Path First (OSPF)
7	Online-1
8	Physical Network Interface Connection/ Router & Switch Configuration
9	Access Control List (ACL)
10	VLAN, InterVLAN, VTP
11	Information Gathering using Wireshark
12	Introduction to NS2
13	Online-2
14	Quiz

Text and Ref Books:

1. Computer Networks - Andrew S. Tanenbaum
2. Computer Networks: Protocols, Standards, and Interfaces - Uyless Black Internetworking with TCP/IP: Principles, Protocols, Architecture - D. E. Comer
3. TCP/IP Illustrated Vol. I - W. R. Stevens
4. Complete Networking : A Top Down Approach Featuring the Internet – James F. Kurose, Keith W. Ross

LEVEL-3 TERM-II

CSE-311 **3 hours in a week, 3.00 Cr.**
Numerical Analysis

Pre-requisite: None

Rationale:

In numerical analysis, a numerical method is a mathematical tool designed to solve numerical problems. The implementation of a numerical method with an appropriate convergence check in a programming language is called a numerical algorithm

Objective:

1. To calculate the solutions of nonlinear equations in one variable
2. To analyse the interpolation and approximation
3. To analyse numerical differentiation and integration
4. To understand direct methods for solving linear systems, numerical solution of ordinary differential equations.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Demonstrate a familiarity with major algorithms and data structures.
2. Write rigorous correctness proof and analyze the running time of the advanced algorithms and data structures for some classic problems;
3. Apply important algorithmic design paradigms and methods of analysis.
4. Synthesize efficient algorithms and data structures in common engineering design situations.

Course Content:

Introduction; Mathematical Model. Sources of errors, their propagation and the idea of conditioning. Solution of algebraic and transcendental equations: Iterative methods for root finding. Rates of convergence. False Position method, Newton-Rhapson method; Solution of simultaneous linear equations: Gauss-Jordan Elimination method, Choleski's process; Dolittle and Crout factorization; Interpolation: diagonal and horizontal difference, differences of a polynomial, Newton's formula for forward and backward interpolation, Spline interpolation; Integration: Gauss quadrature formula, Trapezoidal rule, Simpson's rules, Weddle's rule; Solution of ordinary differential equations: Euler's method, Picard's method, Milne's method, Taylor's series method, Runge-Kutta method; Least squares

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Demonstrate a familiarity with major algorithms and data structures.		√										
Write rigorous correctness proof and analyze the running time of the advanced algorithms and data structures for some classic problems		√										
Apply important algorithmic design paradigms and methods of analysis.					√							
Synthesize efficient algorithms and data structures in common engineering design situations.				√								

Lecture Schedule

Week	Lecture	Topics
1	Lec 1 Lec 2 Lec 3	Introduction; Mathematical Models
2	Lec 4 Lec 5 Lec 6	Sources of errors, their propagation and the idea of conditioning
3	Lec 7 Lec 8 Lec 9	Solution of algebraic and transcendental equations
4	Lec 10 Lec 11 Lec 12	Iterative methods for root finding
5	Lec 13 Lec 14 Lec 15	Rates of convergence, False Position method
6	Lec 16 Lec 17 Lec 18	Newton-Rhapson method
7	Lec 19 Lec 20 Lec 21	Solution of simultaneous linear equations: Gauss-Jordan Elimination method

8	Lec 22 Lec 23 Lec 24	Choleski's process; Dolittle and Crout factorization
9	Lec 25 Lec 26 Lec 27	Interpolation: diagonal and horizontal difference, differences of a polynomial
10	Lec 31 Lec 32 Lec 33	Newton's formula for forward and backward interpolation, Spline interpolation
11	Lec 28 Lec 29 Lec 30	Integration: Gauss quadrature formula
12	Lec 34 Lec 35 Lec 36	Trapezoidal rule, Simpson's rules, Weddle's rule
13	Lec 37 Lec 38 Lec 39	Solution of ordinary differential equations: Euler's method, Picard's method, Milne's method
14	Lec 40 Lec 41 Lec 42	Taylor's series method, Runge-Kutta method; Least squares

Text and Ref Books:

1. Data Structures - Reingold and Hansen
2. Data structures and algorithm – Hopcroft, Ullman
3. Data Structures and Algorithms in Java - Michael T. Goodrich, Roberto Tamassia
4. Introduction to Algorithms - T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, MIT Press

CSE-313 — 3 hours in a week, 3.00 Cr.

Mathematical Analysis for Computer Science

Pre-requisite: None

Rationale:
To achieve knowledge on probability, gain Knowledge on computation of probability with its practical and theoretical application in studying computer science.

Objective:
1. Understands the concept of random variable, moment generating function and their properties.
2. Learn Standard distributions in discrete and continuous cases.
3. Learn basics of probability, Bayes' theorem, stochastic process and Queuing theory.

Course Outcomes (CO):

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

1. Learn basics of probability, Bayes' theorem.
2. Describe the understanding of the concept of random variable, moment generating function and their properties.
3. Apply Standard distributions in discrete and continuous cases.
4. Apply stochastic process and Queuing theory.

Course Content:

Recurrent problems; Manipulation of sums; Number theory; Special numbers; generating functions.

Probability: Probability Models, Sample Space, Events, Algebra of Events, Probability Axioms, Conditional Probability, Multiplication Rule, Total Probability, Bayes' rule.

Random Variables: Discrete, Continuous and Mixed Random Variables, Probability Mass, Distribution and Cumulative Distribution Functions.

Probability Distributions: Discrete probability distributions -Binomial, Poisson, Negative Binominal Distributions and Their Properties Continuous probability distributions -Uniform, Normal, Exponential Distributions and their Properties. Stochastic process; Markov chains (discrete parameter, continuous parameter, birth-death process); Queuing models (birth-death model, Monrovian model), open and closed queuing network; Application of queuing models.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
Learn basics of probability, Bayes' theorem.	√											
Describe the understanding of the concept of random variable, moment generating function and their properties.	√											
Apply Standard distributions in discrete and continuous cases.	√											
Apply stochastic process and Queuing theory.	√											

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	**Recurrence Problems:** The Tower of Hanoi Lines in The Plane The Josephus Problem	

2	Lec 4 Lec 5 Lec 6	**Sums:** Manipulation of sums, Multiple Sums, General Methods, Finite and Infinite Calculus, Infinite Sums	**Class Test 1**
3	Lec 7 Lec 8 Lec 9	**Number Theory:** Divisibility, Primes, Prime Examples, Factorial Factors	
4	Lec 10 Lec 11 Lec 12	**Number Theory:** Relative Primarily, mod: The Congruence Relation, Independent Residues, Additional Applications, Phi and Mu	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	**Special Numbers:** Stirling Numbers, Eulerian Numbers, Harmonic Numbers	
6	Lec 16 Lec 17 Lec 18	**Special Numbers:** Harmonic Summation, Bernoulli Numbers, Fibonacci Numbers	
7	Lec 19 Lec 20 Lec 21	**Generating Functions**	
8	Lec 22 Lec 23 Lec 24	**Introduction to Probability**: Probability Definition, Conditional Probability, Independent Probability, Bayes' Formula	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	**Discrete Random variables**: The Bernoulli Random Variable, The Binomial Random Variable, The Geometric Random Variable, The Poisson Random Variable	
10	Lec 28 Lec 29 Lec 30	Continuous Random variables**: The Uniform Random Variable, Exponential Random Variables, Gamma Random Variables, Normal Random Variables,**	
11	Lec 31 Lec 32 Lec 33	Expectation of a Random Variable**: The Discrete Case, The Continuous Case**	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	**Review on Random Variable** **Stochastic Process**: Definition with application	
13	Lec 37 Lec 38 Lec 39	**Markov chains**: Definition, Transforming a Process into a Markov Chain, Chapman–Kolmogorov Equations	
14	Lec 40 Lec 41 Lec 42	Queuing models Review	

Text and Ref Books:

1. Concrete Mathematics -BY Graham, Knuth, Patashnik, 2nd Edition.
2. Introduction to Probability Models BY Sheldon M. Ross, 9th Edition.

3. Introduction to Probability BY Dimitri P. Bertsekas and John N. Tsitsiklis

CSE-315 — 3 hours in a week, 3.00 Cr.

Digital System Design

Pre-requisite: CSE-305

Rationale:
This course deals with design of different components of basic computer and applying knowledge in the initial interfacing of basic computer.

Objective:

1. To provide a basic idea of the structure and interface of different components of Digital Computer Systems.
2. To design different components of basic computer
3. To understand and design microprocessor of basic computer.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Design different components of a microcomputer like Accumulator, Shifter, ALU, RAM, Scratchpad Memory, 2-port Memory.
2. Design a fully customized microprocessor with special features.
3. Understand how to design a digital system using various methods.

Course Content:

Digital system design Hierarchy; ASM charts; Hardware description language; Design using MSI and LSI components; Combinational and sequential circuit design with PLA's, Design of memory subsystem using SRAM and DRAM; Design of various components of a computer: Accumulator design, Shifter design, ALU, memory and control unit - hardwired and micro-programmed, Microprocessor based designs; Computer bus standards; Design using special purpose controllers. Introduction to Simple As Possible (Microprocessor)- Architecture, Instruction Set, Design, Microprogramming, SAP-1, SAP-2, SAP-3 Introduction to Embedded Systems; Product design; Product development process.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Design different components of a microcomputer like Accumulator, Shifter, ALU, RAM, Scratchpad Memory, 2-port Memory with presentation.	√											
Design a fully customized microprocessor with special features.	√											
Describe the understanding of how to design a digital system using various methods.		√										

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Digital system design Hierarchy; ASM charts; Hardware description language;	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Design using MSI and LSI components; Combinational and sequential circuit design with PLA's	
3	Lec 7 Lec 8 Lec 9	Design of memory subsystem using SRAM and DRAM	
4	Lec 10 Lec 11 Lec 12	Design of various components of a computer: Accumulator design,	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Shifter design	
6	Lec 16 Lec 17 Lec 18	Design ALU, memory and control unit - hardwired and micro-programmed	
7	Lec 19 Lec 20 Lec 21	Microprocessor based designs	**Class Test 3**
8	Lec 22 Lec 23 Lec 24	Computer bus standards; Design using special purpose controllers.	
9	Lec 25 Lec 26 Lec 27	Introduction to Simple As Possible (Microprocessor)- Architecture, Instruction Set	
10	Lec 28	Simple As Possible-1: Design and	

	Lec 29 Lec 30	Microprogramming	
11	Lec 31 Lec 32 Lec 33	Simple as Possible-2: Architecture, Instruction Set, Design and Microprogramming	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Simple as Possible-: Architecture, Instruction Set, Design and Microprogramming	
13	Lec 37 Lec 38 Lec 39	Introduction to Embedded Systems; Product design	
14	Lec 40 Lec 41 Lec 42	Product development process	

Text and Ref Books:

1. Digital Logic and Computer Design-M. Morris Manno
2. Digital Computer Architecture – Malvino, Brown
3. Digital Design and Computer Architecture - David Harris and Sarah Harris

CSE-316 3 hours in alternate week, 0.75 Cr.

Digital System Design Sessional

Pre-requisite: None

Rationale:
This course deals with design of different components of basic computer and fully customized microprocessor of basic computer.

Objective:

1. To design different components of basic computer
2. To understand and design microprocessor of basic computer.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Design different components of the microprocessor using the concept of computer system design.
2. Implement combinatorial and sequential system using simulation software.
3. Design and implement a customized microprocessor with special features and simulate it using simulation software with team presentation.

Course Content:
Design of various components of a computer: Accumulator design, Shifter design, ALU, memory and control unit - hardwired and micro-programmed, Design fully customized Simple As Possible (Microprocessor)- Architecture, Instruction Set, Control Unit.

Teaching-learning and Assessment Strategy:
Lectures, Class Performance, Project, Quiz, Viva

Assessment Methods & their Weights:

Category	**Marks %**
Project	40
Quiz	20
Viva / Presentation	10
Class Participation	10
Report	10
Class Assessment	10
Total	**100**

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
Design different components of the microprocessor using the concept of computer system design.								√				
Implement combinatorial and sequential system using simulation software.											√	
Design and implement a customized microprocessor with special features and simulate it using simulation software with team presentation.									√			

Lecture Schedule

Week	**Lecture**	**Topics**
1	Lec 1	Discuss about Shifter Design
2	Lec 2	Shifter Design (Software Simulation)
3	Lec 3	Shifter Design (Hardware Implementation)
4	Lec 4	Discuss about ALU Design
5	Lec 5	ALU Design (Software Simulation)
6	Lec 6	ALU Design (Hardware Implementation)
7	Lec 7	Class Performance using
8	Lec 8	Discuss about fully customized Simple As Possible
9	Lec 9	Simple As Possible Design: Architecture and Control Unit
10	Lec 10	Simple As Possible software simulation

11	Lec 11	Simple As Possible Design(Hardware Implementation)-Update
12	Lec 12	Simple As Possible Design(Hardware Implementation Without Control Unit)
13	Lec 13	Simple As Possible Design(Hardware Implementation With Control Unit)
14	Lec 14	Quiz

Text and Ref Books:

4. Digital Logic and Computer Design-M. Morris Manno
5. Digital Computer Architecture – Malvino, Brown

CSE-317 3 hours in a week, 3.00 Cr.

Data Communication

Pre-requisite: None

Rationale:
The main course is to learn the working knowledge of data transmission concepts, line control and line sharing and also is to understand the operation of compression optimizing data transfer algorithms.

Objective:

1. Be familiar with modern telecommunications and the architecture of a number of different networks
2. Understand the principles of protocol layering.
3. Apply frequency and time division multiplexing techniques to share network bandwidth among multiple users.
4. Use data compression algorithms to maximize network.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Describe and explain data communication system and its components.
2. Familiarize students to the digital and analogue representations and channels.
3. Describe the mechanism and techniques of encoding.
4. Introduce students to the general principles of circuit and packet switching.
5. Introduce students to the wireless Local Area Networks.

Course Content:

Introduction: Communication models, data communication tasks, data communication network standards and organization introduction to TCP/IP models. Data Transmission basics: Analog and digital data, spectrum and bandwidth, Transmission impairments, data rate, and channel capacity. Data Encoding, NRZI Manchester and Differential Manchester encoding, ASK, FSK, PSK, QPSK, QAM encoding, speared spectrum technique, Sampling theorem and pulse code modulation techniques and speech digitization. Data Transmission: Asynchronous and synchronous data transmission techniques, error, detection techniques, parity cheeks and CRC error correction and hamming code interfacing and EIA 232D or RS 232c. DSL technology: Data Link Control: Line configurations. Multiplexing: Frequency division multiplexing, international FDM carrier standards, Synchronous time division multiplexing, international TDM carrier standards, statistical time division multiplexing, SONET and SDH.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
Describe and explain data communication system and its components.	√											
Familiarize students to the digital and analogue representations and channels.	√											
Describe the mechanism and techniques of encoding.		√										
Introduce students to the general principles of circuit and packet switching.	√											

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction: Communication models, data communication tasks.	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Data communication network standards and organization introduction to TCP/IP models.	
3	Lec 7 Lec 8 Lec 9	Data Transmission basics: Analog and digital data, spectrum and bandwidth, Transmission impairments, data rate, and channel capacity.	
4	Lec 10 Lec 11 Lec 12	Data Encoding, NRZI Manchester and Differential Manchester encoding, ASK, FSK, PSK, QPSK, QAM encoding.	**Class Test 2**
5	Lec 13 Lec 14	Speared spectrum technique, Sampling theorem and pulse code modulation	

	Lec 15	techniques and speech digitization.	
6	Lec 16 Lec 17 Lec 18	Data Transmission: Asynchronous and synchronous data transmission techniques.	
7	Lec 19 Lec 20 Lec 21	Error, detection techniques.	
8	Lec 22 Lec 23 Lec 24	Parity cheeks and CRC error correction and hamming code interfacing.	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Data Link Control: Line configurations.	
10	Lec 31 Lec 32 Lec 33	Multiplexing: Frequency division multiplexing, international FDM carrier standards, Synchronous time division multiplexing.	
11	Lec 28 Lec 29 Lec 30	International TDM carrier standards, statistical time division multiplexing, SONET and SDH.	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	STANDARD ETHERNET: MAC Sublayer, Physical Layer. FAST ETHERNET: MAC Sublayer, Physical Layer. GIGABIT ETHERNET: MAC Sublayer, Physical Layer, Ten-Gigabit Ethernet	
13	Lec 37 Lec 38 Lec 39	GIGABIT ETHERNET: MAC Sublayer, Physical Layer, Ten-Gigabit Ethernet	
14	Lec 40 Lec 41 Lec 42	BLUETOOTH: Architecture, Bluetooth Layers	

Text and Ref Books:

1. Data Communication and Networking(4^{th} ed) - Behrouz A Forouzan (2017)
2. Data and Computer Communication - William Stallings
3. Data Communication & Networks – R L Brewster

CSE-318 — 3 hours in alternate week, 0.75 Cr.

Data Communication Sessional

Pre-requisite: None

Rationale:
The main course is to learn the working knowledge of data transmission concepts, line control and line sharing and also is to understand the operation of compression optimizing data transfer algorithms.

Objective:

1. Understand and explain Data Communications System and its components.
2. Introduce students to the digital and analogue representations and channels.
3. Describe the mechanism and techniques of encoding.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Apply amplitude, frequency and time division multiplexing techniques to share network bandwidth among multiple users.
2. Compare each data transmission methods using both signal processing devices and lab software.
3. Describe the knowledge of data link layer fundamental in error detection, correction and flow control techniques.

Course Content:
Introduction to MATLAB / Delta Modulation, , AM/FM / AM Modulator & Demodulator, Digital to digital Conversion; Line Coding / DSB-SC and SSB Demodulators, FM Modulator and Demodulator, ASK/PSK/FSK, CDMA, Checksum.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Assessment Methods & their Weights:

Category	**Marks %**
Online Test – 1	25
Online Test – 2	25
Viva	10
Class Participation	10
Class Assessment	30
Total	**100**

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Apply amplitude, frequency and time division multiplexing techniques to share network bandwidth among multiple users.						√						
Compare each data transmission methods using both signal processing devices and lab software.									√			
Describe the knowledge of data link layer fundamental in error detection, correction and flow control techniques.						√						

Lecture Schedule:

Week	Topics
1 & 2	Introduction to MATLAB / Delta Modulation
3 & 4	Evaluation On Lab-1, AM/FM / AM Modulator & Demodulator
5 & 6	Digital to digital Conversion; Line Coding / DSB-SC and SSB Demodulators
7	**Online-1**
8 & 9	Digital to digital Conversion; Line Coding / FM Modulator and Demodulator
10 & 11	ASK/PSK/FSK
12 & 13	CDMA, Checksum
14	**Viva/Quiz + Online-2**

Text and Ref Books:

1. Data Communication and Networking(4^{th} ed) - Behrouz A Forouzan (2017)
2. Data and Computer Communication - William Stallings

CSE-319 — 3 hours in a week, 3.00 Cr.

Software Engineering

Pre-requisite: None

Rationale:

This course is designed to provide a general introduction to software engineering and design. It will introduce the important concepts such as software processes and agile methods, essential software development activities from initial software specification through to system evolution.

Objective:

After undergoing this course, students should be able to:

1. Understand the process of designing, building, and maintaining large scale software.
2. Learn to estimate time and cost.

Course Outcomes (CO):

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

1. Describe the process of designing.
2. Build and maintain large scale software.
3. Discuss the time-cost estimation and ethical values.

Course Content:

Concepts of software engineering: Software engineering paradigms: Different phases of software;Design concepts and principles: architectural design, user interface design, object oriented software development and design, iterative development and the unified process, sequential waterfall life cycles; UML diagrams: Interaction and Collaboration Diagram for designing Software, class diagram. Structured and non-Structured programming; Data-directed design techniques: Modular design; Design of automatic, redundant and defensive program; COCOMO model; Tree model; PNR curve; Statistical model; Software testing: white box and black box testing, basis path testing, testing for specialized environment; Software testing strategies: unit testing, integration testing, validation testing, system testing; Art of debugging; Zips Concepts of software reliability and availability; Software repair, downtime, error and faults, specification and correction; New error generation hypothesis; Estimating number of bugs in a computer program; Reliability. Models; Availability models; Quality assurance; Quality measures; Different cost estimation models and their comparisons; Software maintenance; Maintenance-cost models: Growth dynamic models; Documentation; Software project organization; Management and communication skills.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
Describe the process of designing.	√											
Build and maintain large scale software.			√									
Discuss the time-cost estimation & ethical values.					√							

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to Software engineering	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Professional SW development and SW Engg ethics	
3	Lec 7 Lec 8 Lec 9	Requirements Engineering	
4	Lec 10 Lec 11 Lec 12	Software Processes	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Agile view of Process / Agile software development	
6	Lec 16 Lec 17 Lec 18	System modeling	
7	Lec 19 Lec 20 Lec 21	Performing User interface design (Pres)	
8	Lec 22 Lec 23 Lec 24	Architectural Design	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Product Metrics (Pres)	
10	Lec 31 Lec 32 Lec 33	Design and Implementation	
11	Lec 28 Lec 29 Lec 30	Software Testing and Maintenance	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Dependability and Security	
13	Lec 37 Lec 38 Lec 39	Security Engineering	
14	Lec 40 Lec 41 Lec 42	Project planning and management	

Text and Ref Books:

1. Software Engineering BY Ian Sommerville
2. Software Engineering- a practitioner's Approach BY Roger S. Pressman
3. Software Engineering: Principles and Practice BY Hans van Vliet

CSE 360 **3 hours in a week, 1.50 Cr.**

Integrated Design Project/Capstone Project 1

Pre-requisite: CSE 105, CSE 203, CSE 215, CSE 205 and their corresponding sessionals and CSE 220.

Rationale:
Culminating demonstration of skills and knowledge achieved to date to apply and solve real life problems solvable through computer technology.

Objective:

To apply technical knowledge and skills for further research and design of computer system at professional engineering scale.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:
1. Develop systems' requirement specification from top-level customer requirements.
2. Analyse and compare design alternatives, at the system and subsystem levels, and use measures of performance or other criteria to rank alternatives.
3. Plan and organize an engineering design project using tools such as Gantt charts to develop a work breakdown structure, develop a schedule including milestones, and estimate effort and costs incorporating the ethical, financial and environmental issues.
4. Develop a design concept and elaborate it through to a detailed design by decomposing a system concept into component subsystems, identifying the subsystem requirements and applicable standards, and defining interfaces between the subsystems.
5. Build prototypes of key subsystems.

Course Content:
Knowledge Acquisition:

Introduction and brief with IDSs and Softwares, Discussion and submission Project Proposal, Learning Version Control System: Github, Interface design, Database Connectivity: Sqlite, Json, Cloud, Firebase database, Google Api, Sensor.

Implementation:

Idea Submission, Objective, Methodology, Literature Review, High Level Design, Low Level Design, Evaluation and feedback, Design & Partial Implementation (Prototype/Demo).

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, rubrics on problem analysis, literature review and designing prototype.

Assessment Methods & their Weights:

Assessment Method	(100%)
Project	40
Quiz	20
Viva/Presentation	10
Class Participation	10
Report	10
Class Assessment	10

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Develop system requirements from top-level customer requirements.	√	√				√						
Analyse and compare design alternatives, at the system and subsystem levels, and use measures of performance or other criteria to rank alternatives.		√	√		√							
Plan and organize an engineering design project using tools such as Gantt charts to develop a work breakdown structure, develop a schedule including milestones, and estimate effort and costs.				√		√						
Develop a design concept and elaborate it through to a detailed design by decomposing a system concept into component subsystems, identifying the subsystem requirements and applicable standards, and defining interfaces between the subsystems			√	√								
Build prototypes of key subsystems.					√				√			

Lecture Schedule

Week	Topics	Remarks
1	Introduction and brief with software	
2	Learning Version Control System: Github	
3	Interface Design, activity and navication.	
4	Database Connectivity: Sqlite, Json, Cloud* Firebase database	
5	Google Api	
6	Sensor	
7	Database Integration with the application	
8-9	Topic Selection and Project Plan	
10-11	Objective, Methodology, Literature Review	
12-14	Design & Partial Implementation (Prototype/Demo)	

Text and Ref Books:

3. Android Programming: The Big Nerd Ranch Guide (3rd Edition) (Big Nerd Ranch Guides) 3rd Edition
4. Professional Android, Reto Meier, Ian Lake; 4th Edition

HUM-315 — 2 hours in a week, 2 Cr.
Engineering Economics

Pre-requisite: None

Rationale:
To be able to analyze and select the most economical alternative among several design alternatives.

Objective:

1. To understand time-value of money concepts and the criteria for making economic-based decisions.
2. To analyze before-tax and after-tax cash flows.
3. To understand economic risk analysis techniques.
4. To conduct minimum life cycle cost tradeoffs between initial and repair costs.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Explain time-value of money concepts and the criteria for making economic-based decisions.
2. Evaluate the design requirement of various engineering machines.
3. Interpret the economic risk of analysis techniques.
4. Illustrate minimum life cycle cost tradeoffs between initial and repair costs.
5. Apply Deduce before-tax and after-tax cash flows.

Course Content:
Microeconomics: Definition of economics; Fundamentals of economics; Market and government in a modern economy; Basic elements of supply and demand; Choice and utility; indifference curve technique; Analysis of cost; Short run long run theory of production. Macroeconomics: Key concept of macroeconomics; Saving, consumption, investment; National income analysis; Inflation, Unemployment. Development: Theories of developments; Banking system of Bangladesh, National Budget, Development partners(World Bank, Asian Development Bank, World Trade Organization, International Monetary Fund)

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Explain time-value of money concepts and the criteria for making economic-based decisions.	√											
Deduce before-tax and after-tax cash flows.			√									
Interpret the economic risk of analysis techniques.				√								
Illustrate minimum life cycle cost tradeoffs between initial and repair costs.				√								

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2	Definition of economics	**Class Test 1**
2	Lec 3 Lec 4	Fundamentals of economics	
3	Lec 5 Lec 6	Market and government in a modern economy	
4	Lec 7 Lec 8	Basic elements of supply and demand	**Class Test 2**
5	Lec 9 Lec 10	Choice and utility; indifference curve technique	
6	Lec 11 Lec 12	Analysis of cost	
7	Lec 13 Lec 14	Short run long run theory of production	
8	Lec 15 Lec 16	Macroeconomics: Key concept of macroeconomics	**Class Test 3**
9	Lec 17 Lec 18	Saving, consumption, investment	
10	Lec 19 Lec 20	National income analysis	
11	Lec 21 Lec 22	Inflation, Unemployment. Development	**Class Test 4**
12	Lec 23 Lec 24	Theories of developments	
13	Lec 25 Lec 26	Banking system of Bangladesh	
14	Lec 27 Lec 28	National Budget, Development partners	

CSE-350 4 weeks, 1.00 Cr. Industrial Training

This course is mandatory. Evaluation report from industry is to be submitted at the end of the training, and accordingly to be incorporated in the tabulation sheet.

HUM-312

3 hours in a week, 1.50 Cr.

English Sessional

Pre-requisite: None

Rationale:

To help to improve spoken English skills and to enable to communicate more effectively in English.

Objective:

1. To develop confidence among students.
2. To learn how to think logically and how to give group presentation.
3. To develop the English language skills (listening, speaking, reading and writing) that are necessary to be successful on the IELTS test.

Course Outcomes (CO):

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

1. Determine and get a clear idea about how to speak understand and speak English quickly and smartly.
2. Organize them within the shortest possible time to present their ideas and opinions.
3. Find out the main points of any long article within a very limited time.
4. Recognize the techniques of any effective writing.
5. Overcome language barrier.

Course Content:

Introduction to Language: Introducing basic skills of language; Phonetics, English Vowel and consonant sounds, Difference between different accents, Self-Introduction, how a speaker should introduce himself; Situational talks / dialogues; Speaking: IELTS speaking - Part 1, 2 & 3; Group discussion, taking participation in any discussion and drawing conclusion and giving recommendation; Brain storming: Principles of brain storming. How to think logically; Facing any problem, trying to find out possible solutions, drawing conclusion and giving recommendation; Individual / Group presentation, good presentation skills; Skimming, Scanning & Analytical Ability, techniques of skimming, scanning and generating ideas through purpose reading. Reading: Introducing IELTS academic reading comprehension, Listening and understanding, note taking and answering questions; Listening: Introducing IELTS / TOEFL listening section Academic Writing: Introducing IELTS academic writing, Public Speaking: Basic elements of good presentation or public speaking, some tips for good speech.

Teaching-learning and Assessment Strategy:

Speaking, Presentation, Report Writing, Group Discussion, Lab Test/ Quiz.

Assessment Methods & their Weights:

Assessment Method	(100%)
Speaking	25
Presentation	25
Report Writing	20
Quiz/ Viva	10
Class Participation	10
Group Discussion	10

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Determine and get a clear idea about how to speak understand and speak English quickly and smartly.						√						
Organize them within the shortest possible time to present their ideas and opinions.										√		
Find out the main points of any long article within a very limited time.											√	
Recognize the techniques of any effective writing.						√						
Overcome language barrier.										√		

Lecture Schedule:

Week	Lecture	Topics
1	Lab 1	Introduction to Language: Introducing basic skills of language; Phonetics, English Vowel and consonant sounds, Difference between different accents
2	Lab 2	Self-Introduction, how a speaker should introduce himself; Situational talks / dialogues
3	Lab 3	Speaking: IELTS speaking - Part 1, 2 & 3
4	Lab 4	Public Speaking: Basic elements of good presentation or public speaking, some tips for good speech.
5	Lab 5	**Speaking Test**
6	Lab 6	**Group discussion**, taking participation in any discussion and drawing conclusion and giving recommendation
7	Lab 7	Brain storming: Principles of brain storming. How to think logically; Facing any problem, trying to find out possible solutions, drawing conclusion and giving recommendation
8	Lab 8	Individual / Group presentation, good presentation skills; Skimming, Scanning & Analytical Ability, techniques of skimming, scanning and generating ideas through purpose

		reading
9	Lab 9	Reading: Introducing IELTS academic reading comprehension,
10	Lab 10	Academic Writing: Introducing IELTS academic writing, **Report Writing**
11	Lab 11	Listening and understanding, note taking and answering questions
12	Lab 12	Listening: Introducing IELTS / TOEFL listening section
13	Lab 13	**Group Presentation**
14	Lab 14	**Quiz/ Viva**

Text and Ref Books:

1. Introduction to Linguistics- Prof Dr. Maniruzzaman.
2. A Guide to Correct Speech (5th ed)- S M Amanullah, Albatross Publication (2007).
3. Oxford Advanced Learners' Dictionary (7th ed)- Oxford University Press (2007).
4. English Grammar in Use (4th ed)- Raymond & Murphy, Cambridge University Press (2012).
5. From Paragraph to Essay- Maurice Imhoof and Herman Hudson, Longman, London (1976).
6. Headway Series- Advanced Level (2 parts with CDs) (4th ed), Oxford University Press Ltd.
7. IELTS and TOEFL practice book- Cambridge University Press.
8. English for Technical Students- David Bonamy, Longman Publisher.

LEVEL-4 TERM-I

CSE-400 3 hours in a week, 1.50 Cr.

Thesis

Pre-requisite: None

Rationale:

This course motivates to go neck-deep in research, synthesize it, and make a point or look at something in a different way after going through all of it.

Objective:

1. To study, analyze and provide solutions for the problems of Computer Science and Engineering.
2. To learn about the research methodology as well as technical document writing.

Course Outcomes (CO):

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

1. Select, analyze, and classify a particular field to do research.
2. Solve real life complex problems
3. Explain and describe the time-cost estimation and ethical values.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Select, analyze, and classify a particular field to do research.		√										
2. Solve real life complex problems.			√									
3. Explain and describe the time-cost estimation and ethical values.								√				

CSE-401 **3 hours in a week, 3.00 Cr.**

System Analysis, Design and Development

Pre-requisite: None

Rationale:

This course motivates to perceive information systems planning, analysis, design and implementation; graphical methods for representing information structure, practical design methodologies, database design and prototyping; communication skills, project management to solve various real life problems.

Objective:

1. To assist students develop a comprehensive understanding of how information systems are developed through the activities of systems planning, analysis, design and implementation.
2. To analyze different information systems for different real life organizational context.

Course Outcomes (CO):

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

1. Discuss the practical approaches of designing & developing Information Systems for industries/ business organizations.
2. Discover and develop awareness of Information Technological ecosystems.
3. Solve real life complex problems.

Course Content:

Different types of information; Qualities of information; Analysis o Information requirements for modern organizations; Role, tasks and attributes of a Systems Analyst; Sources of information; Information gathering techniques; Editing; Handling of missing information; Requirements specifications; Steps of systems analysis; Concepts of feasibility analysis: Analysis of technical facilities; Cost-benefit analysis; Design of an information system; Design Patterns; Hardware and software analysis; Introduction to IT project management: Estimation of confidence level: Simplex method for minimization of project time; project team organization, ; IT Adoption and Diffusion theories; Ethics and privacy: Control and security.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Discuss the practical approaches of designing & developing Information Systems for industries/ business organizations.			√									
2. Discover and develop awareness of Information Technological ecosystems.				√								
3. Solve real life complex problems.			√									

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to Systems Concepts Types and Qualities of Information Information Systems Environment	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	The Systems Development Life Cycle Analysis of Information Information Requirements for Modern Organizations	
3	Lec 7 Lec 8 Lec 9	The Role of the Systems Analyst The Tasks of the Systems Analyst The Attributes of the Systems Analyst	
4	Lec 10 Lec 11 Lec 12	Systems Planning and the Initial Investigation Sources of information Information Gathering Techniques	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Requirements Analysis Requirement Specification Steps of Requirement Analysis	
6	Lec 16 Lec 17 Lec 18	Business Process Model Data Flow Diagrams Project Effort Analysis Methods	
7	Lec 19 Lec 20 Lec 21	The Tools of Structured Analysis Feasibility Analysis Analysis of Technical Facilities	
8	Lec 22 Lec 23 Lec 24	User Interface Design Interaction Design Information Architecture	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Design of an Information System Introduction to Project Management Introduction to Project Management (Contd.)	

10	Lec 31 Lec 32 Lec 33	Project Time Management Estimation of Confidence Level Network Model for Project Time Estimation	
11	Lec 28 Lec 29 Lec 30	Productivity Tools Feasibility Analysis Analysis of Technical Facilities	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Cost/Benefit Analysis IT Adoption Diffusion Theory	
13	Lec 37 Lec 38 Lec 39	Project Risk Management Project Team Organization Estimation of confidence level	
14	Lec 40 Lec 41 Lec 42	Information System Security Ethics and Privacy Control and Security	

Text and Ref Books:

1. System Analysis and Design (2nd Edition) - Elias M. Awad; Galgotia Publications Pvt. Ltd. (2010)
2. System Analysis and Design (2nd Edition) - Raja Raman; Prentice Hall (2004)
3. System Analysis and Design Methods (7th Edition) - Jeffery L. Whitten; McGraw Hill (2007)
4. System Analysis and Design (9th Edition) - Kendel & Kendel; Pearson (2013)

CSE-402 — 1.50 hours in a week, 0.75 Cr.

Information System Design and Development Sessional

Pre-requisite: None

Rationale:
This course motivates to practically perceive information systems planning, analysis, design and implementation; graphical methods for representing information structure, practical design methodologies, database design and prototyping; communication skills, project management to solve various real life problems.

Objective:

1. To assist students develop a comprehensive understand practically of how information systems are developed through the activities of systems planning, analysis, design and implementation.
2. To analyze different information systems for different real life organizational context practically.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Design and implement Information Systems for industries/ business organizations.
2. Impose security levels to the projects of Information Technological ecosystems.
3. Solve real life complex problems.

Course Content:
Analysis of Information requirements for modern organizations; Information gathering techniques; Editing; Handling of missing information; Requirements specifications; Steps of systems analysis; Concepts of feasibility analysis: Analysis of technical facilities; Cost-benefit analysis; Design of an information system; Design Patterns; Hardware and software analysis; Introduction to IT project management: Estimation of confidence level: Simplex method for minimization of project time; project team organization, ; IT Adoption and Diffusion theories; Ethics and privacy: Control and security.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Assessment Methods & their Weights:

Assessment Method	(100%)
Project	40
Quiz	20
Viva/Presentation	10
Class Participation	10
Home Assignment/Report	10
Class Assessment	10

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Design and implement Information Systems for industries/ business organizations.									√			
Impose security levels to the projects of Information Technological ecosystems.											√	
Solve real life complex problems.							√					

Lecture Schedule

Week	Topics	Remarks
1-2	Introduction to Systems Concepts Project Proposal Approval	
3-4	System Analysis Requirement Specification	Report 1
5-6	Data Flow Diagrams	Report 2
7-8	Prototype Design	Report 3
9-10	Implementation	Project Update 1
11-12	Unit test and performance measure Enhancement of Design Implement	Report 4 Project Update 2
13-14	Final Project Submission Presentation Quiz	

Text and Ref Books:

1. System Analysis and Design (2nd Edition) - Elias M. Awad; Galgotia Publications Pvt. Ltd. (2010)
2. System Analysis and Design (2nd Edition) - Raja Raman; Prentice Hall (2004)

CSE-403 3 hours in a week, 3.00 Cr.

Artificial Intelligence

Pre-requisite: None

Rationale:
Artificial intelligence is the beginning of revolution for rational behavior of intelligent agents along with representation, planning, learning and perception of knowledge.

Objective:

1. To discuss and distinguish the notions of rational behavior and intelligent agents.
2. To develop a general appreciation of the goals, subareas, achievements and difficulties of AI.
3. To have knowledge of methods of blind as well as informed search in case of knowledge representation, planning, learning, robotics and other AI areas and ability to practically apply the corresponding techniques.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Discuss and distinguish the notions of rational behavior and intelligent agents.
2. Develop a general appreciation of the goals, subareas, achievements and difficulties of AI.

3. Analysis methods of blind as well as informed search and ability to practically apply the corresponding technıques.
4. Investigate of major concepts and approaches in knowledge representation, planning, learning, robotics and other AI areas.

Course Content:

Overview of AI, Knowledge representation, LISP/Prolog and other Al programming languages; Review of Uninformed Search Strategies and game playing; Informed search Strategies: A*, Heuristic functions, Memory Bounded Search (IDA*, SMA*); Iterative improvement Search, constraint satisfaction problems. Review of Propositional logic, first order Logic, Introduction to Planning, Partial Order Planning. Bayesian Rule and its use in probabilistic reasoning; Belief Networks and Decision Networks; Learning Decision Trees; Learning General Logical descriptions-Hypothesis. Introduction to Natural Language Processing.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Discuss and distinguish the notions of rational behavior and intelligent agents.	√											
2. Develop a general appreciation of the goals, subareas, achievements and difficulties of AI.			√									
3. Analysis methods of blind as well as informed search and ability to practically apply the corresponding technıques.		√										
4. Investigate of major concepts and approaches in knowledge representation, planning, learning, robotics and other AI areas.				√								

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to AI Uninformed Search I	
2	Lec 4 Lec 5 Lec 6	Uninformed Search II Informed Search I	
3	Lec 7 Lec 8 Lec 9	Informed Search II	**Class Test 1**
4	Lec 10 Lec 11 Lec 12	Beyond Classical Search	
5	Lec 13 Lec 14 Lec 15	Adversarial Search I	
6	Lec 16 Lec 17 Lec 18	Adversarial Search II Constraint Satisfaction Problems I	**Class Test 2**
7	Lec 19 Lec 20 Lec 21	Constraint Satisfaction Problems II	
8	Lec 22 Lec 23 Lec 24	Uncertainty and Probabilities	
9	Lec 25 Lec 26 Lec 27	Markov Models (MM), Hidden MM (HMM)	**Class Test 3**
10	Lec 31 Lec 32 Lec 33	Bayes Net	
11	Lec 28 Lec 29 Lec 30	ML: Naive Bayes	
12	Lec 34 Lec 35 Lec 36	ML: Perceptions ML: Kernels and Clustering	
13	Lec 37 Lec 38 Lec 39	Advanced Applications: NLP, Games and Cars	**Class Test 4**

14	Lec 40 Lec 41 Lec 42	Advanced Applications: (Robotics and Computer Vision)	

Text and Ref Books:

1. Artificial Intelligence: A Modern Approach (3rd Edition) – Stuart Jonathan Russell, Peter Norvig; Prentice Hall (2010)

2. Artificial Intelligence: A New synthesis – Nils J. Nilsson; Routledge

CSE-404 1.5 hours in a week, 0.75 Cr.

Artificial Intelligence Sessional

Pre-requisite: None

Rationale:
Hands on orientation with AI programming, intelligent agents along with how to representation, planning, learning and perception of knowledge of agents.

Objective:

1. To have general understanding of major concepts and approaches in knowledge representation, planning, learning, robotics and other AI areas.

2. To develop programming skills for AI applications and explore traditional AI techniques and algorithms.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Have general understanding of major concepts and approaches in knowledge representation, planning, learning, robotics and other AI areas.

2. Develop programming skills for AI applications.

3. Exposure to traditional AI techniques and algorithms.

Course Contents:
Introduction to Intelligent Machines, State Mapping, A* Search implementation, Local search Algorithm, Advesrarial Search, Constrant Satisfaction Problem Solving.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Assessment Methods & their Weights:

Assessment Method	(100%)
Tasks	50
Quiz/Viva	10
Class Participation	10
Observation	10
Class performance	20

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Have general understanding of major concepts and approaches in knowledge representation, planning, learning, robotics and other AI areas.							√					
Develop programming skills for AI applications.								√				
Exposure to traditional AI techniques and algorithms.											√	

Lecture Schedule

Week	Lecture	Topics
1	Lec 1 Lec 2 Lec 3	Orientation with AI practical areas
2	Lec 4 Lec 5 Lec 6	Assignment on State Mapping
3	Lec 7 Lec 8 Lec 9	Assignment on Search Algorithm
4	Lec 10 Lec 11 Lec 12	Assignment on Local Search
5	Lec 13 Lec 14 Lec 15	Assignment on Adversarial Search
6	Lec 16	Assignment on Constraint Satisfaction Problem

	Lec 17 Lec 18	
7	Lec 19 Lec 20 Lec 21	Quiz/Viva

CSE-405 — 3 hours in a week, 3.00 Cr.

Computer Interfacing

Pre-requisite: None

Rationale:

This course introduces basic concepts and techniques for interfacing a microcontroller or microprocessor to external devices for data collection and process control and developing the related software required. It is aimed at students interested in data acquisition and real-time control systems, design and construct simple control, data logging system incorporating input/output to and from external devices and design simple control system for stepper and DC motor.

Objective:

1. To enable the students familiar to interface external components (peripherals, sensors, PPIs, PICs etc.) with computer systems.
2. To enhance the knowledge on basic working principle and different applications of basic microcomputer and microcontroller.
3. To enable the students capable of designing and constructing simple control system incorporating input/output to and from external devices.

Course Outcomes (CO):

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

1. Describe how to interface different types of external components (peripherals, sensors, PPIs, PICs etc.) with computer systems.
2. Escalate the capability of designing and constructing simple control system incorporating input/output to and from external devices.
3. Analyze the basic working principle of basic microcomputer, microcontroller and enhance applications of different hardware components.

Course Content:

I/0 system; I/O devices, designing I/O systems; Programmable peripheral interface (interface to A/D and D/A converter); keyboard/display interface; Programmable timer; data acquisition systems, Optical interrupters and couplers, incremental encoders, interfacing; Programmable interrupt controller, DMA controller; floppy and hard-disk controller; serial communication interface; ISA. PCI, AGP, PS/2 and USB interface; Interfacing with power circuits, stepper motors, opto-isolation; controlling semiconductor power switches MOSFET, BJT. SCR. Triac and Solenoids; temperature, pressure, light sensors and transducers; Application of Opto-coupler and relays; Embedded Communication Systems, Embedded Computer Security.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Describe how to interface different types of external components (peripherals, sensors, PPIs, PICs etc.) with computer systems	√											
2. Escalate the capability of designing and constructing simple control system incorporating input/output to and from external devices			√									
3. Analyze the basic working principle of basic microcomputer, microcontroller and enhance applications of different hardware components		√										

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Parallel data transfer, parallel printer interface, Keyboard Interface, Display Interface,I/0 system; I/O devices, designing I/O systems	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Interfacing to high power devices, Interface to AC power devices, interfacing to stepper motor	
3	Lec 7 Lec 8	D/A Applications and Interfacing to Microcomputers, A/D converters	

	Lec 9	Specifications/types,	
4	Lec 10 Lec 11 Lec 12	Microcomputers based Scale, Microcomputers based industrial Process Control System , PID Controller	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Triac and Solenoids; temperature, pressure, light sensors and transducers	
6	Lec 16 Lec 17 Lec 18	D/A Converter Operation and Specifications, ISA. PCI, AGP, PS/2 and USB interface	
7	Lec 19 Lec 20 Lec 21	Embedded Communication Systems, Embedded Computer Security	
8	Lec 22 Lec 23 Lec 24	Data Highways, Computer I/O Operations, Programmed I/O, Interrupts, Vectored Interrupt, Priority Interrupts using Priority Encoder ,Priority Interrupt using a Daisy Chain	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Block Data Transfer, DMA, Parallel Interface, SCSI, Serial Interface-Synchronous and Asynchronous Transmission	
10	Lec 31 Lec 32 Lec 33	DMA Controller 8257,RS232, null modem connection, line drivers, Single-ended Transmission, balanced transmission, differential receiver	
11	Lec 28 Lec 29 Lec 30	Disc and tape storage, Recording on a Magnetic surface, Magnetic Disc Formats, zoning, Interleaving, Magnetic recording Code, Recording Codes, Run-length limited (RLL),	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Disc formatting, Track seeking, Sector Location, Optical Storage, Forms of Optical Disc storage, Optical Reading Mechanism	
13	Lec 37 Lec 38 Lec 39	CD-ROM Optical Disks, WORM, Optical Positioning, Magneto Optical Disk, Performance Enhancers	
14	Lec 40 Lec 41 Lec 42	Memory Interfacing, Memory Space Management	

Text and Ref Books:

1. The Intel Microprocessors (8th Edition) - Barry B Brey; Pearson (2008)

2. Microprocessors and Interfacing (2nd Edition) - Douglas V Hall; McGraw Hill (2005)

3. Computer Peripherals (3rd Edition) - Cook and White; Butterworth-Heinemann (1995)

HUM-415 **2 hours in a week, 2.00 Cr.**

Financial and Managerial Accounting

Pre-requisite: None

Rationale:

This course introduces the preliminaries of accounting principles, cost classification and a variety of financial analysis - ratio analysis, capital budgeting, break-even analysis, cost-volume-profit analysis, contribution margin analysis etc. that is helpful for making important decisions of the management control system of any organization or business.

Objective:

1. To discuss the fundamentals of accounting, the use and effects of financial statement for a particular organization.

2. To analyze different types of cost and cost management for different components of a management control system or a business.

Course Outcomes (CO):

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

1. Discuss, describe and interpret a financial accounting statement and the use of financial ratios. The student should be able to understand how the reporting might be affected by a particular (creative) business.

2. Enhance the various elements of a management control system (role, scope, drawbacks, implementation etc.).

3. Determine the variety of cost concepts to be applied in a management control system.

4. Select and analyze the nature of a business and outline main features of an appropriate control system.

Course Content:

Financial Accounting: Objectives and importance of accounting; Accounting as an information system. Computerized system applications in accounting. Recording system, double entry mechanism; account and their classification; Accounting equation: Accounting cycle: Journal, ledger, trial balance. Preparation of financial statements considering adjusting and closing entries; Accounting concepts (principles) and conventions. Financial statement analysis and interpretation: Ratio analysis. Cost and Management Accounting: Cost concepts and classification; Overhead cost: meaning and classification; Distribution of overhead cost: Overhead recover method/rate; Job order costing: preparation of job cost sheet and question price, Inventory valuation: absorption costing and marginal/variable costing technique; Cost-Volume-Profit analysis: meaning, break-even analysis, contribution margin analysis sensitivity analysis. Short-term investment decisions; relevant and differential cost analysis. Long-term investment decisions: capital budgeting, various techniques of evaluation of investments.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Discuss, describe and interpret a financial accounting statement and the use of financial ratios. The student should be able to understand how the reporting might be affected by a particular (creative) business.	√											
2. Enhance the various elements of a management control system (role, scope, drawbacks, implementation etc.).				√								
3. Determine the variety of cost concepts to be applied in a management control system.				√								
4. Select and analyze the nature of a business and outline main features of an appropriate control system.		√										

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2	Financial Accounting Objectives of Accounting Importance of Accounting	**Class Test 1**
2	Lec 3 Lec 4	Accounting as an Information System. Computerized Applications in Accounting Computerized Applications in Accounting	

		(Contd.)	
3	Lec 5 Lec 6	Recording System Double Entry Mechanism Double Entry Mechanism (Contd.)	
4	Lec 7 Lec 8	Account Classification Accounting Equation Account Cycle	**Class Test 2**
5	Lec 9 Lec 10	Journal Ledger Trial Balance	
6	Lec 11 Lec 12	Financial Statement Preparation Adjusting Entries Closing Entries	
7	Lec 13 Lec 14	Accounting Principles Accounting Convention Accounting Convention (Contd.)	
8	Lec 15 Lec 16	Financial Statement Analysis Financial Statement Interpretation Ratio Analysis	**Class Test 3**
9	Lec 17 Lec 18	Cost Accounting Management Accounting Cost Concept and Classification	
10	Lec 19 Lec 20	Distribution of Overhead Cost Overhead Recover Method/Rate Job Order Costing	
11	Lec 21 Lec 22	Preparation of Job Cost Sheet and Question Price Inventory Valuation Absorption Costing	**Class Test 4**
12	Lec 23 Lec 24	Marginal/Variable costing Technique Cost-Volume-Profit Analysis Break-Even Analysis	
13	Lec 25 Lec 26	Contribution Margin Analysis Sensitivity Analysis. Relevant and Differential Cost Analysis	
14	Lec 27 Lec 28	Long-term Investment Decisions Capital Budgeting Various Techniques of Evaluation of Investments	

Text and Ref Books:

1. Managerial Accounting (14th Edition) - Ray Garrison, Eric Noreen and Peter Brewer;

McGraw Hill (2011)

2. Accounting Principles (12th Edition) - Jerry J. Weygandt Paul D. Kimmel Donald E. Kieso; Wiley (2015)

CSE-460 6 hours in a week, 3.00 Cr.

Integrated Design Project/Capstone Project – 2

Pre-requisite: Project CSE-360

Rationale:
Culminating demonstration of skills and knowledge achieved to date to apply and solve real life IT dependent problems using computer technology.

Objective:

Objective of this course is to combine engineering theory with rigorous research in design and development of computerized system considering the contextual ethical, financial and environmental issues.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Design appropriate tests to measure and evaluate the performance of prototype subsystems to determine whether they meet performance and interface requirements considering ethical, financial and environmental issues and recommend changes.
2. Constructively contribute to the accomplishments of a multidisciplinary team, including critical evaluation of self and team-member performance.
3. Communicate the team's logistical and technical approaches to the design project in a polished, co-authored, written proposal, using language and graphics appropriate to the technical discipline.
4. Succinctly report individual and team performance against the plan.
5. Describe organizational and technical plans and progress in oral presentations, using high-quality, informative, graphical and textual elements.

Course Content:
Knowledge Acquisition: Information gathering techniques, Design of an information system; Hardware components, pin configurations of microcontroller, peripherals, Sensors, PPIs, PICs, Use of Arduino, Raspberry Pi;

Implementation: Concept development, prototype enhancement, complete implementation, unit testing and integration testing with verification, feedback and improvement, result analysis and performance evaluation, report writing, paper submission, presentation and final evaluation.

Teaching-learning and Assessment Strategy:
Lectures, performances, assignments, rubrics on prototype design, implementation and report submission.

Assessment Methods & their Weights:

Assessment Method	(100%)
Project	40
Quiz	20
Viva/Presentation	10
Class Participation	10
Report	10
Class Assessment	10

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Design appropriate tests to measure and evaluate the performance of prototype subsystems to determine whether they meet performance and interface requirements considering ethical, financial and environmental issues and recommend changes.			√				√	√				
Constructively contribute to the accomplishments of a multidisciplinary team, including critical evaluation of self and team-member performance.									√	√	√	
Communicate the team's logistical and technical approaches to the design project in a polished, co-authored, written proposal, using language and graphics appropriate to the technical discipline.										√		√
Succinctly report individual and team performance against the plan.										√		
Describe organizational and technical plans and progress in oral presentations, using high-quality, informative, graphical and textual elements.											√	√

Lecture Schedule

Week	Lecture	Topics	Remarks
1	Lec 1-2	Orientation Information gathering techniques	

2	Lec 3-4	Approval of Conceptual development of proposed project Hands on session on designing information system	Project Plan
3	Lec 5-6	Hands on session on hardware components and microcontroller Designing Prototype	Prototype Design
4	Lec 7-8	Hand on session on Arduino, Programming on Arduino	
5	Lec 9-10	Hand on session Raspberry Pi Programming on Raspberry Pi	
6	Lec 11-12	Flowchart and block diagram of the project Prototype enhancement	Prototype Design
7	Lec 13-14	Unit testing and integration testing with verification Submission of abstract of paper/report	Implementation Report
8	Lec 15-16	Feedback and improvement Submission of introduction, methodology of paper/report	Implementation Report
9	Lec 17-18	Result analysis and performance evaluation Integration of result analysis in report	Implementation Report
10	Lec 19-20	Model of the project	
11	Lec 21-22	System architecture of the paper	Report
12	Lec 23-24	Project update following final timeline	
13	Lec 25-26	Implementation part of the paper Draft of poster presentation	
14	Lec 27-28	Final Project submission Final paper/report submission Final poster print and presentation	Report

CSE-4XO **3 hours in a week, 3.00 Cr.**

LEVEL-4 TERM-II

CSE-400
Thesis

6 hours in a week, 3.00 Cr.

Pre-requisite: None

Rationale:

This course motivates to go neck-deep in research, synthesize it, and make a point or look at something in a different way after going through all of it.

Objective:

To study, analyze and provide solutions for the problems of Computer Science and Engineering.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Select, analyze, and classify a particular field to do research.
2. Solve real life complex problems
3. Explain and describe the time-cost estimation and ethical values.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Select, analyze, and classify a particular field to do research.		√										
2. Solve real life complex problems.			√									
3. Explain and describe the time-cost estimation and ethical values.								√				

CSE-411 **3 hours in a week, 3.00 Cr.**

VLSI Design

Pre-requisite: None

Rationale:

This course motivates to enhance the ability to design large integrated digital electronic circuits using various logic and circuit design techniques and contribute to the electronics engineering and have a better understanding of different characteristics of such circuits.

Objective:

1. To recognize different logical components as well as their interconnection and design various integrated electronic circuits to perform certain digital functions.
2. To study and analyze different properties, behaviour and performance metrics of different integrated digital electronic circuits.

Course Outcomes (CO):

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

1. Describe mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnection.
2. Select, analyze and create models of moderately sized CMOS circuits that realize specified digital functions.
3. Solve and apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality, timing, power, and parasitic effects.
4. Have an understanding of the characteristics of CMOS circuit construction and the comparison

Course Content :

VLSI design methodology: Top-down Design Approach, Technology Trends and Design Automation Algorithms; Introduction to CMOS Inverters and Basic Gates; CMOS Fabrication Process and Layout; CMOS Circuit Characteristics and Performance Estimation; Buffer Circuit Design; Introduction Bi-CMOS Circuits; Complex CMOS Gates; CMOS layout design rules, CMOS Building Blocks - Adder, Comparator, Multiplier, Counter, and Shifter; Data Path and Memory structures. Design Methodology and Tools; PLA, FPGA, cell-based and full custom design methods, System-on chip design, Hardware modeling - Hardware Modeling Languages, Logic Networks, State Diagrams, Data-flow and Sequencing Graphs, Behavioral Optimization; Floor Planning and Architecture Design.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Describe mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnection.	√											
2. Select, analyze and create models of moderately sized CMOS circuits that realize specified digital functions.		√										
3. Solve and apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality, timing, power, and parasitic effects.			√									
4. Have an understanding of the characteristics of CMOS circuit construction and the comparison between different state-of-the-art CMOS technologies and processes.	√											

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to VLSI design diodes, BJTs and MOSFETs NMOS and CMOS	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Internal Structure of MOSFETs Hierarchical Design Inverter Principles	
3	Lec 7 Lec 8 Lec 9	Threshold Voltage Ids Calculation for Saturation Region Ids Calculation for Resistive Region	
4	Lec 10 Lec 11 Lec 12	Characteristics Curves Characteristics Curves (Contd.) NMOS Inverter with Resistive Load	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	NMOS Inverter with Enhancement Load Inverter Ratio for NMOS Inverter with Enhancement Load Problems with Enhancement Transistor	
6	Lec 16 Lec 17 Lec 18	NMOS Inverter with Depletion Load Rise Time Calculation Fall Time Calculation	
7	Lec 19 Lec 20	CMOS Characteristics Curve CMOS Power and Transfer Curve	

	Lec 21	Pass Transistor Principles	
8	Lec 22 Lec 23 Lec 24	Pass Transistor NMOS Ratioless NMOS Inverter CMOS Pulse Gate	
9	Lec 25 Lec 26 Lec 27	Buffer Circuits Buffer Chain Super Buffer	**Class Test 3**
10	Lec 31 Lec 32 Lec 33	Power Dissipation Static Power Dissipation Dynamic Power Dissipation	
11	Lec 28 Lec 29 Lec 30	Short Circuit Power Dissipation CMOS Noise Margin CMOS Noise Margin (Contd.)	
12	Lec 34 Lec 35 Lec 36	NMOS Noise Margin NMOS NAND and NOR Gates CMOS NAND and NOR Gates	
13	Lec 37 Lec 38 Lec 39	Stick Diagrams Design Rules of Geometric Layout Circuit Design using Stick Diagrams and Geometric Layout	**Class Test 4**
14	Lec 40 Lec 41 Lec 42	n-well Formation Oxide Layer Formation Cross Section of CMOS	

Text and Ref Books:

1. Modern 1.Modern VLSI Design: System-on-Chip Design (3rd Edition) - Wayne Wolf; Prentice Hall (2002)
2. CMOS VLSI Design- A Circuit and System Perspective (3rd Edition) - Neil H.E. Weste, David Harris and Ayan Banerjee; Pearson (2009)

CSE-413 3 hours in a week, 3.00 Cr.

Computer Graphics

Pre-requisite: None

Rationale:
Motivates to enhance the ability in order to rapidly visualize, design and modify different types of shapes, structures and images interactively that is absolutely mandatory in the field of engineering and imaging technology.

Objective:

1. To provide a comprehensive introduction to computer graphics leading to the ability

to understand contemporary terminology, progress, issues, and trends.

2. To introduce computer graphics techniques, focusing on 3D modeling, image synthesis, and rendering.

Course Outcomes (CO):

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

1. Discuss the algorithmic and mathematical tools used to create a variety of digital images and effects.

2. Demonstrate three main subjects within computer graphics, modeling, rendering, and animation.

3. Select and analyze fundamentals such as digital image representation, color perception, image formation and image processing.

Course Content :

Introduction to computer graphics and its applications; Principles of raster image generation; Light and Color models; Example of a graphics API; Graphics primitives; Graphics hardware; Graphics pipeline; Coordinate convention; Scan conversion; Clipping; Modeling transformations; Viewing transformations; Projection transformations; Polygons and polygon meshes; Curves and surfaces; Hidden lines and surface removal; Introduction to rendering including shading models, textures, ray tracing, and radiosity; Introduction to computer animation and kinematics; Fractals; Graphics programming using OpenGL 4.0 and above.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Discuss the algorithmic and mathematical tools used to create a variety of digital images and effects.	√											
2. Demonstrate three main subjects within computer graphics, modeling, rendering, and animation.				√								
3. Select and analyze fundamentals such as digital image representation, color perception, image formation and image processing.		√										

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1	Introduction to Computer Graphics	
	Lec 2	Applications of Computer graphics	
	Lec 3	Standard Graphics Primitives	
2	Lec 4	Principles of Raster Image Generation	
	Lec 5	Graphics Hardware	
	Lec 6	Graphics Pipeline	
3	Lec 7	Coordinate Convention	**Class Test 1**
	Lec 8	Scan Convention	
	Lec 9	Example of a Graphics API	
4	Lec 10	Introduction to OpenGL	
	Lec 11	Graphics Programming	
	Lec 12	Graphics Programming (Contd.)	
5	Lec 13	Point Clipping	
	Lec 14	Line Clipping	
	Lec 15	Polygon Clipping	**Class Test 2**
6	Lec 16	Modeling Transformations	
	Lec 17	Modeling Transformations (Contd.)	
	Lec 18	Modeling Transformations (Contd.)	
7	Lec 19	Viewing Transformations	
	Lec 20	Viewing Transformations (Contd.)	
	Lec 21	Viewing Transformations (Contd.)	
8	Lec 22	Projection Transformations	
	Lec 23	Projection Transformations (Contd.)	
	Lec 24	Projection Transformations (Contd.)	

9	Lec 25 Lec 26 Lec 27	Polygons Polygons (Contd.) Polygon Meshes	**Class Test 3**
10	Lec 31 Lec 32 Lec 33	Curves Surfaces Surfaces (Contd.)	
11	Lec 28 Lec 29 Lec 30	Introduction to Shading Models Rendering Hidden Lines and Surface Removal	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Introduction to Computer Animation Kinematics Fractals	
13	Lec 37 Lec 38 Lec 39	Textures Ray Tracing Radiosity	
14	Lec 40 Lec 41 Lec 42	Color Perception Color Models Light Models	

Text and Ref Books:

1. Theory and Problems of Computer Graphics (3rd Edition) – Zhigang Xiang, Roy A. Plastock; McGraw Hill (2000)
2. Computer Graphics C Version (3rd Edition) – Donald Hearn, M. Pauline Baker; Pearson Prentice Hall (2004)
3. Computer Graphics Principle and Practice (3rd Edition) – Donald Hearn, M. Pauline Baker; Addison-Wesley Professional (2013)

CSE-414 **3 hours in alternate week, 0.75 Cr.**

Computer Graphics Sessional

Pre-requisite: None

Rationale:

This course motivates to develop and modify 2D and 3D visualization and transformation of any geometric object by using graphics library as well as working with texturing, lighting and coloring of such objects to develop different types of digital images with various effects.

Objective:

1. To develop 2D, 3D and animation graphics project using OpenGL graphics library.
2. To develop projects using lighting, coloring and texturing techniques.

Course Outcomes (CO):

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

1. Achieve a basic idea about OpenGL graphics library.
2. Design and develop 2D and 3D graphical geometric objects using OpenGL.
3. Learning simple animation, lighting, coloring and texturing.

Course Content :

Introduction to OpenGL, Drawing 2D geometric object, Simple 2D animation and modeling transformation, Drawing 3D geometric object, Viewing transformation and Texturing and lighting.

Teaching-learning and Assessment Strategy:

Lectures, class performances, project, assignment, viva, presentation, quiz.

Assessment Methods & their Weights:

Category	**Marks %**
Project	40
Quiz	20
Viva / Presentation	10
Class Participation	10
Report	10
Class Assessment	10
Total	**100**

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Achieve a basic idea about OpenGL graphics library.							√					
2. Design and develop 2D and 3D graphical geometric objects using OpenGL.						√						
3. Learning simple animation, lighting, coloring and texturing.									√			

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to OpenGL (GLSL) Discussion on Project 1 Discussion on Project 1 (Contd.)	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Programming with OpenGL (GLSL) Lab Assignment Home Assignment	
3	Lec 7 Lec 8 Lec 9	Programming with OpenGL (GLSL) (Contd.) Lab Assignment Home Assignment	
4	Lec 10 Lec 11 Lec 12	Introduction to Animation (with Blender) Animation Project Discussion Animation Project Discussion (Contd.)	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Project 1 Demo and Submission Project 1 Demo and Submission (Contd.) Project 1 Demo and Submission (Contd.)	
6	Lec 16 Lec 17 Lec 18	Discussion on Project 2 Discussion on Project 2 (Contd.) Discussion on Project 2 (Contd.)	
7	Lec 19 Lec 20 Lec 21	Discussion on Project 2 Discussion on Project 2 (Contd.) Discussion on Project 2 (Contd.)	
8	Lec 22 Lec 23 Lec 24	Animation Project Submission Animation Project Submission (Contd.) Report Submission	
9	Lec 25	Animation Project Submission	

	Lec 26 Lec 27	Animation Project Submission (Contd.) Report Submission	**Class Test 3**
10	Lec 31 Lec 32 Lec 33	Project 2 Initial Demo Project 2 Initial Demo (Contd.) Project 2 Initial Demo (Contd.)	
11	Lec 28 Lec 29 Lec 30	Project 2 Initial Demo Project 2 Initial Demo (Contd.) Project 2 Initial Demo (Contd.)	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Project 2 Final Demo and Submission Project 2 Final Demo and Submission (Contd.) Project 2 Final Demo and Submission (Contd.)	
13	Lec 37 Lec 38 Lec 39	Project 2 Final Demo and Submission Project 2 Final Demo and Submission (Contd.) Project 2 Final Demo and Submission (Contd.)	
14	Lec 40 Lec 41 Lec 42	Quiz Viva Viva (Contd.)	

Text and Ref Books:

1. OpenGL Programming Guide: The Official Guide to Learning OpenGL (8th Edition) - Dave Shreiner, Graham Sellers, John Kessenich and Bill Licea-Kane; Addison Wesley Professional (2013)

CSE-407 — 3 hours in a week, 3.00 Cr.
Applied Statistics and Queuing Theory

Pre-requisite: None

Rationale:

To provide in deep idea of working with data sets and impact of data sets as well as application of queuing models in Computer Science domain.

Objective:

1. To discuss the theories of applied statistics.
2. To select the practical applications in the field of Information Technology and explain the real life applications of statistics.

Course Outcomes (CO):

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

1. Discuss the theories of applied statistics.
2. Select the practical applications in the field of Information Technology.
3. Explain the real life applications of statistics.

Course Content:

Introduction; Frequency distribution, Mean, median, Mode and other measure of central tendency standard deviation and other measure of dispersion, Moments, Skewness and kurtosis, Elementary probability theory, Characteristics of distributions, elementary sampling theory, Estimation, Hypothesis testing and regression analysis. Probability distribution and expectations, discontinuous probability distribution, e.g. binomial, position and negative binomial. Continuous probability distributions, e.g. normal and exponential. Queuing Theory: Stochastic processes, Discrete time Markov chain and continuous time Markov Chain. birth-death process in queuing. Queuing models: M/M/1,M/M/C,M/G/1,M/D/1,G/M/1 solution of network of queue-closed queuing models and approximate models. Application of queuing models in Computer Science.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Discuss the theories of applied statistics.	√											
Select the practical applications in the field of Information Technology.		√										
Explain the real life applications of statistics.						√						

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction Frequency distribution	
2	Lec 4 Lec 5	Central Tendency Mean, median, Mode	

	Lec 6		**Class Test 1**
3	Lec 7 Lec 8 Lec 9	Standard deviation Dispersion	
4	Lec 10 Lec 11 Lec 12	Moments Skewness and kurtosis	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Elementary probability theory Characteristics of distributions	
6	Lec 16 Lec 17 Lec 18	Elementary sampling theory Estimation	
7	Lec 19 Lec 20 Lec 21	Hypothesis testing and regression analysis	
8	Lec 22 Lec 23 Lec 24	Probability distribution Expectations	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Discontinuous probability distribution Binomial distribution Position and negative binomial distribution	
10	Lec 31 Lec 32 Lec 33	Continuous probability distributions Normal Distribution Exponential Distribution	
11	Lec 28 Lec 29 Lec 30	Queuing Theory: Stochastic processes Discrete time Markov chain	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Continuous time Markov Chain Birth-death process in queuing	
13	Lec 37 Lec 38 Lec 39	Queuingmodels: M/M/1,M/M/C,M/G/1,M/D/1,G/M/1 Queue-closed queuing models	
14	Lec 40 Lec 41 Lec 42	Approximate models Application of queuing models	

Text and Ref Books:

1. Applied Statistics - Rebecca (Becky) M. (Margaret) Warner
2. Applied Statistics for Engineers and Scientists - Jay L. Devore and Nicholas R. Farnum
3. An Introduction to Queuing Theory - U. Narayan Bhat
4. Probability, Markov Chains, Queues, and Simulation: The Mathematical Basis of Performance Modeling - William J. Stewart

CSE-417 **3 hours in a week, 3.00 Cr.**

Engineering Management

Pre-requisite: None

Rationale:
This course motivates engineers to perform under a standard of professional behavior that requires adherence to the highest principles of ethical conduct and manage the resources and decisions effectively. It elevates the profession and raises future standards and imprints on individual moral mindsets and behaviors.

Objective:
1. To identify and analyze practical legal problems commonly encountered in computing industry and formulate solutions to some of the legal problems.
2. To gain the ability to continue professional development with an understanding of the legal issues, and to critically assess the codes of professional conduct for computer professional.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Demonstrate awareness of different management and control frameworks and their impact on the Project Management discipline.
2. Solve and apply cognitive skills and ability to identify, analysis, and articulate the importance of team building, project risk, and time cost management.
3. Using management software to help plan and manage information technology projects.
4. Explain the theoretical aspects of 'ethics', 'social norms', 'virtues', 'values', 'legal bindings in professional fields' etc.

Course Content:
Engineering Management: Principles of management, Introduction to Project Management;, Project Integration Management; Project Scope Management; Project Time Management; Project Cost Management; Project Quality Management; Project Human Resource Management; Project Risk Management; MIS: Introduction, Decision Support Systems, MIS in decision making. Concept of Invention, Innovation, and Entrepreneurship.
Engineering Ethics: Introduction to Ethics. Theories of Ethics. Principles of Engineering Ethics. Ethical expectation: Employers and employees, inter-professional relationship, Standards and codes: Fundamental Canons, NSPE codes, IEEE codes of conduct, ACM codes; Institutionalization of ethical conduct. Ethical Dilemmas, Choices (Whistle Blowing), Computer Ethics: Computer Crime and Cyber Security, Privacy and Confidentiality issue in CSE, Legal Framework in CSE-Copyright laws, ICT Act, Right To Information (RTI),

Patents, Royalty etc. Ethical Challenges for CSE Engineers with the advancement of Technology; Case studies related to ethical issues in ICT and other Engineering disciplines.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Demonstrate awareness of different management and control frameworks and their impact on the Project Management discipline.					√							
2. Solve and apply cognitive skills and ability to identify, analysis, and articulate the importance of team building, project risk, and time cost management.		√										
3. Using management software to help plan and manage information technology projects.					√							
4. Explain the theoretical aspects of 'ethics', 'social norms', 'virtues', 'values', 'legal bindings in professional fields' etc.	√											

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to Engineering Management Importance of Engineering Management (Contd.) Importance of Engineering Management	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Introduction to Project Management Introduction to Project Management (Contd.) Principles of Management	
3	Lec 7 Lec 8 Lec 9	Project Integration Management Project Scope Management Project Time Management	
4	Lec 10 Lec 11	Project Cost Management Project Quality Management	**Class Test 2**

	Lec 12	Project Human Resource Management	
5	Lec 13 Lec 14 Lec 15	Project Communication Management Project Risk Management Project Procurement Management	
6	Lec 16 Lec 17 Lec 18	Introduction to MIS Decision Support System MIS in Decision Making	
7	Lec 19 Lec 20 Lec 21	Development of Communication Skill Concept of Invention and Innovation Concept of Entrepreneurship	
8	Lec 22 Lec 23 Lec 24	Introduction to Ethics Theories of Ethics Principles of Engineering Ethics	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Ethical expectation Employers and Employees Relationship Obligation of an Engineer to Clients	
10	Lec 31 Lec 32 Lec 33	Professional Organization: IEEE, ACM Standards and Codes Institutionalization of Ethical Conduct	
11	Lec 28 Lec 29 Lec 30	Ethical Dilemmas Choices (Whistle Blowing) Moral framework for resolving Ethical dilemmas	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Computer Crime and Cyber Security Privacy and Confidentiality Issue in CSE Legal Framework in CSE-CopyRight laws	
13	Lec 37 Lec 38 Lec 39	ICT Act Right To Information (RTI) Patents and Royalty	
14	Lec 40 Lec 41 Lec 42	Ethical Challenges for CSE Engineers Case Studies Regarding Ethical Issues in ICT Case Studies Regarding Ethical Issues in ICT	

Text and Ref Books:

1. Engineering Ethics Concepts and Cases (2nd Edition) - Charles E. Harris. Jr. , Michael S. Pritchard , Michael J. Rabins; Wadsworth Cengage Learning (2009)

2. Introduction to Engineering Ethics (3rd Edition) - Schinzinger and Martin; McGraw Hill (2000)

CSE-4XO **3 hours in a week, 3.00 Cr.**

Option-II

CSE-4XE **3 hours in alternate week, 0.75 Cr.**

Option-II Sessional

Option-I

CSE-419 **3 hours in a week, 3.00 Cr.**
Advanced Algorithms

Pre-requisite: None

Rationale:

This course motivates to implement advanced methods of algorithmic design, analysis, and implementation. techniques that include amortization, randomization, word-level parallelism, bit scaling, dynamic programming, network flow, linear programming, fixed-parameter algorithms, approximation algorithms etc. to identify which algorithm will provide efficient result for a specific problem or context.

Objective:

1. To study advanced techniques and recognize the resource requirements of various algorithms and their applications to solve and approximate real life problems.
2. To analyze the complexity and design necessary parameters of different techniques and methods of advanced algorithms.

Course Outcomes (CO):

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

1. Select and explain a variety of algorithms with practical applications and the resource requirements of each.

2. Determine the most suitable algorithm for any given task and then apply it to the problem.
3. Demonstrate adequate comprehension of the theory of intractability and prove when certain kinds of problems are intractable.

Course Content :
Randomized Algorithms: Las Vegas and Monte Carlo Algorithms; Randomized Data Structures: Skip Lists; Amortized Analysis: Different methods, Applications in Fibonacci Heaps; Lower Bounds: Decision Trees, Information Theoretic Lower Bounds, Adversary Arguments; Approximation Algorithms: Approximation Schemes, Hardness of Approximation; Fixed Parameter Tractability: Parameterized Complexity, Techniques of designing Fixed Parameter Algorithms, Examples; Online Algorithms: Competitive Analysis, Online Paging Problem, k-server Problem; External Memory Algorithms; Advanced Data Structures: Linear and Non-linear Methods.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Select and explain a variety of algorithms with practical applications and the resource requirements of each.		√										
2. Determine the most suitable algorithm for any given task and then apply it to the problem.			√									
3. Demonstrate adequate comprehension of the theory of intractability and prove when certain kinds of problems are intractable.				√								

Lecture Schedule

Week	**Lecture**	**Topics**	**Class Test**
1	Lec 1 Lec 2 Lec 3	Introduction to Advanced Algorithms Applications of Advanced Algorithms Fundamental Algorithms versus Advanced Algor thms	
2	Lec 4 Lec 5 Lec 6	Randomized Algorithms Las Vegas Algorithm Las Vegas Algorithm (Contd.)	**Class Test 1**

3	Lec 7 Lec 8 Lec 9	Monte Carlo Algorithm Monte Carlo Algorithm (Contd.) Randomized Data Structures	
4	Lec 10 Lec 11 Lec 12	Skip Lists Amortized Analysis Amortized Analysis Methods	
5	Lec 13 Lec 14 Lec 15	Amortized Analysis Methods (Contd.) Applications in Fibonacci Heaps Lower Bounds	**Class Test 2**
6	Lec 16 Lec 17 Lec 18	Decision Trees Decision Trees (Contd.) Information Theoretic Lower Bounds	
7	Lec 19 Lec 20 Lec 21	Adversary Arguments Approximation Algorithms Approximation Algorithms (Contd.)	
8	Lec 22 Lec 23 Lec 24	Approximation Schemes Approximation Schemes (Contd.) Hardness of Approximation	
9	Lec 25 Lec 26 Lec 27	Fixed Parameter Tractability Parameterized Complexity Parameterized Complexity (Contd.)	
10	Lec 31 Lec 32 Lec 33	Fixed Parameter Algorithms Techniques of Designing Fixed Parameter Algorithms Techniques of Designing Fixed Parameter Algorithms	**Class Test 3**
11	Lec 28 Lec 29 Lec 30	Online Algorithms Online Algorithms (Contd.) Online Algorithms (Contd.)	
12	Lec 34 Lec 35 Lec 36	Competitive Analysis Online Paging Problem k-server Problem	
13	Lec 37 Lec 38 Lec 39	External Memory Algorithms External Memory Algorithms (Contd.) External Memory Algorithms (Contd.)	**Class Test 4**
14	Lec 40 Lec 41 Lec 42	Advanced Data Structures Linear Models Non-linear Models	

Text and Ref Books:

1. An Introduction to Computational Learning Theory - Michael J. Kearns , Umesh Vazirani; The MIT Press (1994)
2. Algorithm Design (1st Edition) - Jon Kleinberg , ÉvaTardos; Pearson (2012)
3. Randomized Algorithms (1st Edition) - Rajeev Motwani , Prabhakar Raghavan; Cambridge

University Press (1995)

4. Probability and Computing: Randomized Algorithms and Probabilistic Analysis - Michael Mitzenmacher, Eli Upfal; Cambridge University Press (2005)

CSE-421 — 3 hours in a week, 3.00 Cr.
Basic Graph Theory

Pre-requisite: None

Rationale:
Provides a framework to model a large set of problems in CS for better mathematical structures and pairwise relations between objects.

Objective:

1. To learn the standard uses of graphs as models and the fundamental theory about graphs with a sense of some of its modern applications.
2. To formulate algorithms to solve problems with graph theories

Course Outcomes (CO):

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

1. Learn the standard uses of graphs as models and the fundamental theory about graphs with a sense of some of its modern applications.
2. Explain and discuss mathematical proofs, including an appreciation of why this is important.
3. Formulate algorithms to solve problems with graph theories

Course Content:

Graphs and their applications, Basic graph terminologies, Basic operations on graphs, Graph representations, Degree sequence and graphic sequence, Paths, cycles and connectivity, Network flow, Euler tours, Hamiltonian cycles Ear decomposition, Trees and counting of trees, Distance in graphs and trees, Graceful labeling, Matching and covering, Planar graphs, Digraphs, Graph coloring, Special classes of graphs.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Learn the standard uses of graphs as models and the fundamental theory about graphs with a sense of some of its modern applications.	√											
Explain and discuss mathematical proofs, including an appreciation of why this is important.				√								
Formulate algorithms to solve problems with graph theories			√									

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Graphs and their applications	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Basic graph terminologies	
3	Lec 7 Lec 8 Lec 9	Basic operations on graphs	
4	Lec 10 Lec 11 Lec 12	Graph representations	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Degree sequence and graphic sequence	
6	Lec 16 Lec 17 Lec 18	Paths Cycles Connectivity	
7	Lec 19 Lec 20 Lec 21	Network flow	
8	Lec 22 Lec 23 Lec 24	Euler tours Hamiltonian cycles Ear decomposition	
9	Lec 25	Trees and counting of trees	

	Lec 26 Lec 27		**Class Test 3**
10	Lec 31 Lec 32 Lec 33	Distance in graphs Distance in trees	
11	Lec 28 Lec 29 Lec 30	Graceful labeling Matching and covering	
12	Lec 34 Lec 35 Lec 36	Planar graphs	
13	Lec 37 Lec 38 Lec 39	Digraphs Graph coloring	**Class Test 4**
14	Lec 40 Lec 41 Lec 42	Special classes of graphs	

Text and Ref Books:

1. Introduction to graph theory - Douglas B West
2. Introduction to Graph Theory - Robin J. Wilson, Pearson Education Asia

CSE-423 — 3 hours in a week, 3.00 Cr.
Fault Tolerant System

Pre-requisite: None

Rationale:
This course motivates to implement a feature on a system that enables a system to continue with its operations even when there is a failure on one part of the system and helps in fault isolation through various failure detection mechanisms.

Objective:
1. To detect and isolate faults on a system and design accordingly to achieve a fault tolerant system using different fault tolerance design techniques.
2. To test and analyze the faults in order to create a reliable and high performance system.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Discuss, explain and analyze underlying notions of fault tolerance.
2. Model reliability of different types of systems.

3. Recognize defect avoidance and circumvention.
4. Identify methodologies of hardening systems.

Course Content :
Introduction of Fault Tolerant Systems and architectures; Goal and Application of Fault Tolerant computing, Fundamental Definitions,Design techniques to achieve fault Tolerance,Reliability Modeling Using Probability Theory, Fault detection and location in combinational and sequential circuits; Fault test generation for combinational and sequential circuits; Fault modeling; Faults in memory, memory test pattern and reliability;Performance monitoring, self-checking circuits, burst error correction and triple modular redundancy, Defect Avoidance,Defect Circumvention, Shield and Hardening,Yields Enhancement, Degradation Allowance.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Discuss, explain and analyze underlying notions of fault tolerance		√										
2. Model reliability of different types of systems.			√									
3. Recognize defect avoidance and circumvention.		√										
4. Identify methodologies of hardening systems.				√								

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to Fault Tolerant Systems Goals of Fault Tolerant Computing Applications of Fault Tolerant Computing	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Fundamental Definitions Design Techniques to Achieve Fault Tolerance Architecture of Fault Tolerant System	
3	Lec 7 Lec 8 Lec 9	Reliability Modeling using Probability Theory Reliability Modeling using Probability Theory (Contd.)	

		Fault Detection and Location	
4	Lec 10 Lec 11 Lec 12	Fault Detection and Location in Sequential Circuit Fault Detection and Location in Combinational Circuit Fault Modeling	
5	Lec 13 Lec 14 Lec 15	Fault Test Fault Test Generation for Sequential Circuit Fault Test Generation for Combinational Circuit	**Class Test 2**
6	Lec 16 Lec 17 Lec 18	Faults in Memory Memory Test Pattern Memory Test Reliability	
7	Lec 19 Lec 20 Lec 21	Performance Monitoring Performance Monitoring (Contd.) Self-checking circuits	
8	Lec 22 Lec 23 Lec 24	Errors Error Types Error Types (Contd.)	
9	Lec 25 Lec 26 Lec 27	Error Correction Burst Error Burst Error Correction	**Class Test 3**
10	Lec 31 Lec 32 Lec 33	N-modular Redundancy Triple Modular Redundancy Triple Modular Redundancy (Contd.)	
11	Lec 28 Lec 29 Lec 30	Defect Defect Types Defect Avoidance	
12	Lec 34 Lec 35 Lec 36	Defect Avoidance (Contd.) Defect Circumvention Defect Circumvention (Contd.)	
13	Lec 37 Lec 38 Lec 39	Hardening Systems Methods of Hardening Shield Hardening (Contd.)	**Class Test 4**
14	Lec 40 Lec 41 Lec 42	Yields Enhancement Yields Enhancement (Contd.) Degradation Allowance	

Text and Ref Books:

1. Design and Analysis of Fault Tolerant Digital System (1st Edition) - Barry W. Johnson; Addison Wesley (1989)

2. Dependable Computing: A Multilevel Approach - Behrooz Parhami
3. Fault-Tolerant Systems (1st Edition) - Israel Koren, C. Mani Krishna; Morgan Kauffman (2010)

CSE-425 — 3 hours in a week, 3.00 Cr.
Basic Multimedia Theory

Pre-requisite: None

Rationale:
This course motivates to study the architecture, different standards of compressing and coding a multimedia document; database, network and operating system issues, traffic and service issues, security issues and hence apply this knowledge to implement different multimedia applications.

Objective:
1. To apply different techniques and methods for developing secured and high quality multimedia applications for different context.
2. To recognize and analyze different issues - storing, indexing, resource management, scheduling, security etc. of multimedia applications.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Discuss indexing and storing multimedia data for multimedia document.
2. Explain disk placement, disk scheduling, searching techniques for multimedia document.
3. Discover and apply the knowledge acquired in developing multimedia applications – audio and video conferencing, video on demand, and voice over IP.

Course Content :
Multimedia systems - introduction; Coding and compression standards; Architecture issues in multimedia; Operating systems issues in multimedia - real-time OS issues, synchronization, interrupt handling; Database issues in multimedia - indexing and storing multimedia data, disk placement, disk scheduling, searching for a multimedia document; Networking issues in multimedia - Quality-of-service guarantees, resource reservation, traffic specification, shaping, and monitoring, admission control; Multicasting issues; Session directories; Protocols for controlling sessions; Security issues in multimedia-digital water making, partial encryption schemes for video streams; multimedia applications – audio and video conferencing, video on demand, voice over IP.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Discuss indexing and storing multimedia data for multimedia document.	√											
2. Explain disk placement, disk scheduling, searching techniques for multimedia document.			√									
3. Discover and apply the knowledge acquired in developing multimedia applications – audio and video conferencing, video on demand, and voice over IP.				√								

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1	Introduction to Multimedia Systems	
	Lec 2	Introduction to Multimedia Systems (Contd.)	
	Lec 3	Application of Multimedia Systems	
2	Lec 4	Coding Standards	
	Lec 5	Compression Standards	
	Lec 6	Architecture Issues in Multimedia	
3	Lec 7	Architecture Issues in Multimedia (Contd.)	**Class Test 1**
	Lec 8	Operating System Issues in Multimedia	
	Lec 9	Real-time OS Issues	
4	Lec 10	Synchronization Issues	
	Lec 11	Interrupt Handling	
	Lec 12	Interrupt Handling (Contd.)	
5	Lec 13	Database Issues in Multimedia	
	Lec 14	Indexing Multimedia Data	
	Lec 15	Storing Multimedia Data	
6	Lec 16	Storing Multimedia Data (Contd.)	**Class Test 2**
	Lec 17	Disk Placement	
	Lec 18	Disk Scheduling	
7	Lec 19	Disk Scheduling (Contd.)	
	Lec 20	Searching for a Multimedia Document	
	Lec 21	Networking Issues in Multimedia	
8	Lec 22	Quality-of-Service guarantees	
	Lec 23	Resource Reservation	
	Lec 24	Traffic Specification	

9	Lec 25 Lec 26 Lec 27	Shaping Monitoring Admission Control	**Class Test 3**
10	Lec 31 Lec 32 Lec 33	Multicasting Issues Multicasting Issues (Contd.) Session Directories	
11	Lec 28 Lec 29 Lec 30	Protocols for Controlling Sessions Protocols for Controlling Sessions (Contd.) Security Issues in Multimedia	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Security Issues in Multimedia (Contd.) Digital Water Making Partial Encryption Schemes for Video Streams	
13	Lec 37 Lec 38 Lec 39	Multimedia Applications Audio Conferencing Video Conferencing	
14	Lec 40 Lec 41 Lec 42	Video on Demand Voice over IP Voice over IP (Contd.)	

Text and Ref Books:

1. Multimedia: Computing, Communications & Applications (US Edition) - Ralf Steinmetz, Klara Nahrstedt; Prentice Hall (1995)

CSE-427 — 3 hours in a week, 3.00 Cr.

Digital Image Processing

Pre-requisite: None

Rationale:

Introduce the fundamentals of image processing and manipulation of television, medical imaging modalities such as X-ray or ultrasound, photography, security, astronomy and remote sensing.

Objective:

1. To describe image formation and the role human visual system plays in perception of gray and color image data.

2. To explain the basic elements and applications of image processing.
3. To select and analyze image sampling and quantization requirements and implications.
4. To perform Gray level transformations for Image enhancement.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Describe image formation and the role of human visual system in perception of gray and color image data.
2. Explain the basic elements and applications of image processing.
3. Select and analyze image sampling and quantization requirements and implications.
4. Perform Gray level transformations for Image enhancement.

Course Content :

Digital image fundamentals: visual perception, Light and Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Some basic relationships between pixels, Linear and Nonlinear operations; image transforms: First Fourier Transform (FFT), Discrete Cosine Transform (DCT), Karhunen and Loeve Transform (KLT), Wavelet transform and sub-band decomposition; image enhancement in the frequency domain and image restoration techniques, image compression techniques, image compression standards: JPEG,MPEG, H.261, and H.263, Image Segmentation.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
Describe image formation and the role of human visual system in perception of gray and color image data.	√											
Explain the basic elements and applications of image processing.	√											
Select and analyze image sampling and quantization requirements and implications.		√										
Perform Gray level transformations for Image enhancement.			√									

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Digital image fundamentals Visual perception Light and Electromagnetic Spectrum	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Image Sensing and Acquisition Image Sampling and Quantization Basic relationships between pixels	
3	Lec 7 Lec 8 Lec 9	Linear and Nonlinear operations Image transforms First Fourier Transform (FFT)	
4	Lec 10 Lec 11 Lec 12	Discrete Cosine Transform (DCT) Karhunen and Loeve Transform (KLT)	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Wavelet Transform	
6	Lec 16 Lec 17 Lec 18	Sub-Band Decomposition	
7	Lec 19 Lec 20 Lec 21	Image restoration technique Properties of Noise Estimation of Noise Parameters	
8	Lec 22 Lec 23 Lec 24	Filters Mean Filter Bandpass and Band reject Filter Notch Filter and Inverse Filter	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Color Image Processing Fundamentals, Models Smoothing and Sharpening	
10	Lec 31 Lec 32 Lec 33	Image compression techniques Coding Redundancy Measuring Image Information	
11	Lec 28 Lec 29 Lec 30	Image compression standards JPEG, MPEG, H.261, and H.26	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Image Enhancement in the Frequency Domain	

13	Lec 37 Lec 38 Lec 39	Image Segmentation Detection of Discontinuities Thresholding	
14	Lec 40 Lec 41 Lec 42	Edge Linking Boundary Detection	

Text and Ref Books:

1. Digital Image Processing (3rd/2nd Edition) - R. C. Gonzalez and R.E. Woods; Pearson Prentice Hall (2009)

CSE-429 3 hours in a week, 3.00 Cr.

Data and Network Security

Pre-requisite: None

Rationale:
To gather brief review of computer crimes and causes, Internet, strategies, crime prevention, security.

Objective:

1. To understand the development of security, traditional encryption, security attacks and the fundamental security objectives

2. To determine and analyze the security objectives, attacks, and models, so is able to recognize the security requirements in real-life cases.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Understand the development of security, traditional encryption, security attacks and the fundamental security objectives

2. Determine the security objectives, attacks, and models, so is able to recognize the security requirements in real-life cases.

3. Analyze the design and implementation issues of a real-life security solution.

Course Content :

Overview, Symmetric cipher, Classical encryption technique, Block cipher and the data encryption standard (DES), Triple DES, Introduction to finite fields, Advanced Encryption Standard, Contemporary Symmetric Ciphers, confidentiality using symmetric encryption public, Key encryption and Hash functions, Public-key Cryptography, RSA algorithm, Key management, Diffie-Hellman key exchange, Other Public Key Cryptosystem, Message Authentication and Hash function, Hash Algorithm, Digital Signatures and Authentication protocols, Network Security practice, Authentication application, Wireless Network Security, Electrical Mail security, IP security, Web security, System security, Intruders, Malicious software and Firewall, Legal and Ethical Aspects.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Understand the development of security, traditional encryption, security attacks and the fundamental security objectives	√											
Determine the security objectives, attacks, and models, so is able to recognize the security requirements in real-life cases.		√										
Analyze the design and implementation issues of a real-life security solution.			√									

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction Symmetric cipher	
2	Lec 4 Lec 5 Lec 6	Classical encryption technique Block cipher	**Class Test 1**
3	Lec 7	Data Encryption Standard (DES)	

	Lec 8 Lec 9	Triple DES	
4	Lec 10 Lec 11 Lec 12	Introduction to finite fields Advanced Encryption Standard	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Contemporary Symmetric Ciphers Symmetric Encryption	
6	Lec 16 Lec 17 Lec 18	Key Encryption Hash Functions	
7	Lec 19 Lec 20 Lec 21	Public-key Cryptography RSA Algorithm Key Management	
8	Lec 22 Lec 23 Lec 24	Diffie-Hellman key exchange Public Key Cryptosystem	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Message Authentication and Hash function Hash Algorithm	
10	Lec 31 Lec 32 Lec 33	Digital Signatures Authentication protocols	
11	Lec 28 Lec 29 Lec 30	Network Security practice Authentication application Wireless	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Network Security Electrical Mail security IP security	
13	Lec 37 Lec 38 Lec 39	Web security System security Intruders	
14	Lec 40 Lec 41 Lec 42	Malicious software and Firewall Legal and Ethical Aspects.	

Text and Ref Books:

1. Cryptography and Network Security - William Stallings;
2. Cryptography and Network Security- Behrouz A. Forouzan;

CSE-431 **3 hours in a week, 3.00 Cr.**

Object Oriented Software Engineering

Pre-requisite: None

Rationale:

This course provides in depth concepts, properties, relationships of object driven software, exception handling and reusable library.

Objective:

1. To describe various O-O concepts, their properties, relationships along with model/ represent considering constraints.
2. To design, develop and explain various modeling techniques to model different perspectives of Object-Oriented Software Design.

Course Outcomes (CO):

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

1. Describe various O-O concepts along with their applicability contexts.
2. Identify domain objects, their properties, and relationships among them.
3. Model/ represent domain constraints on the objects and (or) on their relationships.
4. Develop design solutions for problems on various O-O concepts.

Course Content:

The object-oriented approach within the context of software engineering, the language, basic (procedural) elements of language: what an Eiffel program is, what the instruction set is, and how to declare and use entities (variables) and routines; The concepts underlying the object-oriented approach: modularity, inheritance, and dynamic binding, case study from the management information-system domain; Environment matters: system configuration, interfacing with external software, and garbage collection. Advanced issues involving exception handling, repeated inheritance, typing problems, and parallelism; object-oriented software engineering process, concentrating on specific guidelines facilitate the translation OOAD to a maintainable Addresses verification and validation (V&V) issues of Eiffel software systems built in a software engineering context; Building reusable libraries; The building of a parallel linear algebra library (Paladin).

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Describe various O-O concepts along with their applicability contexts.	√											
Identify domain objects, their properties, and relationships among them.		√										
Model/ represent domain constraints on the objects and (or) on their relationships.		√										
Develop design solutions for problems on various O-O concepts.			√									
Explain and select various modeling techniques to model different perspectives of Object-Oriented Software Design.	√											

Lecture Schedule

Week	**Lecture**	**Topics**	**Class Test**
1	Lec 1 Lec 2 Lec 3	Object-oriented approach	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Basic (procedural) elements of language	
3	Lec 7 Lec 8 Lec 9	Eiffel program Instruction set Entities (variables) and routines;	
4	Lec 10 Lec 11 Lec 12	Concepts underlying the O-O approach Modularity	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Inheritance Dynamic binding Management information-system domain	
6	Lec 16 Lec 17 Lec 18	Environment matters: system configuration,	
7	Lec 19 Lec 20 Lec 21	Interfacing with external software Garbage collection.	

8	Lec 22 Lec 23 Lec 24	Advanced issues involving exception handling	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Repeated inheritance Typing problems	
10	Lec 31 Lec 32 Lec 33	Parallelism O-O software engineering process	
11	Lec 28 Lec 29 Lec 30	OOAD to a maintainable Addresses verification	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	OOAD to Address validation (V&V) Issues of Eiffel software systems	
13	Lec 37 Lec 38 Lec 39	Building reusable libraries	
14	Lec 40 Lec 41 Lec 42	The building of a parallel linear algebra library (Paladin).	

Text and Ref Books:

1. Object-Oriented Software Engineering - Stephen Schach
2. Object Oriented Software Engineering: A Use Case Driven Approach - Ivar Jacobson
3. Object-Oriented Software Engineering: Practical Software Development using UML and Java – Timothy Lethbridge, Robert Laganiere, Robert Laganiere

CSE-433 3 hours in a week, 3.00 Cr.
Artificial Neural Networks and Fuzzy Systems

Pre-requisite: None

Rationale:

Reasoning complex situations by the artificial agents with the help of neural network and fuzzy system provides better performance.

Objective:

1. To develop the skills on neural network theory and fuzzy logic theory and explore the functional components of neural network classifiers or controllers, and the functional components of fuzzy logic classifiers or controllers.
2. To design and implement basic trainable neural network or a fuzzy logic system for a typical control, computing application or biomedical application.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory.
2. Explore the functional components of neural network classifiers or controllers, and the functional components of fuzzy logic classifiers or controllers.
3. Select and implement a basic trainable neural network or a fuzzy logic system for a typical control, computing application or biomedical application.

Course Content:
Biological nervous system: the brain and neurons, Introduction to artificial neural network and fuzzy systems, Theory and application of Artificial neural networks and fuzzy logic; Multi-layer perception: Back propagation algorithm, Self organization map, Radial basis network, Hop field network, Recurrent network, Fuzzy set theory, Failing Adaptive Linear (ADALINE) and Multiple Adaptive Linear (MADALINE) networks, Generating internal representation, Cascade correlation and counter propagation networks, Higher order and bi-directional associated memory, Lyapunov energy function, attraction basin, Probabilistic updates: simulated annealing, Boltzmann machine, Adaptive Resonance Theory (ART) network. ARTI. ART2. Fuzzy ART mapping (ARTMAF) networks. Kohonen feature .l\ Learning Vector Quantization (LVQ) networks, Logic control: Adaptive fuzzy neural network; Genetic algorithm and evolution compacting, Applications to control; Pattern recognition; Nonlinear system modeling, Speech and image processing.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory	√											
Explore the functional components of neural network classifiers or controllers, and the functional components of fuzzy logic classifiers		√										

or controllers.												
Select and implement a basic trainable neural network or a fuzzy logic system for a typical control, computing application or biomedical application.			√									

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Biological nervous system Brain and neurons	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Introduction to artificial neural network and fuzzy systems	
3	Lec 7 Lec 8 Lec 9	Adaption of Artificial neural networks Fuzzy logic	
4	Lec 10 Lec 11 Lec 12	Multi-layer perception Back propagation algorithm Self-organization map	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Radial basis network Hop field network Recurrent network	
6	Lec 16 Lec 17 Lec 18	Fuzzy set theory Failing Adaptive Linear (ADALINE) Multiple Adaptive Linear (MADALINE)	
7	Lec 19 Lec 20 Lec 21	Generating internal representation Cascade correlation Counter propagation networks	
8	Lec 22 Lec 23 Lec 24	Higher order bi-directional associated memory Lyapunov energy function	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Attraction basin Probabilistic updates: simulated annealing Boltzmann machine	
10	Lec 31 Lec 32 Lec 33	Adaptive Resonance Theory (ART) network. ARTI. ART2.	
11	Lec 28	Fuzzy ART mapping (ARTMAF)	

	Lec 29 Lec 30	Kohonen feature LVQ networks	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Logic control Adaptive fuzzy neural network	
13	Lec 37 Lec 38 Lec 39	Genetic algorithm Evolution compacting Applications to control	
14	Lec 40 Lec 41 Lec 42	Pattern recognition Nonlinear system modeling Speech and image processing.	

Text and Ref Books:

1. Neural Networks and Fuzzy Systems - Shigeo Abe
2. Introduction to Artificial Neural Systems - Jacek M. Zurada
3. Artificial neural systems: foundations, paradigms, applications, and implementations - Patrick K. Simpson

CSE-435 — 3 hours in a week, 3.00 Cr.
Distributed Algorithms

Pre-requisite: None

Rationale:

Execution of algorithms in parallel and distributed settings along with correctness, reliability, security, and performance is very vital for computing.

Objective:

1. To acquire concepts of models, limitations, and fundamentals of message passing and shared memory concurrency, and apply this understanding to example systems and algorithms.
2. Adapt, design algorithms and distinguish for execution in parallel and distributed settings along with correctness, reliability, security, and performance.

Course Outcomes (CO):

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

1. Discuss and account for models, limitations, and fundamental concepts in the area of message passing and shared memory concurrency, and apply this understanding to example systems and algorithms.
2. Adapt, and design algorithms for execution in parallel and distributed settings.
3. Distinguish the algorithms for correctness, reliability, security, and performance.

Course Content:

Models of distributed computing, Synchrony, communication and failure concerns, Synchronous message-passing distributed systems, Algorithms in systems with no failures - Leader Election and Breadth-First Search algorithms, The atomic commit problem, Consensus problems - the Byzantine Generals Problem, Asynchronous message-passing distributed systems, Failure detectors, Logical time and vector clocks, Routing algorithms.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Discuss and account for models, limitations, and fundamental concepts in the area of message passing and shared memory concurrency, and apply this understanding to example systems and algorithms.	√											
Adapt, and design algorithms for execution in parallel and distributed settings.			√									
Distinguish the algorithms for correctness, reliability, security, and performance.		√										

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Models of distributed computing	
	Lec 4 Lec 5 Lec 6	Synchrony communication	**Class Test 1**
3	Lec 7	Failure concerns	

	Lec 8 Lec 9		
4	Lec 10 Lec 11 Lec 12	Synchronous message-passing	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Distributed systems	
6	Lec 16 Lec 17 Lec 18	Algorithms in systems with no failures - Leader Election	
7	Lec 19 Lec 20 Lec 21	Breadth-First Search algorithms	
8	Lec 22 Lec 23 Lec 24	The atomic commit problem	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Consensus problems - the Byzantine Generals Problem	
10	Lec 31 Lec 32 Lec 33	Asynchronous message-passing of distributed systems	
11	Lec 28 Lec 29 Lec 30	Failure detectors I	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Failure detectors II	
13	Lec 37 Lec 38 Lec 39	Logical time Vector clocks	
14	Lec 40 Lec 41 Lec 42	Routing algorithms	

Text and Ref Books:

1. Distributed Systems - S. Mullender (ed.), Addison-Wesley
2. Introduction to Distributed Algorithms - G. Tel. Cambridge Univ. Press

CSE-437 **3 hours in a week, 3.00 Cr.**
Bioinformatics

Pre-requisite: None

Rationale:

This course motivates to generate all sorts of data that involves generating protein sequence and predicting protein domains to even producing 3D structures of proteins from computer based databases of biological information for bioinformatics experiments.

Objective:

1. To be able to work with the vast amount of biomedical and genomic data using bioinformatics tools.
2. To analyze the properties of different genome sequences and their alignment from databases using dynamic programming.

Course Outcomes (CO):

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

1. Explain and learn the knowledge of basic topics regarding bioinformatics.
2. Define and describe the contents and properties of the most important bioinformatics databases and searches.
3. Enhance the major steps in pairwise and multiple sequence alignment, explain the principle for, and execute pairwise sequence alignment by dynamic programming.

Course Content :

Molecular biology basics: DNA, RNA, genes, and proteins; Genome Rearrangements. Sequence similarity, homology, and alignment. Pair-wise alignment: scoring model, dynamic programming algorithms, heuristic alignment, and pair-wise alignment using Hidden Markov Models. Combinatorial pattern matching: Database Search, Rapid String Matching, BLAST, FASTA; Multiple alignment: scoring model, local alignment gapped and un-gapped global alignment. Motif finding: motif models, finding occurrence of known sites, discovering new sites. Gene Finding: predicting reading frames, maximal dependence decomposition. Analysis of DNA microarray data using hierarchical clustering, model-based clustering, expectation-maximization clustering, Bayesian model selection.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain and learn the knowledge of basic topics regarding bioinformatics.	√											
2. Define and describe the contents and properties of the most important bioinformatics databases and searches.	√											
3. Enhance the major steps in pairwise and multiple sequence alignment, explain the principle for, and execute pairwise sequence alignment by dynamic programming.		√										

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to Bioinformatics Applications of Bioinformatics Molecular Biology Basics	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	DNA and RNA Genes Proteins	
3	Lec 7 Lec 8 Lec 9	Genome Rearrangements Sequence Similarity Homology	
4	Lec 10 Lec 11 Lec 12	Alignment Pair-wise Alignment Scoring Model Pair-wise Alignment Scoring Model (Contd.)	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Dynamic Programming Algorithms Dynamic Programming Algorithms (Contd.) Heuristic Alignment	
6	Lec 16 Lec 17 Lec 18	Hidden Markov Model Pair-wise Alignment using HMM Pair-wise Alignment using HMM (Contd.)	
7	Lec 19 Lec 20 Lec 21	Combinatorial Pattern Matching Database Search Rapid String Matching	
8	Lec 22	BLAST	

	Lec 23 Lec 24	FASTA Multiple Alignment Scoring Model	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Local Alignment Gapped Global Alignment Un-gapped Global Alignment	
10	Lec 31 Lec 32 Lec 33	Motif Finding: Motif Models Finding Occurence of Known Sites Discovering New Sites	
11	Lec 28 Lec 29 Lec 30	Gene Finding Predicting Reading Frames Maximal Dependence Decomposition	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Analysis of DNA Microarray Data Hierarchical Clustering Hierarchical Clustering (Contd.)	
13	Lec 37 Lec 38 Lec 39	Model Based Clustering Model Based Clustering (Contd.) Expectation Maximization Clustering	
14	Lec 40 Lec 41 Lec 42	Expectation Maximization Clustering (Contd.) Bayesian Model Selection Bayesian Model Selection (Contd.)	

Text and Ref Books:

1. 1. An Introduction to Bioinformatics Algorithm (1st Edition)- Neil C. Jones, Pavel A. Pevzner; The MIT Press (2004)

CSE-439 — 3 hours in a week, 3.00 Cr.
Robotics

Pre-requisite: None

Rationale:

This course introduces the fundamentals of robotics design and development, the principles of robot kinematics, dynamics, motion planning, trajectory generation and control as well as plan and research complete robots for various industrial applications.

Objective:

1. To explain the basics of robotic systems, robot design, development process and their vast

applications.
2. To specify and analyze the simulation, modeling and drawbacks of a robotic system for an interactive complex environment.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Explain with the concept development and key components of robotics technologies.
2. Solve problems in spatial coordinate representation and spatial transformation, robot locomotion design, kinematics, motion control, localization and mapping, navigation and path planning.
3. Design and implement a robotic project on a physical mobile robot platform, with tasks involving project specification, algorithm design, software programming, simulation and modeling, control and obstacle avoidance in a complex and interactive environment.

Course Content :
Introduction to robotics, overview of robot mechanisms, dynamics, and intelligent controls, planar and spatial kinematics, and motion planning; mechanism design for manipulators and mobile robots, multi-rigid body dynamics, 3D graphic simulation; control design, actuators, and sensors; wireless networking, task modeling, human-machine interface, and embedded software mechanical design, rigidbody velocity, Jacobean, inverse kinematics, redundant and parallel robots, trajectory control, face control and haptics, Micro and Nano-robotics, mobile robots. Human-robot interaction, Multiagents, fault diagnosis.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Explain with the concept development and key components of robotics technologies.	√											
Solve problems in spatial coordinate representation and spatial transformation, robot locomotion design, kinematics, motion control, localization and mapping, navigation and path planning.		√										
Design and implement a robotic project on a physical mobile robot platform, with tasks			√									

involving project specification, algorithm design, software programming, simulation and modeling, control and obstacle avoidance in a complex and interactive environment.												

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1	Introduction to Robotics	
	Lec 2	Applications of Robotics	
	Lec 3	Evolution of Robotics	
2	Lec 4	Overview of Robot Mechanisms	
	Lec 5	Overview of Robot Dynamics	
	Lec 6	Overview of Robot Intelligent Controls	
3	Lec 7	Spatial Descriptions	**Class Test 1**
	Lec 8	Transformations	
	Lec 9	Introduction to Kinematics	
4	Lec 10	Planar Kinematics	
	Lec 11	Spatial Kinematics	
	Lec 12	Motion Planning	
5	Lec 13	Mechanism Design for Manipulators	
	Lec 14	Mechanism Design for Mobile Robots	
	Lec 15	Mechanism Design for Mobile Robots (Contd.)	**Class Test 2**
6	Lec 16	Manipulator Kinematics	
	Lec 17	Inverse Manipulator Kinematics	
	Lec 18	Introduction to Dynamics	
7	Lec 19	Manipulator Dynamics	
	Lec 20	Trajectory Generation	
	Lec 21	Multi-rigid body Dynamics	
8	Lec 22	Linear Control of manipulators	
	Lec 23	Non-Linear Control Manipulators	
	Lec 24	Force Control of Manipulators	
9	Lec 25	3D Graphic Simulation	
	Lec 26	3D Graphic Simulation (Contd.)	
	Lec 27	3D Graphic Simulation (Contd.)	**Class Test 3**
10	Lec 31	Control Design	
	Lec 32	Actuators	
	Lec 33	Sensors	
11	Lec 28	Task Modeling, Face Control and Haptics	
	Lec 29	Human-Machine Interface	

	Lec 30	Embedded Software Mechanical Design	
12	Lec 34 Lec 35 Lec 36	Jacobean Kinematics Inverse Kinematics Redundant and Parallel Robots	**Class Test 4**
13	Lec 37 Lec 38 Lec 39	Micro Robotics Nano-Robotics Mobile Robots	
14	Lec 40 Lec 41 Lec 42	Human-robot interaction Multiagents Fault Diagnosis	

Text and Ref Books:

1. Introduction to Robotics: Analysis, Control, Applications (2nd Edition) - Saeed B. Niku; Wiley (2010)
2. Introduction to Robotics: Mechanics and Control (3rd Edition) - John J. Craig; Pearson (2004)

CSE-441 — 3 hours in a week, 3.00 Cr.
Machine Learning

Pre-requisite: NONE

Rationale:
Machine learning provides appropriate learning algorithm to best suit the current need and enhance the learning parameters for maximum performance.

Objective:

1. To learn paradigms in different environmental setting and apply the appropriate learning algorithm to best suit the current need.
2. To enhance the learning parameters to achieve maximum performance.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:
1. Discuss the different learning paradigms in different environmental setting
2. Select and apply the appropriate learning algorithm to best suit the current need.
3. Enhance the learning parameters to achieve maximum performance.

Course Content:

Introduction to Machine Learning; Regression analysis: Logistic Regression, Linear Regression; Supervised and Unsupervised learning; Bayesian Learning; Decision Tree Learning; Rule based learning; Instance based learning; Neural Nets; Support Vector Machine; Genetic Algorithms; Reinforcement learning; Ensemble learning; Hidden Markov Models; Maximum Likelihood Estimates, Parameter Estimation; Computational learning theory.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
Discuss the different learning paradigms in different environmental setting.	√											
Select and apply the appropriate learning algorithm to best suit the current need.		√										
Enhance the learning parameters to achieve maximum performance.		√										

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to Machine Learning	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Regression analysis Logistic Regression	
3	Lec 7 Lec 8 Lec 9	Linear Regression	
4	Lec 10 Lec 11 Lec 12	Supervised learning Unsupervised learning	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Bayesian Learning Decision Tree Learning	
6	Lec 16 Lec 17 Lec 18	Rule based learning Instance based learning	

7	Lec 19 Lec 20 Lec 21	Neural Nets	
8	Lec 22 Lec 23 Lec 24	Support Vector Machine Genetic Algorithms	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Reinforcement learning	
10	Lec 31 Lec 32 Lec 33	Ensemble learning	
11	Lec 28 Lec 29 Lec 30	Hidden Markov Models	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Maximum Likelihood Estimates	
13	Lec 37 Lec 38 Lec 39	Parameter Estimation	
14	Lec 40 Lec 41 Lec 42	Computational learning theory	

Text and Ref Books:

1. Pattern Recognition and Machine Learning - Christopher M. Bishop; Springer
2. Machine Learning - Tom Mitchell, McGraw Hill
3. Pattern Recognition –SergiosTheodoridis and KonstantinosKoutroumbas; Elsevier Inc.

Option-II

CSE-443 **3 hours in a week, 3.00 Cr.**

Pattern Recognition

Pre-requisite: None

Rationale:

This course motivates to recognize patterns, regularities and also irregularities in data by using various pattern recognition algorithms and techniques to find useful information for science, business, organizational decisions as well as contributing to the field of machine learning, data mining and artificial intelligence.

Objective:

1. To provide a comprehensive introduction to pattern recognition techniques leading to the ability to understand contemporary terminology, progress, issues, and trends.
2. To specify sectors and context where the application of pattern recognition can provide a fruitful solution.

Course Outcomes (CO):

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

1. Identify areas where pattern recognition techniques can offer a solution.
2. Describe the strength and limitations of some techniques used in pattern recognition for classification, regression and density estimation problems.
3. Conduct, document and present a literature review on a topic related to Machine Learning and Pattern Recognition.
4. Solve problems in regression and classification.

Course Content :

Introduction to pattern recognition, Statistical and Neural Pattern Recognition, Bayesian decision theory, Linear classifiers, Nonlinear classifiers, Parametric estimation techniques; Non-parametric estimation techniques; Template matching, Dynamic programming methods, Correlation methods, Hidden Markov model, Support vector machine, Syntactic pattern recognition, Clustering algorithms, Principle component analysis.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Identify areas where pattern recognition techniques can offer a solution.		√										
2. Describe the strength and limitations of some techniques used in pattern r cognition for classification, regression and density estimation problems.		√										
3. Conduct, document and present a literature review on a topic related o Machine Learning and Pattern Recognition.			√									
4. Sol e problems in regression and classification.			√									

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to Pattern Recognition Importance of Pattern Recognition tatistical and Neural Pattern Recognition	
2	Lec 4 Lec 5 Lec 6	Review of Probability Distributions Review of Probability Distributions (Contd.) Bayesian classifier	**Class Test 1**
3	Lec 7 Lec 8 Lec 9	Bayes Decision Theory Discriminate Functions Decision Surfaces	
4	Lec 10 Lec 11 Lec 12	Bayesian Classifier for Normal Distribution Naïve Bayes Classifier Bayesian Belief Networks	
5	Lec 13 Lec 14 Lec 15	Linear classifiers Discriminate Functions Decision Hyperplanes	**Class Test 2**
6	Lec 16 Lec 17	Perceptron Algorithm Least Squares Methods	

	Lec 18	Kessler's Construction	
7	Lec 19 Lec 20 Lec 21	Nonlinear Classifier Two and Three Layer Perceptrons Back Propagation Algorithm	
8	Lec 22 Lec 23 Lec 24	Template matching Optimal Path Searching Techniques Optimal Path Searching Techniques (Contd.)	
9	Lec 25 Lec 26 Lec 27	Dynamic Programming Methods (Contd.) Dynamic Programming Methods (Contd.) Correlation Methods	**Class Test 3**
10	Lec 31 Lec 32 Lec 33	Context Dependent Classification Observable and Hidden Markov Models Viterbi Algorithm	
11	Lec 28 Lec 29 Lec 30	Problems of HMM Problems of HMM Application of HMM in Speech Recognition	
12	Lec 34 Lec 35 Lec 36	Syntactic Pattern Recognition Syntactic Pattern Recognition (Contd.) Syntactic Pattern Recognition (Contd.)	
13	Lec 37 Lec 38 Lec 39	Clustering Algorithms Clustering Algorithms (Contd.) Clustering Algorithms (Contd.)	**Class Test 4**
14	Lec 40 Lec 41 Lec 42	Support Vector Machine Support Vector Machine (Contd.) Support Vector Machine (Contd.)	

Text and Ref Books:

1. Pattern Classification (2nd Edition) - R. O. Duda, P.E.D. Hart and G. Stork; John Wiley and Sons (2000)
2. Pattern recognition (4th Edition) –Sergios Theodoridis and Konstantinos Koutroumbas; Academic Press (2008)

CSE-444 **3 hours in alternate week, 0.75 Cr.**

Pattern Recognition Sessional

Pre-requisite: None

Rationale:

This course motivates to apply various algorithm and techniques - classification, regression, clustering, neural network, decision tree and other estimation techniques which helps to identify different types of pattern in data that can give required solution and suggestions to real-life problems for various applications.

Objective:

1. To achieve a basic idea about designing and developing pattern recognition applications using different algorithm and techniques.
2. To analyze regular/irregular pattern in data in order to find out potentially useful information.

Course Outcomes (CO):

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

1. Use practical knowledge to identify areas where pattern recognition techniques can offer a solution.
2. Conduct, document and present a literature review on a topic related to Machine Learning and Pattern Recognition practically.
3. Solve problems in regression and classification.

Course Content :
Bayes Classifier, Perceptron Algorithm, Pocket Algorithm, Edit Distance, Basic Sequential Algorithmic Scheme, K-Means Clustering algorithm, Support Vector Machine, Neural Network, Decision Tree.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, presentation, project, quiz, viva, lab test.

Assessment Methods & their Weights:

Category	**Marks %**
Project	40
Quiz	20
Viva / Presentation	10
Class Participation	10
Report	10
Class Assessment	10
Total	**100**

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Use practical knowledge to identify areas where pattern recognition techniques can offer a solution.						√						
2. Conduct, document and present a literature review on a topic related to Machine Learning and Pattern Recognition practically.								√				
3. Solve problems in regression and classification.									√			

Lecture Schedule

Week	Lecture	Topics
1	Lec 1	Introduction to MATLAB
	Lec 2	Python Script
	Lec 3	Project Idea Distribution
2	Lec 4	Introduction to MATLAB (Contd.)
	Lec 5	Python Script
	Lec 6	Pro ect Idea Distribution
3	Lec 7	Project Proposal Presentation
	Lec 8	Project Proposal Presentation (Contd.)
	Lec 9	Project Proposal Presentation (Contd.)
4	Lec 10	Bayes Classifier
	Lec 11	Bayes Classifier (Contd.)
	Lec 12	Home Assignment
5	Lec 13	K-Nearest Neighbour Classification K-Nearest Neighbour
	Lec 14	Classification (Contd.)
	Lec 15	Home Assignment
6	Lec 16	Linear Classifiers
	Lec 17	Linear Classifiers (Contd.)
	Lec 18	Home Assignment
7	Lec 19	Perceptron Algorithm
	Lec 20	Perceptron Algorithm (Contd.)
	Lec 21	Home Assignment
8	Lec 22	Lab Test 1
	Lec 23	Lab Test 1 (Contd.)
	Lec 24	Lab Test 1 (Contd.)

9	Lec 25 Lec 26 Lec 27	Clustering Algorithms Clustering Algorithms (Contd.) Home Assignment
10	Lec 31 Lec 32 Lec 33	Project Update Project Update (Contd.) Project Update (Contd.)
11	Lec 28 Lec 29 Lec 30	Support Vector Machine Support Vector Machine (Contd.) Neural Network
12	Lec 34 Lec 35 Lec 36	Neural Network (Contd.) Decision Tree Decision Tree (Contd.)
13	Lec 37 Lec 38 Lec 39	Quiz Quiz (Contd.) Viva
14	Lec 40 Lec 41 Lec 42	Project Final Submission Project Final Submission (Contd.) Project Final Submission (Contd.)

Text and Ref Books:

1. A Guide to MATLAB for Beginners and Experienced Users (2nd Edition) - Brian R. Hunt Ronald L. Lipsman Jonathan M. Rosenberg with Kevin R. Coombes, John E. Osborn, and Garrett J. Stuck; Cambridge University Press (2006)
2. Sergios Theodoridis Introduction to Pattern Recognition: A Matlab Approach (1st Edition) - Sergios Theodoridis, Aggelos Pikrakis, Konstantinos Koutroumbas and Dionisis Covourous; Academic Press (2010)

CSE-445 — 3 hours in a week, 3.00 Cr.

Digital Signal Processing

Pre-requisite: None

Rationale:

This course discusses the concepts of discrete signal processing and their applications in communications, control and instrumentation.

Objective:

1. To understand the key theoretical principles underpinning DSP in a design procedure through design examples and case studies.
2. To learn how to use a powerful general-purpose mathematical package such as MATLAB to design and simulate Digital Signal Processing systems.
3. To determine the architecture of a digital signal processor and some programming issues in

fixed-point digital signal processor in real-time implementation.
4. To design a real-time signal processing algorithms using the latest fixed-point processor.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Explain the key theoretical principles underpinning DSP in a design procedure through this design examples and case study
2. Determine the architecture of a digital signal processor and some programming issues in fixed-point digital signal processor in real-time implementation.
3. Design signal processing algorithms

Course Content :
Introduction to speech, image & data processing; Discrete time signals, sequences; Linear Constant Coefficient difference equation; Sampling continuous time signals; Two dimensional sequences and systems; Z-transform, Inverse Z-transform, H-transform; Frequency domain representation, discrete time systems and signals; Fourier series and Fourier Transform; Parseval's theorem; Equivalent noise definition of bandwidth; Convolution, Correlation and method of numerical integration; Computation of the DFT: Goertzel FFT, Chirp Z-transform algorithms. Two-dimensional filter design, Quantization effects in digital filters.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Explain the key theoretical principles underpinning DSP in a design procedure through this design examples and case study	√											
Determine the architecture of a digital signal processor and some programming issues in fixed-point digital signal processor in real-time implementation.		√										
Design signal processing algorithms					√							

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to speech image & data processing	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Discrete time signals Sequences	
3	Lec 7 Lec 8 Lec 9	Linear Constant Coefficient difference equation	
4	Lec 10 Lec 11 Lec 12	Sampling continuous time signals	
5	Lec 13 Lec 14 Lec 15	Two dimensional sequences and systems	**Class Test 2**
6	Lec 16 Lec 17 Lec 18	Z-transform Inverse Z-transform H-transform	
7	Lec 19 Lec 20 Lec 21	Frequency domain representation Discrete time systems and signals	
8	Lec 22 Lec 23 Lec 24	Fourier series and Fourier Transform	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Parseval's Theorem	
10	Lec 31 Lec 32 Lec 33	Equivalent Bandwidth Noise Convolution	
11	Lec 28 Lec 29 Lec 30	Correlation Numerical integration	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Computation of the DFT	
13	Lec 37	Goertzel FFT	

	Lec 38 Lec 39	Chirp Z-transform algorithms.	
14	Lec 40 Lec 41 Lec 42	Two-dimensional filter design Quantization effects in digital filters.	

Text and Ref Books:

1. Digital Signal Processing - John G. Proakis & Dimitris Manolakis
2. Discrete-Time Signal processing - Allan Oppenheim & Ronald Schafer
3. Digital Signal Processing-A practical approach - Emmanuel C. Ifeachor Barrie W. Jervis
4. Signals and Systems - Rodger Ziemer & William Tranter

CSE-446 — 3 hours in alternate week, 0.75 Cr.
Digital Signal Processing Sessional

Pre-requisite: None

Rationale:

This course helps to better understanding of dealing with signals and processing signals for getting desired output, removing noise associate with signals.

Objective:

1. To design, simulate and implement digital signal processing systems in MATLAB
2. To design and implement a real-time signal processing algorithms using the latest fixed-point processor.

Course Outcomes (CO):

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

1. Learn how to use a powerful general-purpose mathematical package such as MATLAB to design and simulate Digital Signal Processing systems.
2. Determine the architecture of a digital signal processor and some programming issues in fixed-point digital signal processor in real-time implementation.
3. Design a real-time signal processing algorithms using the latest fixed-point processor.

Course Content:

Speech, image & data processing algorithms; Sampling continuous time signals; Z-transform, Inverse Z-transform, Frequency domain representation, Fourier series and Fourier Transform; Equivalent noise definition of bandwidth; Convolution, Correlation and method of numerical integration; Computation of the DFT: Goertzel FFT, Chirp Z-transform algorithms. Two-dimensional filter design.

Teaching-learning and Assessment Strategy:
Lectures, class performances, lab test, quiz, viva.

Assessment Methods & their Weights:

Category	Marks %
Lab test	40
Quiz	20
Viva	10
Class Performance	10
Report	10
Class Assessment	10
Total	**100**

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Learn how to use a powerful general-purpose mathematical package such as MATLAB to design and simulate Digital Signal Processing systems.									√			
Determine the architecture of a digital signal processor and some programming issues in fixed-point digital signal processor in real-time implementation.							√					
Design a real-time signal processing algorithms using the latest fixed-point processor.									√			

Lecture Schedule

Week	Lecture	Topics	Remarks
1	Lec 1 Lec 2 Lec 3	Orientation Implementing signal processing algorithm	
2	Lec 4 Lec 5	Sampling continuous time signals	Assignment on sampling

	Lec 6		
3	Lec 7 Lec 8 Lec 9	Implementing Z-transform, Inverse Z-transform	
4	Lec 10 Lec 11 Lec 12	Problem solving on noise removal using bandwidth	
5	Lec 13 Lec 14 Lec 15	Fourier Transformation of signals Assignment: Chirp Z-transform algorithms	
6	Lec 16 Lec 17 Lec 18	Lab Test	
7	Lec 19 Lec 20 Lec 21	Quiz Viva	

CSE-447 3 hours in a week, 3.00 Cr.
Telecommunication Engineering

Pre-requisite: None

Rationale:

This course motivates to design and install equipment used for transmitting wired phone, cellular, cable and broadband data as well as working with copper or fiber optic cabling, complex networks and switching systems in order to enable companies to communicate effectively with customers and deliver high standards of customer service.

Objective:
1. To perceive knowledge regarding different components and techniques of telecommunication system.
2. To specify problems and design various telecommunication system and networks for solving the respective problems.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Demonstrate theoretical and technical knowledge of telecommunications systems associated with LANs, MANs, and WANs.
2. Learn to design, implement, and manage telecommunications systems using voice and data
3. Model and simulate telecommunications systems and networks in order to identify and solve these problems.
4. Acquire the knowledge and expertise in the field of telecommunication hardware.

Course Content :

Introduction: overview of telecommunication; history, evolution, convergence of telecommunication and data networks; National and International regulatory bodies; Basic elements of Telecommunication: Telephone apparatus, microphone, speaker, ringer, pulse and tone dialing mechanism; local and central batteries and advanced systems of power supplies; Transmission media: Characteristics and applications of twisted pairs, coaxial cables and optical fibers, Terrestrial and satellite microwave, radio waves, VSAT; Telephone operating principles: telephone equipment, description of the modern phone; Telephone switching systems: PSTN, PBX, standards; Basics of communication systems: modulation, multiplexing; Switching system: circuit switching, packet switching; Traffic analysis: Traffic characterization, grades of service, network blocking probabilities, delay system and queuing; Integrated services digital network (ISDN), Digital subscriber loop (DSL), Data communication equipment: Tele-Traffic analysis; Cellular telephony: Frequency reuse, frequency management, channel alignment, handoff strategies, FDMA, TDMA, CDMA and GSM, Introduction to satellite communication, Optical fiber communication, Submarine cables, Digital Radio Microwave, etc.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
1.Demonstrate theoretical and technical knowledge of telecommunications systems associated with LANs, MANs, and WANs.	√											
2. Learn to design, implement, and manage telecommunications systems using voice and data.			√									
3. Model and simulate telecommunications systems and networks in order to identify and solve these problems.				√								
4. Acquire the knowledge and expertise in the field of telecommunication hardware.	√											

Lecture Schedule

Week	**Lecture**	**Topics**	**Class Test**
1	Lec 1 Lec 2 Lec 3	Introduction: Overview of Telecommunication History of Telecommunication Evolution of Telecommunication	
2	Lec 4	Convergence of Telecommunication	**Class Test 1**

	Lec 5 Lec 6	Data Networks Introduction: Regulatory Bodies	
3	Lec 7 Lec 8 Lec 9	National Regulatory Bodies International Regulatory Bodies International Regulatory Bodies (Contd.)	
4	Lec 10 Lec 11 Lec 12	Basic Elements of Telecommunication, Telephone Apparatus Microphone, Speaker and Ringer Pulse and Tone Dialing Mechanism, Local and Central Batteries	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Advanced Systems of Power Supplies Transmission Media Characteristics and Applications: Twisted Pairs	
6	Lec 16 Lec 17 Lec 18	Characteristics and Applications: Coaxial Cable Characteristics and Applications: Optical Fibers Terrestrial Microwave	
7	Lec 19 Lec 20 Lec 21	Satellite Microwave VSAT Radio Waves	
8	Lec 22 Lec 23 Lec 24	Telephone Operating Principles Telephone Equipment Description of a Modern Phone	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	PSTN, PBX Standards Modulation Multiplexing	
10	Lec 31 Lec 32 Lec 33	Switching System Circuit Switching Packet Switching	
11	Lec 28 Lec 29 Lec 30	Traffic Characterization Traffic Analysis Grades of Service	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	ISDN DSL Cellular Telephony	
13	Lec 37 Lec 38 Lec 39	FDMA, CDMA TDMA, GSM Introduction to Satellite Communication	
14	Lec 40 Lec 41 Lec 42	Optical Fibre Communication Submarine Cables Digital radio Microwave	

Text and Ref Books:

1. Introduction to Telecommunication: Voice, Data and the Internet (1st Edition) – Marion

Cole; Prentice Hall (2010)
2. Essential Guide to Telecommunications (5th Edition) - Annabel Z. Dodd; Prentice Hall (2012)
3. Optical Fiber Communication: Principles and Practice (3rd Edition) – John M Senior; Pearson (2010)
4. Modern Digital and Analog Communication System (4th Edition) – B P Lathi; Oxford (2011)

CSE-448 — 3 hours in a week, 3.00 Cr.
Telecommunication Engineering Sessional

Pre-requisite: None

Rationale:

This course aims provide hands on practice to design and install equipment used for transmitting wired phone, cellular, cable and broadband data as well as working with copper or fiber optic cabling, complex networks and switching systems in order to enable companies to communicate effectively with customers and deliver high standards of customer service.

Objective:

1. To perceive knowledge regarding different components and techniques of telecommunication system.
2. To specify problems and design various telecommunication system and networks for solving the respective problems.

Course Outcomes (CO):

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

1. Demonstrate theoretical and technical knowledge of telecommunications systems associated with LANs, MANs, and WANs.
2. Learn to design, implement, and manage telecommunications systems using voice and data
3. Model and simulate telecommunications systems and networks in order to identify and solve these problems.
4. Acquire the knowledge and expertise in the field of telecommunication hardware.

Course Content :

Introduction: overview of telecommunication; history, evolution, convergence of telecommunication and data networks; National and International regulatory bodies; Basic elements of Telecommunication: Telephone apparatus, microphone, speaker, ringer, pulse and tone dialing mechanism; local and central batteries and advanced systems of power supplies; Transmission media: Characteristics and applications of twisted pairs, coaxial cables and optical fibers, Terrestrial and satellite microwave, radio waves, VSAT; Telephone operating principles: telephone equipment, description of the modern phone; Telephone switching systems: PSTN, PBX, standards; Basics of communication systems: modulation, multiplexing; Switching system: circuit switching, packet switching; Traffic analysis: Traffic characterization, grades of service, network blocking probabilities, delay system and queuing; Integrated services digital network (ISDN), Digital subscriber loop (DSL), Data communication equipment: Tele-Traffic analysis; Cellular telephony: Frequency reuse, frequency management, channel alignment, handoff strategies, FDMA, TDMA, CDMA and GSM, Introduction to satellite communication, Optical fiber communication, Submarine cables, Digital Radio Microwave, etc.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, presentation, class tests, final exam.

Assessment Methods & their Weights:

Assessment Method	**(100%)**
Project	40
Quiz	20
Viva/Presentation	10
Class Participation	10
Report	10
Class Assessment	10

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
1.Demonstrate theoretical and technical knowledge of telecommunications systems associated with LANs, MANs, and WANs.							√					
2. Learn to design, implement, and manage telecommunications systems using voice and data.											√	
3. Model and simulate telecommunications systems and networks in order to identify and solve these problems.												√
4. Acquire the knowledge and expertise in the field of telecommunication hardware.												√

Lecture Schedule

Week	Lecture	Topics
1	Lec 1	Introduction: Overview of Telecommunication History of Telecommunication
	Lec 2	Evolution of Telecommunication
	Lec 3	
2	Lec 4	Convergence of Telecommunication
	Lec 5	Data Networks
	Lec 6	Introduction: Regulatory Bodies
3	Lec 7	National Regulatory Bodies
	Lec 8	International Regulatory Bodies
	Lec 9	International Regulatory Bodies (Contd.)
4	Lec 10	Basic Elements of Telecommunication, Telephone Apparatus Microphone, Speaker and Ringer
	Lec 11	Pulse and Tone Dialing Mechanism, Local and Central Batteries
	Lec 12	
5	Lec 13	Advanced Systems of Power Supplies
	Lec 14	Transmission Media
	Lec 15	Characteristics and Applications: Twisted Pairs
6	Lec 16	Characteristics and Applications: Coaxial Cable Characteristics and Applications: Optical Fibers
	Lec 17	Terrestrial Microwave
	Lec 18	
7	Lec 19	Satellite Microwave
	Lec 20	VSAT
	Lec 21	Radio Waves
8	Lec 22	Telephone Operating Principles
	Lec 23	Telephone Equipment
	Lec 24	Description of a Modern Phone
9	Lec 25	PSTN, PBX Standards
	Lec 26	Modulation
	Lec 27	Multiplexing
10	Lec 31	Switching System
	Lec 32	Circuit Switching
	Lec 33	Packet Switching
11	Lec 28	Traffic Characterization
	Lec 29	Traffic Analysis
	Lec 30	Grades of Service
12	Lec 34	ISDN
	Lec 35	DSL
	Lec 36	Cellular Telephony
13	Lec 37	FDMA, CDMA
	Lec 38	TDMA, GSM
	Lec 39	Introduction to Satellite Communication

14	Lec 40 Lec 41 Lec 42	Optical Fibre Communication Submarine Cables Digital radio Microwave

Text and Ref Books:

1. Introduction to Telecommunication: Voice, Data and the Internet (1st Edition) – Marion Cole; Prentice Hall (2010)
2. Essential Guide to Telecommunications (5th Edition) - Annabel Z. Dodd; Prentice Hall (2012)
3. Optical Fiber Communication: Principles and Practice (3rd Edition) – John M Senior; Pearson (2010)
4. Modern Digital and Analog Communication System (4th Edition) – B P Lathi; Oxford (2011)

CSE-449 — 3 hours in a week, 3.00 Cr.

Mobile and Ubiquitous Computing

Pre-requisite: None

Rationale:

This course motivates to enable computing technologies in such a way where computing is allowed to appear anytime and everywhere by studying affordances, limitations, necessary protocols, user interfaces, framework design etc. of such computing systems in order to implement them for different applications.

Objective:

1. To identify different features that helps to develop a mobile, personalized and context independent computing system.
2. To analyze the different properties and requirements that influences the development of a mobile and ubiquitous computing system.

Course Outcomes (CO):

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

1. Describe mobile wireless communication technologies and explain their functioning.
2. Explain the fundamental trade-offs related to resource limitations and communication

needs in mobile communication and sensing systems.
3. Demonstrate an understanding of the range of novel applications based upon mobile systems as well as their particular requirements

Course Content :

Introduction - Evolution of mobile computing systems, Affordances of mobile systems (ubiquitous connectivity, personalization, context awareness), Constraints of the mobile platform (wireless quality, battery limitations, UI limitations, sensing accuracy).Network and Transport Protocol for Wireless Networks, Mobile IP and Variants of TCP; Distributed Systems platforms for Mobile Computing, Proxy Based Architectures, Service Discovery, Interaction Platforms; File System support for Mobile Computing; Development in Context-aware and Ubiquitous computing; Smart Embedded devices, Information Appliance and Wearable computers; Sensing and Context Acquisition in Ubiquitous Computing; Proximity-based Networking, Communication protocol for Wireless Sensor Networks; Human Interaction in Ubiquitous Computing Environments, Tangible User Interfaces, Privacy and Security. Technological Component of Location Based Service (LBS)-WAP, GPS, Cell Based Location, 3G wireless, VXML, SMS-MMS, Personal Area Networks (802.11, Bluetooth, IRFIDs), Micro-Electro- Mechanical (MEMES), Recommender systems (Collaborative Filtering, Intelligent Agents).Android Framework, and Application structure.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
Describe mobile wireless communication technologies and explain their functioning.	√											
Explain the fundamental trade-offs related to resource limitations and communication needs in mobile communication and sensing systems.		√										
Demonstrate an understanding of the range of novel applications based upon mobile systems as well as their particular requirements.	√											

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction Evolution of Mobile Computing Systems Affordances of Mobile Systems	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Constraints of the Mobile Platform Network Protocol for Wireless Networks Transport Protocol for Wireless Networks	
3	Lec 7 Lec 8 Lec 9	Mobile IP Variants of TCP Distributed Platforms for Mobile Computing	
4	Lec 10 Lec 11 Lec 12	Proxy Based Architectures Service Discovery Interaction Platforms	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	File System Support for Mobile Computing Development of Context Aware Computing Development of Ubiquitous Computing	
6	Lec 16 Lec 17 Lec 18	Smart Embedded Device Information Appliance Wearable Computers	
7	Lec 19 Lec 20 Lec 21	Sensing Acquisition Context Acquisition Proximity Based Networking	
8	Lec 22 Lec 23 Lec 24	Proximity Based Networking (Contd.) Communication Protocol for Wireless Sensor Network Human Interaction in Ubiquitous Computing Environment	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Tangible User Interfaces Privacy and Security Privacy and Security (Contd.)	
10	Lec 31 Lec 32 Lec 33	Components of LBS-WAP Components of GPS Cell-based Location Service	
11	Lec 28 Lec 29 Lec 30	3G Wireless VXML SMS-MMS	**Class Test 4**
12	Lec 34	Personal Area Network	

	Lec 35 Lec 36	802.11 and Bluetooth IRFIDs	
13	Lec 37 Lec 38 Lec 39	Micro-electro-mechanical (MEMES) Android Framework Android Application Structure	
14	Lec 40 Lec 41 Lec 42	Recommender System Collaborative Filtering Intelligent Agents	

Text and Ref Books:

1. Context-Aware Mobile and Ubiquitous Computing for Enhanced Usability: Adaptive Technologies and Applications (1st Edition) –Dragan Stojanovic; Information Science Reference (2009)
2. Fundamentals of Mobile and Pervasive Computing (1st Edition) - Frank Adelstein,

   Sandeep KS Gupta, Golden Richard III and Loren Schwiebert; McGraw-Hill (2004)

   3. Handbook on Mobile and Ubiquitous Computing: Status and Perspective (1st Edition) - Laurence T. Yang, EviS Yukur and Seng W. Loke; CRC Press (2013)

CSE-450 — 3 hours in alternate week, 0.75 Cr.

Mobile and Ubiquitous Computing Sessional

Pre-requisite: None

Rationale:

This course motivates to use mobile communication and sensing systems based on devices which are equipped with sensors that enable the inference of the surrounding context, including the position, activity, and the environment of the user and emphasize on developing deeper understanding of the functioning of mobile wireless networks, mobile sensing, pervasive computing and applications of mobile systems.

Objective:

1. To demonstrate understanding of the technical, commercial and social issues relating to ubiquitous communications and the basics of wireless communications.
2. To develop simple wireless web applications.

Course Outcomes (CO):

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

1. Demonstrate practical skills in developing mobile sensing applications.
2. Design and create mobile application in team base with presentation.
3. Explain the range of novel applications based upon mobile systems as well as their particular requirements.

Course Content :

Evolution of mobile computing systems, Affordances of mobile systems, Network and Transport Protocol for Wireless Networks, Mobile IP and Variants of TCP, Proximity based Networking, Communication protocol for Wireless Sensor Networks.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, presentation, viva, quiz, project.

Assessment Methods & their Weights:

Assessment Method	**(100%)**
Project	40
Quiz	20
Viva/Presentation	10
Class Participation	10
Report	10
Class Assessment	10

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Demonstrate practical skills in developing mobile sensing applications.						√						
2. Design and create mobile application in team base with presentation.									√			
3. Explain the range of novel applications based upon mobile systems as well as their particular requirements.							√					

Lecture Schedule

Week	Lecture	Topics
1	Lec 1 Lec 2 Lec 3	Introduction to Mobile and Ubiquitous Computing Affordances of Mobile Systems Constraints of Mobile Platform
2	Lec 4 Lec 5 Lec 6	Wireless Fundamentals Introduction to Mobile OS - iOS, Android Android Programming
3	Lec 7 Lec 8 Lec 9	Discussion of Project Proposal Discussion of Project Proposal (Contd.) Discussion of Project Proposal (Contd.)
4	Lec 10 Lec 11 Lec 12	Android Programming - Android Framework Android Application Structure
5	Lec 13 Lec 14 Lec 15	UI components and Layouts Notification Manager and Listeners Home Assignment
6	Lec 16 Lec 17 Lec 18	Presentation on the project proposal Presentation on the project proposal Submission of a report
7	Lec 19 Lec 20 Lec 21	Local- Area Wireless Interfaces on Smartphones Details of IEEE 802.11 and Bluetooth Lab Assignment
8	Lec 22 Lec 23 Lec 24	Mobile Sensing Strategies Mobile Sensing Strategies (Contd.) Home Assignment
9	Lec 25 Lec 26 Lec 27	Show Project Update Show Project Update (Contd.) Show Project Update (Contd.)

10	Lec 31 Lec 32 Lec 33	Sensor Sampling Best Practices in Sensing Sensing position, Activity, Environment.
11	Lec 28 Lec 29 Lec 30	Communication Management in Android Java Sockets Data transfer with Android
12	Lec 34 Lec 35 Lec 36	Show Project Update Show Project Update (Contd.) Show Project Update (Contd.)
13	Lec 37 Lec 38 Lec 39	Wireless Traffic Analysis from Large Scale Data sets Call Data Record Home Assignment: Case Study
14	Lec 40 Lec 41 Lec 42	Viva Submission of Final Project Project Presentation

Text and Ref Books:

1. Handbook on Mobile and Ubiquitous Computing: Status and Perspective (1st Edition) - Laurence T. Yang, EviS Yukur and Seng W. Loke; CRC Press (2013)
2. Android Studio 3.0 Development Essentials (1st Edition) - Android 8 Edition; CreateSpace Independent Publishing Platform (2017)

CSE-451 — 3 hours in a week, 3.00 Cr.

Simulation and Modeling

Pre-requisite: None

Rationale:

This course motivates to enable a substitute of physical experimentation that is often utilized when conducting experiments on a real system which is impossible or impractical, often because of cost or time and instead uses mathematical knowledge and computer's computation power to solve real-world problems reasonably and in a time efficient manner.

Objective:

1. To recognize different parameters and variables that affects a system's simulation.
2. To design a model for a particular dataset and analyze a system's behaviour for real life problems.

Course Outcomes (CO):

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

1. Define basic concepts in modeling and simulation (M&S).
2. Classify various simulation models and give practical examples for each category.
3. Construct a model for a given set of data and motivate its validity.

Course Content :

Simulation modeling basics: systems, models and simulation; Classification of simulation model; Steps in a simulation study; Concepts in discrete-event simulation: event scheduling vs. process interaction approaches, Time-advance mechanism, organization of a discrete-event simulation model; continuous simulation models; Combined discrete-continuous models; Monte Carlo simulation; Simulation of queuing systems. Building valid and credible simulation models: validation principles and techniques, statistical procedures (or comparing real-world observations and simulation outputs, input modeling; Generating random numbers and random variants; Output analysis. Simulation languages; Analysis and modeling of some practical systems, Random Number Generator, Random Variables, Probability Distribution.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Define basic concepts in modeling and simulation (M&S).	√											
2. Classify various simulation models and give practical examples for each category.		√										
3. Construct a model for a given set of data and motivate its validity.			√									

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to Simulation Applications of Simulation System and System Environment	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Attributes of a System Types of Models Components and Organization of a Discrete Event Simulation Model	
3	Lec 7 Lec 8 Lec 9	Single Server Queuing System Performance Measure Event Routines	
4	Lec 10 Lec 11 Lec 12	Review Of Basic Probability And Statistics PDF And CDF Properties Of Random Variables	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Covariance and Correlation Jointly Continuous Random Variables Simulation of Inventory System	
6	Lec 16 Lec 17 Lec 18	Continuous Simulation Predator-Prey Model Useful Probability Distributions	
7	Lec 19 Lec 20 Lec 21	Parameterization of Continuous Distributions Continuous Probability Distribution Continuous Probability Distribution (Contd.)	
8	Lec 22 Lec 23 Lec 24	Discrete Probability Distribution Discrete Probability Distribution (Contd.) Monte Carlo Simulation	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Monte Carlo Simulation (Contd.) Generating Random Variables Random Variable Method: Inverse Transform	
10	Lec 31 Lec 32 Lec 33	Random Variable Method: Composition Random Variable Method: Convolution Random Variable Method: Acceptance - Rejection	
11	Lec 28 Lec 29 Lec 30	Random Variable Method: Acceptance - Rejection (Contd.) Mathematical Problems For Inverse Method Generating Random Variates	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Acceptance-Rejection Method For Generating Random Variates Sample Variance And Mean Central Limit Theorem	

13	Lec 37 Lec 38 Lec 39	Mathematical Problems of Central Limit Theorem Confidence Interval Test of Hypothesis And its Error	
14	Lec 40 Lec 41 Lec 42	Markov's Inequality and Chebyshev's Inequality Combined Discrete-Continuous Simulation Validation and Verification Of Simulation Model	

Text and Ref Books:

1. Simulation Modeling and Analysis (5th Edition) - Law A. M., Kelton W. D.; McGraw Hill (2014)
2. Computer Aided Modeling and simulation - J. A. Spriet
3. Computer Simulation and Modeling - R. S. Lehman
4. System Simulation - G. Cordon

3 hours in alternate week, 0.75 Cr.

CSE-452
Simulation and Modeling Sessional

Pre-requisite: None

Rationale:

This course motivates to design various models to solve real-world problems using mathematics, computer programming language, computation power etc. and analyze the behaviour of a system for different types of dataset to provide a reasonable decision regarding the performance of a system in a cost and time effective manner.

Objective:

1. To design a model for a physical experimentation using different programming languages on different platforms.
2. To analyze the the characteristics of the simulation result basing on different sets of data and test its validity.

Course Outcomes (CO):

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

1. Generate and test random number variants and apply them to develop simulation models.
2. Select and analyze output data produced by a model and test the validity of the model.
3. Construct a model for a given set of data and motivate its validity.

Course Content :
Simulation modeling basics: systems, models and simulation, Classification of simulation model, Steps in a simulation study, Single Server Queuing System, Inventory Management System, Monte Carlo Method, Pure Pursuit Problem, Probability Distribution Fitting, Random Number Generation, Hypothesis Testing.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, lab test, quiz, viva.

Assessment Methods & their Weights:

Assessment Method	(100%)
Lab Test	40
Quiz	20
Viva	10
Class Participation	10
Report	10
Class Assessment	10

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Generate and test random number variants and apply them to develop simulation models.								√		√	√	√
2. Select and analyze output data produced by a model and test the validity of the model.					√			√			√	√
3. Construct a model for a given set of data and motivate its validity.							√		√		√	

Lecture Schedule

Week	Lecture	Topics	Remarks
1	Lec 1	Simulation Modeling Basics	
	Lec 2	Systems, Models and Simulation Types	
	Lec 3	Sequence of Simulation Study	
2	Lec 4	Single Server Queuing System	
	Lec 5	Lab Assignment	
	Lec 6	Home Assignment	
3	Lec 7	Single Server Queuing System (Contd.)	
	Lec 8	Lab Assignment	
	Lec 9	Home Assignment	
4	Lec 10	Inventory Management System	
	Lec 11	Lab Assignment	
	Lec 12	Home Assignment	
5	Lec 13	Inventory Management System (Contd.)	
	Lec 14	Lab Assignment	
	Lec 15	Home Assignment	
6	Lec 16	Monte Carlo Method	
	Lec 17	Lab Assignment	
	Lec 18	Home Assignment	
7	Lec 19	Monte Carlo Method (Contd.)	
	Lec 20	Lab Assignment	
	Lec 21	Home Assignment	
8	Lec 22	Pure Pursuit Problem	
	Lec 23	Lab Assignment	
	Lec 24	Home Assignment	
9	Lec 25	Pure Pursuit Problem (Contd.)	
	Lec 26	Lab Assignment	
	Lec 27	Home Assignment	
10	Lec 31	Probability Distribution Fitting	
	Lec 32	Lab Assignment	
	Lec 33	Home Assignment	
11	Lec 28	Probability Distribution Fitting (Contd.)	
	Lec 29	Lab Assignment	
	Lec 30	Home Assignment	
12	Lec 34	Random Number Generation	
	Lec 35	Lab Assignment	
	Lec 36	Home Assignment	
13	Lec 37	Hypothesis Testing	
	Lec 38	Lab Assignment	
	Lec 39	Home Assignment	
14	Lec 40	Lab Test	
	Lec 41	Quiz	
	Lec 42	Viva	

Text and Ref Books:

1. Discrete-Event System Simulation (5th Edition) - Jerry Banks; Prentice Hall (2009)

CSE-453

Data Ware-housing and Data Mining 3 hours in a week, 3.00Cr.

Pre-requisite: NONE

Rationale:

For better data analysis, visualization and decision making concepts of data ware housing and data mining plays vital role.

Objective:

1. To evaluate accuracy of models/ algorithms, discover and measure interesting patterns from different kinds of databases of clustering, classification, association finding, feature selection and visualization to real world data.
2. To identify problems profitably be addressed via data mining methods.

Course Outcomes (CO):

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

1. Decide and evaluate models/ algorithms with respect to their accuracy.
2. Discover and measure interesting patterns from different kinds of databases. Apply the techniques of clustering, classification, association finding, feature selection and visualization to real world data.
3. Learn to identify problems that can profitably be addressed via data mining methods.

Course Content:

Introduction; Data warehousing and OLAP technology for data mining; Data preprocessing; Data mining
primitives, languages and systems; Data visualization techniques; Data Cube computation and multidimensional data analysis; Descriptive data mining: characterization and comparison; Association analysis; Classification and prediction; Cluster analysis; Mining complex types of data; Applications and trends in data mining.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Decide and evaluate models/ algorithms with respect to their accuracy		√										
Discover and measure interesting patterns from different kinds of databases. Apply the techniques of clustering, classification, association finding, feature selection and visualization to real world data.			√									
Learn to identify problems that can profitably be addressed via data mining methods.		√										

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Data warehousing and OLAP technology for data mining	
3	Lec 7 Lec 8 Lec 9	Data preprocessing	
4	Lec 10 Lec 11 Lec 12	Data mining primitives, languages and systems	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Data Visualization Techniques	
6	Lec 16 Lec 17 Lec 18	Data Cube computation	
7	Lec 19 Lec 20 Lec 21	Multidimensional data analysis	
8	Lec 22 Lec 23	Descriptive Data mining	

	Lec 24		
9	Lec 25 Lec 26 Lec 27	Characterization and comparison	**Class Test 3**
10	Lec 31 Lec 32 Lec 33	Association analysis	
11	Lec 28 Lec 29 Lec 30	Classification and prediction	
12	Lec 34 Lec 35 Lec 36	Cluster analysis	
13	Lec 37 Lec 38 Lec 39	Mining complex types of data	**Class Test 4**
14	Lec 40 Lec 41 Lec 42	Applications and trends in data mining	

Text and Ref Books:

1. Data Mining: Concepts and Techniques - Jiawei Han, MichelineKamber, and Jian Pei, (Morgan Kaufmann)
2. Data Mining and Data Warehousing - Bharat BhushanAgarwal, SumitPrakashTayal
3. Data Warehousing, Data Mining, and OLAP - Alex Berson and Stephen J. Smith

CSE-454 3 hours in alternate week, 0.75 Cr.

Data Ware-housing and Data Mining Sessional

Pre-requisite: None

Rationale:

Implementing data analysis methods, visualization and decision making concepts of data ware housing and data mining.

Objective:

1. Gain a working knowledge of the strengths and limitations of modern data mining methods (algorithms).
2. Learn to identify problems that can profitably be addressed via data mining methods.
3. Learn how to set up data for data mining experiments.

Course Outcomes (CO):

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

1. Gain a working knowledge of the strengths and limitations of modern data mining methods (algorithms).
2. Learn to identify problems that can profitably be addressed via data mining methods.
3. Learn how to set up data for data mining experiments.

Course Content:

Data warehousing and OLAP technology, Data preprocessing, Data visualization techniques, Data Cube computation and multidimensional data analysis, Association analysis; Classification and prediction; Cluster analysis; Mining complex types of data.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, lab tests, quiz, viva.

Assessment Methods & their Weights:

Assessment Method	(100%)
Lab Test	40
Quiz	20
Viva	10
Class Participation	10
Report	10
Class Assessment	10

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Gain a working knowledge of the strengths and limitations of modern data mining methods (algorithms).	√											
Learn to identify problems that can profitably be addressed via data mining methods.		√										
Learn how to set up data for data mining experiments.			√									

Lecture Schedule

Week	Lecture	Topics	Remarks
1	Lec 1 Lec 2 Lec 3	Orientation lab Practical on Data warehousing	
2	Lec 4 Lec 5 Lec 6	Implementing Data preprocessing techniques	Assignment
3	Lec 7 Lec 8 Lec 9	Implementing Data visualization techniques Implementing association analysis	Assignment
4	Lec 10 Lec 11 Lec 12	Practice on Classification and prediction;	Lab Test 1
5	Lec 13 Lec 14 Lec 15	Practice on Cluster analysis	Assignment
6	Lec 16 Lec 17 Lec 18	Final Lab Test	
7	Lec 19 Lec 20 Lec 21	Final Quiz Viva	

Text and Ref Books:

1. Data Mining: Concepts and Techniques - Jiawei Han, MichelineKamber, and Jian Pei, (Morgan Kaufmann)
2. Data Mining and Data Warehousing - Bharat BhushanAgarwal, Sumit Prak

APPLICABLE FOR CSE-16

CSE-16 has already completed up to Level-3, Term-II on the approved syllabus applicable for CSE - 15, 16 & 17 as on December 2018. From Level-4, Term-I onwards they will follow the rest of the syllabus according to the following outline.

LEVEL-4 TERM-I

3 hours in a week, 1.50 Cr.

CSE-400

Thesis

Pre-requisite: None

Rationale:

This course motivates to go neck-deep in research, synthesize it, and make a point or look at something in a different way after going through all of it.

Objective:

1. To study, analyze and provide solutions for the problems of Computer Science and Engineering.
2. To learn about the research methodology as well as technical document writing.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Select, analyze, and classify a particular field to do research.
2. Solve real life complex problems
3. Explain and describe the time-cost estimation and ethical values.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Select, analyze, and classify a particular field to do research.		√										
2. Solve real life complex problems.			√									
3. Explain and describe the time-cost estimation and ethical values.								√				

CSE-401 **3 hours in a week, 3.00 Cr.**

System Analysis, Design and Development

Pre-requisite: None

Rationale:
This course motivates to perceive information systems planning, analysis, design and implementation; graphical methods for representing information structure, practical design methodologies, database design and prototyping; communication skills, project management to solve various real life problems.

Objective:
1. To assist students develop a comprehensive understanding of how information systems are developed through the activities of systems planning, analysis, design and implementation.
2. To analyze different information systems for different real life organizational context.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Discuss the practical approaches of designing & developing Information Systems for industries/ business organizations.
2. Discover and develop awareness of Information Technological ecosystems.
3. Solve real life complex problems.

Course Content:
Different types of information; Qualities of information; Analysis o Information requirements for modern organizations; Role, tasks and attributes of a Systems Analyst; Sources of information; Information gathering techniques; Editing; Handling of missing information; Requirements specifications; Steps of systems analysis; Concepts of feasibility analysis: Analysis of technical facilities; Cost-benefit analysis; Design of an information system; Design Patterns; Hardware and software analysis; Introduction to IT project management: Estimation of confidence level: Simplex method for minimization of project time; project team organization, ; IT Adoption and Diffusion theories; Ethics and privacy: Control and security.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Discuss the practical approaches of designing & developing Information Systems for industries/ business organizations.			√									
2. Discover and develop awareness of Information Technological ecosystems.				√								
3. Solve real life complex problems.			√									

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to Systems Concepts Types and Qualities of Information Information Systems Environment	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	The Systems Development Life Cycle Analysis of Information Information Requirements for Modern Organizations	
3	Lec 7 Lec 8 Lec 9	The Role of the Systems Analyst The Tasks of the Systems Analyst The Attributes of the Systems Analyst	
4	Lec 10 Lec 11 Lec 12	Systems Planning and the Initial Investigation Sources of information Information Gathering Techniques	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Requirements Analysis Requirement Specification Steps of Requirement Analysis	
6	Lec 16 Lec 17 Lec 18	Business Process Model Data Flow Diagrams Project Effort Analysis Methods	
7	Lec 19 Lec 20 Lec 21	The Tools of Structured Analysis Feasibility Analysis Analysis of Technical Facilities	
8	Lec 22 Lec 23 Lec 24	User Interface Design Interaction Design Information Architecture	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Design of an Information System Introduction to Project Management Introduction to Project Management (Contd.)	
10	Lec 31 Lec 32	Project Time Management Estimation of Confidence Level	

	Lec 33	Network Model for Project Time Estimation	
11	Lec 28 Lec 29 Lec 30	Productivity Tools Feasibility Analysis Analysis of Technical Facilities	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Cost/Benefit Analysis IT Adoption Diffusion Theory	
13	Lec 37 Lec 38 Lec 39	Project Risk Management Project Team Organization Estimation of confidence level	
14	Lec 40 Lec 41 Lec 42	Information System Security Ethics and Privacy Control and Security	

Text and Ref Books:

1. System Analysis and Design (2nd Edition) - Elias M. Awad; Galgotia Publications Pvt. Ltd. (2010)
2. System Analysis and Design (2nd Edition) - Raja Raman; Prentice Hall (2004)
3. System Analysis and Design Methods (7th Edition) - Jeffery L. Whitten; McGraw Hill (2007)
4. System Analysis and Design (9th Edition) - Kendel & Kendel; Pearson (2013)

CSE-403 — 3 hours in a week, 3.00 Cr.

Artificial Intelligence

Pre-requisite: None

Rationale:
Artificial intelligence is the beginning of revolution for rational behavior of intelligent agents along with representation, planning, learning and perception of knowledge.

Objective:
1. To discuss and distinguish the notions of rational behavior and intelligent agents.
2. To develop a general appreciation of the goals, subareas, achievements and difficulties of AI.
3. To have knowledge of methods of blind as well as informed search in case of knowledge representation, planning, learning, robotics and other AI areas and ability to practically apply the corresponding techniques.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Discuss and distinguish the notions of rational behavior and intelligent agents.

2. Develop a general appreciation of the goals, subareas, achievements and difficulties of AI.
3. Analysis methods of blind as well as informed search and ability to practically apply the corresponding technıques.

Investigate of major concepts and approaches in knowledge representation, planning, learning, robotics and other AI areas.

Course Content:

Overview of AI, Knowledge representation, LISP/Prolog and other Al programming languages; Review of Uninformed Search Strategies and game playing; Informed search Strategies: A*, Heuristic functions, Memory Bounded Search (IDA*, SMA*); Iterative improvement Search, constraint satisfaction problems. Review of Propositional logic, first order Logic, Introduction to Planning, Partial Order Planning. Bayesian Rule and its use in probabilistic reasoning; Belief Networks and Decision Networks; Learning Decision Trees; Learning General Logical descriptions-Hypothesis. Introduction to Natural Language Processing.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Discuss and distinguish the notions of rational behavior and intelligent agents.	√											
2. Develop a general appreciation of the goals, subareas, achievements and difficulties of AI.			√									
3. Have knowledge of methods of blind as well as informed search and ability to practically apply the corresponding technıques.		√										
4. Have general understanding of major concepts and approaches in knowledge representation, planning, learning, robotics and other AI areas.				√								
5. Develop programming skills for AI applications.	√											

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to AI Uninformed Search I	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Uninformed Search II Informed Search I	
3	Lec 7 Lec 8 Lec 9	Informed Search II	
4	Lec 10 Lec 11 Lec 12	Beyond Classical Search	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Adversarial Search I	
6	Lec 16 Lec 17 Lec 18	Adversarial Search II Constraint Satisfaction Problems I	
7	Lec 19 Lec 20 Lec 21	Constraint Satisfaction Problems II	
8	Lec 22 Lec 23 Lec 24	Uncertainty and Probabilities	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Markov Models (MM), Hidden MM (HMM)	
10	Lec 31 Lec 32 Lec 33	Bayes Net	
11	Lec 28 Lec 29 Lec 30	ML: Naive Bayes	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	ML: Perceptions ML: Kernels and Clustering	
13	Lec 37 Lec 38 Lec 39	Advanced Applications: NLP, Games and Cars	
14	Lec 40 Lec 41 Lec 42	Advanced Applications: (Robotics and Computer Vision)	

Text and Ref Books:

1. Artificial Intelligence: A Modern Approach (3rd Edition) – Stuart Jonathan Russell, Peter Norvig; Prentice Hall (2010)
2. Artificial Intelligence: A New synthesis – Nils J. Nilsson; Routledge

CSE-404 3.00 hour in alternative week, 0.75 Cr.

Artificial Intelligence Sessional

Pre-requisite: None

Rationale:
Hands on orientation with AI programming, intelligent agents along with how to representation, planning, learning and perception of knowledge of agents.

Objective:

1. To have general understanding of major concepts and approaches in knowledge representation, planning, learning, robotics and other AI areas.
2. To develop programming skills for AI applications and explore traditional AI techniques and algorithms.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Have general understanding of major concepts and approaches in knowledge representation, planning, learning, robotics and other AI areas.
2. Develop programming skills for AI applications.
3. Exposure to traditional AI techniques and algorithms.

Course Contents:
Hands on orientation with AI programming, intelligent agents along with representation, planning, learning and perception of knowledge of agents.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Assessment Methods & their Weights:

Assessment Method	(100%)
Project	40
Quiz	20
Viva/Presentation	10
Class Participation	10
Report	10
Class Assessment	10

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Have general understanding of major concepts and approaches in knowledge representation, planning, learning, robotics and other AI areas.							√					
Develop programming skills for AI applications.								√				
Exposure to traditional AI techniques and algorithms.											√	

Lecture Schedule

Week	Lecture	Topics
1	Lec 1 Lec 2 Lec 3	Orientation with AI practical areas A* search algorithm implementation
2	Lec 4 Lec 5 Lec 6	Problem solving using A* search Assignment on A* search
3	Lec 7 Lec 8 Lec 9	Project Idea Approval
4	Lec 10 Lec 11 Lec 12	Orientation of Prolog Problem solving using prolog
5	Lec 13 Lec 14 Lec 15	Introduction with swift programming Problem solving using swift programming Project Progress
6	Lec 16 Lec 17 Lec 18	Implementation of CSP Problem solving using CSP
7	Lec 19 Lec 20 Lec 21	Final Quiz and Viva Project Final Submission and Presentation

CSE-405 **3 hours in a week, 3.00 Cr.**

Computer Interfacing

Pre-requisite: None

Rationale:

This course introduces basic concepts and techniques for interfacing a microcontroller or microprocessor to external devices for data collection and process control and developing the related software required. It is aimed at students interested in data acquisition and real-time control systems, design and construct simple control, data logging system incorporating input/output to and from external devices and design simple control system for stepper and DC motor.

Objective:

1. To enable the students familiar to interface external components (peripherals, sensors, PPIs, PICs etc.) with computer systems.
2. To enhance the knowledge on basic working principle and different applications of basic microcomputer and microcontroller.
3. To enable the students capable of designing and constructing simple control system incorporating input/output to and from external devices.

Course Outcomes (CO):

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

1. Describe how to interface different types of external components (peripherals, sensors, PPIs, PICs etc.) with computer systems.
2. Escalate the capability of designing and constructing simple control system incorporating input/output to and from external devices.
3. Analyze the basic working principle of basic microcomputer, microcontroller and enhance applications of different hardware components.

Course Content:

I/0 system; I/O devices, designing I/O systems; Programmable peripheral interface (interface to A/D and D/A converter); keyboard/display interface; Programmable timer; data acquisition systems, Optical interrupters and couplers, incremental encoders, interfacing; Programmable interrupt controller, DMA controller; floppy and hard-disk controller; serial communication interface; ISA. PCI, AGP, PS/2 and USB interface; Interfacing with power circuits, stepper motors, opto-isolation; controlling semiconductor power switches MOSFET, BJT. SCR. Triac and Solenoids; temperature, pressure, light sensors and transducers; Application of Opto-coupler and relays; Embedded Communication Systems, Embedded Computer Security.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Describe how to interface different types of external components (peripherals, sensors, PPIs, PICs etc.) with computer systems	√											
2. Escalate the capability of designing and constructing simple control system incorporating input/output to and from external devices			√									
3. Analyze the basic working principle of basic microcomputer, microcontroller and enhance applications of different hardware components		√										

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Parallel data transfer, parallel printer interface, Keyboard Interface, Display Interface,I/0 system; I/O devices, designing I/O systems	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Interfacing to high power devices, Interface to AC power devices, interfacing to stepper motor	
3	Lec 7 Lec 8 Lec 9	D/A Applications and Interfacing to Microcomputers, A/D converters Specifications/types,	
4	Lec 10 Lec 11 Lec 12	Microcomputers based Scale, Microcomputers based industrial Process Control System , PID Controller	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Triac and Solenoids; temperature, pressure, light sensors and transducers	
6	Lec 16 Lec 17 Lec 18	D/A Converter Operation and Specifications, ISA. PCI, AGP, PS/2 and USB interface	

7	Lec 19 Lec 20 Lec 21	Embedded Communication Systems, Embedded Computer Security	
8	Lec 22 Lec 23 Lec 24	Data Highways, Computer I/O Operations, Programmed I/O, Interrupts, Vectored Interrupt, Priority Interrupts using Priority Encoder ,Priority Interrupt using a Daisy Chain	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Block Data Transfer, DMA, Parallel Interface, SCSI, Serial Interface- Synchronous and Asynchronous Transmission	
10	Lec 31 Lec 32 Lec 33	DMA Controller 8257,RS232, null modem connection, line drivers, Single-ended Transmission, balanced transmission, differential receiver	
11	Lec 28 Lec 29 Lec 30	Disc and tape storage, Recording on a Magnetic surface, Magnetic Disc Formats, zoning, Interleaving, Magnetic recording Code, Recording Codes, Run-length limited (RLL),	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Disc formatting, Track seeking, Sector Location, Optical Storage, Forms of Optical Disc storage, Optical Reading Mechanism	
13	Lec 37 Lec 38 Lec 39	CD-ROM Optical Disks, WORM, Optical Positioning, Magneto Optical Disk, Performance Enhancers	
14	Lec 40 Lec 41 Lec 42	Memory Interfacing, Memory Space Management	

Text and Ref Books:

1. The Intel Microprocessors (8th Edition) - Barry B Brey; Pearson (2008)
2. Microprocessors and Interfacing (2nd Edition) - Douglas V Hall; McGraw Hill (2005)
3. Computer Peripherals (3rd Edition) - Cook and White; Butterworth-Heinemann (1995)

CSE-407 **3 hours in a week, 3.00 Cr.**

Applied Statistics and Queuing Theory

Pre-requisite: None

Rationale:

To provide in deep idea of working with data sets and impact of data sets as well as application of queuing models in Computer Science domain.

Objective:

1. To discuss the theories of applied statistics.
2. To select the practical applications in the field of Information Technology and explain the real life applications of statistics.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:
1. Discuss the theories of applied statistics.
2. Select the practical applications in the field of Information Technology.
3. Explain the real life applications of statistics.

Course Content:

Introduction; Frequency distribution, Mean, median, Mode and other measure of central tendency standard deviation and other measure of dispersion, Moments, Skewness and kurtosis, Elementary probability theory, Characteristics of distributions, elementary sampling theory, Estimation, Hypothesis testing and regression analysis. Probability distribution and expectations, discontinuous probability distribution, e.g. binomial, position and negative binomial. Continuous probability distributions, e.g. normal and exponential. Queuing Theory: Stochastic processes, Discrete time Markov chain and continuous time Markov Chain. birth-death process in queuing. Queuing models: M/M/1,M/M/C,M/G/1,M/D/1,G/M/1 solution of network of queue-closed queuing models and approximate models. Application of queuing models in Computer Science.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Discuss the theories of applied statistics.	√											
Select the practical applications in the field of Information Technology.		√										
Explain the real life applications of statistics.						√						

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction Frequency distribution	
2	Lec 4 Lec 5 Lec 6	Central Tendency Mean, median, Mode	
3	Lec 7 Lec 8 Lec 9	Standard deviation Dispersion	**Class Test 1**
4	Lec 10 Lec 11 Lec 12	Moments Skewness and kurtosis	
5	Lec 13 Lec 14 Lec 15	Elementary probability theory Characteristics of distributions	
6	Lec 16 Lec 17 Lec 18	Elementary sampling theory Estimation	**Class Test 2**
7	Lec 19 Lec 20 Lec 21	Hypothesis testing and regression analysis	
8	Lec 22 Lec 23 Lec 24	Probability distribution Expectations	
9	Lec 25 Lec 26 Lec 27	Discontinuous probability distribution Binomial distribution Position and negative binomial distribution	**Class Test 3**
10	Lec 31 Lec 32 Lec 33	Continuous probability distributions Normal Distribution Exponential Distribution	
11	Lec 28 Lec 29 Lec 30	Queuing Theory: Stochastic processes Discrete time Markov chain	
12	Lec 34 Lec 35 Lec 36	Continuous time Markov Chain Birth-death process in queuing	
13	Lec 37 Lec 38 Lec 39	Queuingmodels: M/M/1,M/M/C,M/G/1,M/D/1,G/M/1 Queue-closed queuing models	**Class Test 4**
14	Lec 40 Lec 41 Lec 42	Approximate models Application of queuing models	

Text and Ref Books:

1. Applied Statistics - Rebecca (Becky) M. (Margaret) Warner
2. Applied Statistics for Engineers and Scientists - Jay L. Devore and Nicholas R. Farnum
3. An Introduction to Queuing Theory - U. Narayan Bhat
4. Probability, Markov Chains, Queues, and Simulation: The Mathematical Basis of Performance Modeling - William J. Stewart

CSE-460 9 hours in alterative weeks, 2.25 Cr.

Integrated Design Project/Capstone Project 1

Pre-requisite: CSE 105, CSE 203, CSE 215, CSE 205 and their corresponding sessionals and CSE 220.

Rationale:
Culminating demonstration of skills and knowledge achieved to date to apply and solve real life problems solvable through computer technology.

Objective:

To apply technical knowledge and skills for further research and design of computer system at professional engineering scale.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:
1. Develop systems' requirement specification from top-level customer requirements.
2. Analyse and compare design alternatives, at the system and subsystem levels, and use measures of performance or other criteria to rank alternatives.
3. Plan and organize an engineering design project using tools such as Gantt charts to develop a work breakdown structure, develop a schedule including milestones, and estimate effort and costs incorporating the ethical, financial and environmental issues.
4. Develop a design concept and elaborate it through to a detailed design by decomposing a system concept into component subsystems, identifying the subsystem requirements and applicable standards, and defining interfaces between the subsystems.
5. Build prototypes of key subsystems.

Course Content:
<u>Knowledge Acquisition:</u>

Introduction and brief with software (Advance tool), Discussion and submission Project Proposal, Learning Version Control System: Github, Interface design, Database Connectivity: Sqlite, Json, Cloud, Firebase database, Google Api, Sensor.

<u>Implementation:</u>

Idea Submission, Objective, Methodology, Literature Review, High Level Design, Low Level Design, Evaluation and feedback, Design & Partial Implementation (Prototype/Demo).

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, rubrics on problem analysis, literature review and designing prototype.

Assessment Methods & their Weights:

Assessment Method	(100%)
Project	40
Quiz	20
Viva/Presentation	10
Class Participation	10
Report	10
Class Assessment	10

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Develop system requirements from top-level customer requirements.	√	√				√						
Analyse and compare design alternatives, at the system and subsystem levels, and use measures of performance or other criteria to rank alternatives.		√	√		√							
Plan and organize an engineering design project using tools such as Gantt charts to develop a work breakdown structure, develop a schedule including milestones, and estimate effort and costs.				√		√						
Develop a design concept and elaborate it through to a detailed design by decomposing a system concept into component subsystems, identifying the subsystem requirements and applicable standards, and defining interfaces between the subsystems			√	√								
Build prototypes of key subsystems.					√				√			

Lecture Schedule

Week	Topics	Remarks
1	Introduction and brief with software (Advance tool)	
2	Learning Version Control System: GitHub	
3	Interface Design, activity and navigation.	
4	Database Connectivity: SQLite, JSON, Cloud* Firebase database	
5	Google Api	
6	Sensor	
7	Database Integration with the application	
8-9	Topic Selection and Project Plan	
10-11	Objective, Methodology, Literature Review	
12-14	Design & Partial Implementation (Prototype/Demo)	

Text and Ref Books:

1. Android Programming: The Big Nerd Ranch Guide (3rd Edition) (Big Nerd Ranch Guides) 3rd Edition
2. Professional Android, Reto Meier, Ian Lake; 4th Edition

CSE-4XO 3 hours in a week, 3 Cr.
Option-I

LEVEL-4 TERM-II

CSE-400 **6 hours in a week, 3.00 Cr.**

Thesis

Pre-requisite: None

Rationale:

This course motivates to go neck-deep in research, synthesize it, and make a point or look at something in a different way after going through all of it.

Objective:

To study, analyze and provide solutions for the problems of Computer Science and Engineering.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Select, analyze and classify a particular field to do research.
2. Solve real life complex problems
3. Explain and describe the time-cost estimation and ethical values.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Select, analyze and classify a particular field to do research.		√										
2. Solve real life complex problems.			√									
3. Explain and describe the time-cost estimation and ethical values.								√				

CSE-411 **3 hours in a week, 3.00 Cr.**

VLSI Design

Pre-requisite: None

Rationale:
This course motivates to enhance the ability to design large integrated digital electronic circuits using various logic and circuit design techniques and contribute to the electronics engineering and have a better understanding of different characteristics of such circuits.

Objective:
1. To recognize different logical components as well as their interconnection and design various integrated electronic circuits to perform certain digital functions.
2. To study and analyze different properties, behaviour and performance metrics of different integrated digital electronic circuits.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Describe mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnection.
2. Select, analyze and create models of moderately sized CMOS circuits that realize specified digital functions.
3. Solve and apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality, timing, power, and parasitic effects.
4. Have an understanding of the characteristics of CMOS circuit construction and the comparison between different state-of-the-art CMOS technologies and processes.
5. Enhance one’s ability to complete a significant VLSI design project, having a set of objective criteria and design constraints.

Course Content :
VLSI design methodology: Top-down Design Approach, Technology Trends and Design Automation Algorithms; Introduction to CMOS Inverters and Basic Gates; CMOS Fabrication Process and Layout; CMOS Circuit Characteristics and Performance Estimation; Buffer Circuit Design; Introduction Bi-CMOS Circuits; Complex CMOS Gates; CMOS layout design rules, CMOS Building Blocks - Adder, Comparator, Multiplier, Counter, and Shifter; Data Path and Memory structures. Design Methodology and Tools; PLA, FPGA, cell-based and full custom design methods, System-on chip design, Hardware modeling - Hardware Modeling Languages, Logic Networks, State Diagrams, Data-flow and Sequencing Graphs, Behavioral Optimization; Floor Planning and Architecture Design.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, presentation, class tests, final exam.

Assessment Methods & their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Class Participation	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Describe mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnection.	√											
2. Select, analyze and create models of moderately sized CMOS circuits that realize specified digital functions.		√	√									√
3. Solve and apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality, timing, power, and parasitic effects.			√			√					√	√
4. Have an understanding of the characteristics of CMOS circuit construction and the comparison between different state-of-the-art CMOS technologies and processes.						√	√			√		
5. Enhance one's ability to complete a significant VLSI design project, having a set of objective criteria and design constraints.						√		√			√	√

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to VLSI design diodes, BJTs and MOSFETs NMOS and CMOS	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Internal Structure of MOSFETs Hierarchical Design Inverter Principles	
3	Lec 7 Lec 8 Lec 9	Threshold Voltage Ids Calculation for Saturation Region Ids Calculation for Resistive Region	
4	Lec 10 Lec 11	Characteristics Curves Characteristics Curves (Contd.)	**Class Test 2**

	Lec 12	NMOS Inverter with Resistive Load	
5	Lec 13 Lec 14 Lec 15	NMOS Inverter with Enhancement Load Inverter Ratio for NMOS Inverter with Enhancement Load Problems with Enhancement Transistor	
6	Lec 16 Lec 17 Lec 18	NMOS Inverter with Depletion Load Rise Time Calculation Fall Time Calculation	
7	Lec 19 Lec 20 Lec 21	CMOS Characteristics Curve CMOS Power and Transfer Curve Pass Transistor Principles	
8	Lec 22 Lec 23 Lec 24	Pass Transistor NMOS Ratioless NMOS Inverter CMOS Pulse Gate	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Buffer Circuits Buffer Chain Super Buffer	
10	Lec 31 Lec 32 Lec 33	Power Dissipation Static Power Dissipation Dynamic Power Dissipation	
11	Lec 28 Lec 29 Lec 30	Short Circuit Power Dissipation CMOS Noise Margin CMOS Noise Margin (Contd.)	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	NMOS Noise Margin NMOS NAND and NOR Gates CMOS NAND and NOR Gates	
13	Lec 37 Lec 38 Lec 39	Stick Diagrams Design Rules of Geometric Layout Circuit Design using Stick Diagrams and Geometric Layout	
14	Lec 40 Lec 41 Lec 42	n-well Formation Oxide Layer Formation Cross Section of CMOS	

Text and Ref Books:

1. Modern 1.Modern VLSI Design: System-on-Chip Design (3rd Edition) - Wayne Wolf; Prentice Hall (2002)
2. CMOS VLSI Design- A Circuit and System Perspective (3rd Edition) - Neil H.E. Weste, David Harris and Ayan Banerjee; Pearson (2009)

CSE-413 3 hours in a week, 3.00 Cr.

Computer Graphics

Pre-requisite: None

Rationale:
Motivates to enhance the ability in order to rapidly visualize, design and modify different types of shapes, structures and images interactively that is absolutely mandatory in the field of engineering and imaging technology.

Objective:
1. To provide a comprehensive introduction to computer graphics leading to the ability to understand contemporary terminology, progress, issues, and trends.
2. To introduce computer graphics techniques, focusing on 3D modeling, image synthesis, and rendering.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Discuss the algorithmic and mathematical tools used to create a variety of digital images and effects.
2. Demonstrate three main subjects within computer graphics, modeling, rendering, and animation.
3. Select and analyze fundamentals such as digital image representation, color perception, image formation and image processing.

Course Content :
Introduction to computer graphics and its applications; Principles of raster image generation; Light and Color models; Example of a graphics API; Graphics primitives; Graphics hardware; Graphics pipeline; Coordinate convention; Scan conversion; Clipping; Modeling transformations; Viewing transformations; Projection transformations; Polygons and polygon meshes; Curves and surfaces; Hidden lines and surface removal; Introduction to rendering including shading models, textures, ray tracing, and radiosity; Introduction to computer animation and kinematics; Fractals; Graphics programming using OpenGL 4.0 and above.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Discuss the algorithmic and mathematical tools used to create a variety of digital images and effects.	√											
2. Demonstrate three main subjects within computer graphics, modeling, rendering, and animation.				√								
3. Select and analyze fundamentals such as digital image representation, color perception, image formation and image processing.		√										

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to Computer Graphics Applications of Computer graphics Standard Graphics Primitives	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Principles of Raster Image Generation Graphics Hardware Graphics Pipeline	
3	Lec 7 Lec 8 Lec 9	Coordinate Convention Scan Convention Example of a Graphics API	
4	Lec 10 Lec 11 Lec 12	Introduction to OpenGL Graphics Programming Graphics Programming (Contd.)	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Point Clipping Line Clipping Polygon Clipping	
6	Lec 16 Lec 17 Lec 18	Modeling Transformations Modeling Transformations (Contd.) Modeling Transformations (Contd.)	
7	Lec 19 Lec 20 Lec 21	Viewing Transformations Viewing Transformations (Contd.) Viewing Transformations (Contd.)	
8	Lec 22 Lec 23 Lec 24	Projection Transformations Projection Transformations (Contd.) Projection Transformations (Contd.)	

			Class Test 3
9	Lec 25 Lec 26 Lec 27	Polygons Polygons (Contd.) Polygon Meshes	
10	Lec 31 Lec 32 Lec 33	Curves Surfaces Surfaces (Contd.)	
11	Lec 28 Lec 29 Lec 30	Introduction to Shading Models Rendering Hidden Lines and Surface Removal	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Introduction to Computer Animation Kinematics Fractals	
13	Lec 37 Lec 38 Lec 39	Textures Ray Tracing Radiosity	
14	Lec 40 Lec 41 Lec 42	Color Perception Color Models Light Models	

Text and Ref Books:

1. Theory and Problems of Computer Graphics (3rd Edition) – Zhigang Xiang, Roy A. Plastock; McGraw Hill (2000)
2. Computer Graphics C Version (3rd Edition) – Donald Hearn, M. Pauline Baker; Pearson Prentice Hall (2004)
3. Computer Graphics Principle and Practice (3rd Edition) – Donald Hearn, M. Pauline Baker; Addison-Wesley Professional (2013)

CSE-414 **3 hours in alternate week, 0.75 Cr.**

Computer Graphics Sessional

Pre-requisite: None

Rationale:

This course motivates to develop and modify 2D and 3D visualization and transformation of any geometric object by using graphics library as well as working with texturing, lighting and coloring of such objects to develop different types of digital images with various effects.

Objective:

1. To develop 2D, 3D and animation graphics project using OpenGL graphics library.
2. To develop projects using lighting, coloring and texturing techniques.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Achieve a basic idea about OpenGL graphics library.
2. Design and develop 2D and 3D graphical geometric objects using OpenGL.
3. Learning simple animation, lighting, coloring and texturing.

Course Content :
Introduction to OpenGL, Drawing 2D geometric object, Simple 2D animation and modeling transformation, Drawing 3D geometric object, Viewing transformation and Texturing and lighting.

Teaching-learning and Assessment Strategy:
Lectures, class performances, project, assignment, viva, presentation, quiz.

Assessment Methods & their Weights:

Assessment Method	(100%)
Project	40
Quiz	20
Viva/Presentation	10
Class Participation	10
Report	10
Class Assessment	10

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Achieve a basic idea about OpenGL graphics library.							√					
2. Design and develop 2D and 3D graphical geometric objects using OpenGL.						√						
3. Learning simple animation, lighting, coloring and texturing.									√			

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to OpenGL (GLSL) Discussion on Project 1 Discussion on Project 1 (Contd.)	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Programming with OpenGL (GLSL) Lab Assignment Home Assignment	
3	Lec 7 Lec 8 Lec 9	Programming with OpenGL (GLSL) (Contd.) Lab Assignment Home Assignment	
4	Lec 10 Lec 11 Lec 12	Introduction to Animation (with Blender) Animation Project Discussion Animation Project Discussion (Contd.)	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Project 1 Demo and Submission Project 1 Demo and Submission (Contd.) Project 1 Demo and Submission (Contd.)	
6	Lec 16 Lec 17 Lec 18	Discussion on Project 2 Discussion on Project 2 (Contd.) Discussion on Project 2 (Contd.)	
7	Lec 19 Lec 20 Lec 21	Discussion on Project 2 Discussion on Project 2 (Contd.) Discussion on Project 2 (Contd.)	
8	Lec 22 Lec 23 Lec 24	Animation Project Submission Animation Project Submission (Contd.) Report Submission	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Animation Project Submission Animation Project Submission (Contd.) Report Submission	
10	Lec 31 Lec 32	Project 2 Initial Demo Project 2 Initial Demo (Contd.)	

	Lec 33	Project 2 Initial Demo (Contd.)	
11	Lec 28 Lec 29 Lec 30	Project 2 Initial Demo Project 2 Initial Demo (Contd.) Project 2 Initial Demo (Contd.)	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Project 2 Final Demo and Submission Project 2 Final Demo and Submission (Contd.) Project 2 Final Demo and Submission (Contd.)	
13	Lec 37 Lec 38 Lec 39	Project 2 Final Demo and Submission Project 2 Final Demo and Submission (Contd.) Project 2 Final Demo and Submission (Contd.)	
14	Lec 40 Lec 41 Lec 42	Quiz Viva Viva (Contd.)	

Text and Ref Books:

1. OpenGL Programming Guide: The Official Guide to Learning OpenGL (8th Edition) - Dave Shreiner, Graham Sellers, John Kessenich and Bill Licea-Kane; Addison Wesley Professional (2013)

CSE-417 — 3 hours in a week, 3.00 Cr.

Engineering Management

Pre-requisite: None

Rationale:
This course motivates engineers to perform under a standard of professional behavior that requires adherence to the highest principles of ethical conduct and manage the resources and decisions effectively. It elevates the profession and raises future standards and imprints on individual moral mindsets and behaviors.

Objective:
1. To identify and analyze practical legal problems commonly encountered in computing industry and formulate solutions to some of the legal problems.
2. To gain the ability to continue professional development with an understanding of the legal issues, and to critically assess the codes of professional conduct for computer professional.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Demonstrate awareness of different management and control frameworks and their impact on the Project Management discipline.
2. Solve and apply cognitive skills and ability to identify, analysis, and articulate the importance of team building, project risk, and time cost management.

3. Using management software to help plan and manage information technology projects.
4. Explain the theoretical aspects of 'ethics', 'social norms', 'virtues', 'values', 'legal bindings in professional fields' etc.

Course Content:
Engineering Management: Introduction to Project Management; Principles of management, Project Integration Management; Project Scope Management; Project Time Management; Project Cost Management; Project Quality Management; Project Human Resource Management; Project Communications Management; Project Risk Management; Project Procurement Management; MIS: Introduction, Decision Support Systems, MIS in decision making, Development of communication skills. Concept of Invention, Innovation, and Entrepreneurship.
Engineering Ethics: Introduction to Ethics. Theories of Ethics. Principles of Engineering Ethics.
Obligation of an engineer to the clients. Ethical expectation: Employers and employees, inter-professional relationship, Professional Organizations, standards and codes: Fundamental Canons, NSPE codes, IEEE codes of conduct, ACM codes; Institutionalization of ethical conduct. Ethical Dilemmas, Choices (Whistle Blowing), Moral framework for resolving Ethical dilemmas, Computer Ethics: Computer Crime and Cyber Security, Privacy and Confidentiality issue in CSE, Legal Framework in CSE-Copyright laws, ICT Act, Right To Information (RTI), Patents, Royalty etc. Ethical Challenges for CSE Engineers with the advancement of Technology; Case studies related to ethical issues in ICT and other Engineering disciplines.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Demonstrate awareness of different management and control frameworks and their impact on the Project Management discipline.				√								
2. Solve and apply cognitive skills and ability to identify, analysis, and articulate the importance of team building, project risk, and time cost management.		√										
3. Using management software to help plan and manage information technology projects.					√							
4. Explain the theoretical aspects of 'ethics', 'social norms', 'virtues', 'values', 'legal	√											

bindings in professional fields' etc.												

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to Engineering Management Importance of Engineering Management (Contd.) Importance of Engineering Management	
2	Lec 4 Lec 5 Lec 6	Introduction to Project Management Introduction to Project Management (Contd.) Principles of Management	**Class Test 1**
3	Lec 7 Lec 8 Lec 9	Project Integration Management Project Scope Management Project Time Management	
4	Lec 10 Lec 11 Lec 12	Project Cost Management Project Quality Management Project Human Resource Management	
5	Lec 13 Lec 14 Lec 15	Project Communication Management Project Risk Management Project Procurement Management	**Class Test 2**
6	Lec 16 Lec 17 Lec 18	Introduction to MIS Decision Support System MIS in Decision Making	
7	Lec 19 Lec 20 Lec 21	Development of Communication Skill Concept of Invention and Innovation Concept of Entrepreneurship	
8	Lec 22 Lec 23 Lec 24	Introduction to Ethics Theories of Ethics Principles of Engineering Ethics	
9	Lec 25 Lec 26 Lec 27	Ethical expectation Employers and Employees Relationship Obligation of an Engineer to Clients	**Class Test 3**
10	Lec 31 Lec 32 Lec 33	Professional Organization: IEEE, ACM Standards and Codes Institutionalization of Ethical Conduct	
11	Lec 28 Lec 29 Lec 30	Ethical Dilemmas Choices (Whistle Blowing) Moral framework for resolving Ethical dilemmas	**Class Test 4**
12	Lec 34 Lec 35	Computer Crime and Cyber Security Privacy and Confidentiality Issue in CSE	

	Lec 36	Legal Framework in CSE-CopyRight laws	
13	Lec 37 Lec 38 Lec 39	ICT Act Right To Information (RTI) Patents and Royalty	
14	Lec 40 Lec 41 Lec 42	Ethical Challenges for CSE Engineers Case Studies Regarding Ethical Issues in ICT Case Studies Regarding Ethical Issues in ICT	

Text and Ref Books:

1. Engineering Ethics Concepts and Cases (2nd Edition) - Charles E. Harris. Jr. , Michael S. Pritchard , Michael J. Rabins; Wadsworth Cengage Learning (2009)
2. Introduction to Engineering Ethics (3rd Edition) - Schinzinger and Martin; McGraw Hill (2000)

CSE-462 — 3 hours in alternating week, 0.75 Cr.

Integrated Design Project/Capstone Project 2

Pre-requisite: CSE 460

Rationale:
Culminating demonstration of skills and knowledge achieved to date to apply and solve real life IT dependent problems using computer technology.

Objective:

Objective of this course is to combine engineering theory with rigorous research in design and development of computerized system considering the contextual ethical, financial and environmental issues.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Design appropriate tests to measure and evaluate the performance of prototype subsystems to determine whether they meet performance and interface requirements considering ethical, financial and environmental issues and recommend changes.
2. Constructively contribute to the accomplishments of a multidisciplinary team, including critical evaluation of self and team-member performance.
3. Communicate the team’s logistical and technical approaches to the design project in a polished, co-authored, written proposal, using language and graphics appropriate to the technical discipline.
4. Succinctly report individual and team performance against the plan.
5. Describe organizational and technical plans and progress in oral presentations, using high-quality, informative, graphical and textual elements.

Course Content:

Knowledge Acquisition: Information gathering techniques, Design of an information system; Hardware components, pin configurations of microcontroller, peripherals, Sensors, PPIs, PICs, Use of Arduino, Raspberry Pi;

Implementation: Concept development, prototype enhancement, complete implementation, unit testing and integration testing with verification, feedback and improvement, result analysis and performance evaluation, report writing, paper submission, presentation and final evaluation.

Teaching-learning and Assessment Strategy:

Lectures, performances, assignments, rubrics on prototype design, implementation and report submission.

Assessment Methods & their Weights:

Assessment Method	**(100%)**
Project	40
Quiz	20
Viva/Presentation	10
Class Participation	10
Report	10
Class Assessment	10

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
Design appropriate tests to measure and evaluate the performance of prototype subsystems to determine whether they meet performance and interface requirements considering ethical, financial and environmental issues and recommend changes.			√				√	√				
Constructively contribute to the accomplishments of a multidisciplinary team, including critical evaluation of self and team-member performance.									√	√	√	
Communicate the team's logistical and technical approaches to the design project in a polished, co-authored, written proposal, using language and graphics appropriate to the technical discipline.										√		√

Succinctly report individual and team performance against the plan.										√		
Describe organizational and technical plans and progress in oral presentations, using high-quality, informative, graphical and textual elements.											√	√

Lecture Schedule

Week	Lecture	Topics	Remarks
1	Lec 1-2	Orientation Information gathering techniques	
2	Lec 3-4	Approval of Conceptual development of proposed project Hands on session on designing information system	Project Plan
3	Lec 5-6	Hands on session on hardware components and microcontroller Designing Prototype	Prototype Design
4	Lec 7-8	Hand on session on Arduino, Programming on Arduino	
5	Lec 9-10	Hand on session Raspberry Pi Programming on Raspberry Pi	
6	Lec 11-12	Flowchart and block diagram of the project Prototype enhancement	Prototype Design
7	Lec 13-14	Unit testing and integration testing with verification Submission of abstract of paper/report	Implementation Report
8	Lec 15-16	Feedback and improvement Submission of introduction, methodology of paper/report	Implementation Report
9	Lec 17-18	Result analysis and performance evaluation Integration of result analysis in report	Implementation Report
10	Lec 19-20	Model of the project	
11	Lec 21-22	System architecture of the paper	Report
12	Lec 23-24	Project update following final timeline	
13	Lec 25-26	Implementation part of the paper Draft of poster presentation	
14	Lec 27-28	Final Project submission Final paper/report submission Final poster print and presentation	Report

HUM-415 **2 hours in a week, 2.00 Cr.**

Financial and Managerial Accounting

Pre-requisite: None

Rationale:

This course introduces the preliminaries of accounting principles, cost classification and a variety of financial analysis - ratio analysis, capital budgeting, break-even analysis, cost-volume-profit analysis, contribution margin analysis etc. that is helpful for making important decisions of the management control system of any organization or business.

Objective:

1. To discuss the fundamentals of accounting, the use and effects of financial statement for a particular organization.
2. To analyze different types of cost and cost management for different components of a management control system or a business.

Course Outcomes (CO):

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

1. Discuss, describe and interpret a financial accounting statement and the use of financial ratios. The student should be able to understand how the reporting might be affected by a particular (creative) business.
2. Enhance the various elements of a management control system (role, scope, drawbacks, implementation etc.).
3. Determine the variety of cost concepts to be applied in a management control system.
4. Select and analyze the nature of a business and outline main features of an appropriate control system.

Course Content:

Financial Accounting: Objectives and importance of accounting; Accounting as an information system. Computerized system applications in accounting. Recording system, double entry mechanism; account and their classification; Accounting equation: Accounting cycle: Journal, ledger, trial balance. Preparation of financial statements considering adjusting and closing entries; Accounting concepts (principles) and conventions. Financial statement analysis and interpretation: Ratio analysis. Cost and Management Accounting: Cost concepts and classification; Overhead cost: meaning and classification; Distribution of overhead cost: Overhead recover method/rate; Job order costing: preparation of job cost sheet and question price, Inventory valuation: absorption costing and marginal/variable costing technique; Cost-Volume-Profit analysis: meaning, break-even analysis, contribution margin analysis sensitivity analysis. Short-term investment decisions; relevant and differential cost analysis. Long-term investment decisions: capital budgeting, various techniques of evaluation of investments.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Discuss, describe and interpret a financial accounting statement and the use of financial ratios. The student should be able to understand how the reporting might be affected by a particular (creative) business.	√											
2. Enhance the various elements of a management control system (role, scope, drawbacks, implementation etc.).				√								
3. Determine the variety of cost concepts to be applied in a management control system.				√								
4. Select and analyze the nature of a business and outline main features of an appropriate control system.		√										

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Financial Accounting Objectives of Accounting Importance of Accounting	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Accounting as an Information System. Computerized Applications in Accounting Computerized Applications in Accounting (Contd.)	
3	Lec 7 Lec 8 Lec 9	Recording System Double Entry Mechanism Double Entry Mechanism (Contd.)	
4	Lec 10 Lec 11 Lec 12	Account Classification Accounting Equation Account Cycle	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Journal Ledger Trial Balance	
6	Lec 16 Lec 17 Lec 18	Financial Statement Preparation Adjusting Entries Closing Entries	
7	Lec 19 Lec 20 Lec 21	Accounting Principles Accounting Convention Accounting Convention (Contd.)	
8	Lec 22 Lec 23	Financial Statement Analysis Financial Statement Interpretation	

	Lec 24	Ratio Analysis	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Cost Accounting Management Accounting Cost Concept and Classification	
10	Lec 31 Lec 32 Lec 33	Distribution of Overhead Cost Overhead Recover Method/Rate Job Order Costing	
11	Lec 28 Lec 29 Lec 30	Preparation of Job Cost Sheet and Question Price Inventory Valuation Absorption Costing	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Marginal/Variable costing Technique Cost-Volume-Profit Analysis Break-Even Analysis	
13	Lec 37 Lec 38 Lec 39	Contribution Margin Analysis Sensitivity Analysis. Relevant and Differential Cost Analysis	
14	Lec 40 Lec 41 Lec 42	Long-term Investment Decisions Capital Budgeting Various Techniques of Evaluation of Investments	

Text and Ref Books:

1. Managerial Accounting (14th Edition) - Ray Garrison, Eric Noreen and Peter Brewer; McGraw Hill (2011)
2. Accounting Principles (12th Edition) - Jerry J. Weygandt Paul D. Kimmel Donald E. Kieso; Wiley (2015)

CSE4XO — 3 hours in a week, 3.00 Cr.

Option-II

CSE4XE — 3 hours in a week, 3.00 Cr.

Option-II Sessional

Option-I

CSE-419 — 3 hours in a week, 3.00 Cr.

Advanced Algorithms

Pre-requisite: None

Rationale:

This course motivates to implement advanced methods of algorithmic design, analysis, and implementation. techniques that include amortization, randomization, word-level parallelism, bit scaling, dynamic programming, network flow, linear programming, fixed-parameter algorithms, approximation algorithms etc. to identify which algorithm will provide efficient result for a specific problem or context.

Objective:

1. To study advanced techniques and recognize the resource requirements of various algorithms and their applications to solve and approximate real life problems.
2. To analyze the complexity and design necessary parameters of different techniques and methods of advanced algorithms.

Course Outcomes (CO):

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

1. Select and explain a variety of algorithms with practical applications and the resource requirements of each.
2. Determine the most suitable algorithm for any given task and then apply it to the problem.
3. Demonstrate adequate comprehension of the theory of intractability and prove when certain kinds of problems are intractable.

Course Content :

Randomized Algorithms: Las Vegas and Monte Carlo Algorithms; Randomized Data Structures: Skip Lists; Amortized Analysis: Different methods, Applications in Fibonacci Heaps; Lower Bounds: Decision Trees, Information Theoretic Lower Bounds, Adversary Arguments; Approximation Algorithms: Approximation Schemes, Hardness of Approximation; Fixed Parameter Tractability: Parameterized Complexity, Techniques of designing Fixed Parameter Algorithms, Examples; Online Algorithms: Competitive Analysis, Online Paging Problem, k-server Problem; External Memory Algorithms; Advanced Data Structures: Linear and Non-linear Methods.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Select and explain a variety of algorithms with practical applications and the resource requirements of each.		√										
2. Determine the most suitable algorithm for any given task and then apply it to the problem.			√									
3. Demonstrate adequate comprehension of the theory of intractability and prove when certain kinds of problems are intractable.				√								

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to Advanced Algorithms Applications of Advanced Algorithms Fundamental Algorithms versus Advanced Algor thms	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Randomized Algorithms Las Vegas Algorithm Las Vegas Algorithm (Contd.)	
3	Lec 7 Lec 8 Lec 9	Monte Carlo Algorithm Monte Carlo Algorithm (Contd.) Randomized Data Structures	
4	Lec 10 Lec 11 Lec 12	Skip Lists Amortized Analysis Amortized Analysis Methods	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Amortized Analysis Methods (Contd.) Applications in Fibonacci Heaps Lower Bounds	
6	Lec 16 Lec 17 Lec 18	Decision Trees Decision Trees (Contd.) Information Theoretic Lower Bounds	
7	Lec 19 Lec 20 Lec 21	Adversary Arguments Approximation Algorithms Approximation Algorithms (Contd.)	
8	Lec 22 Lec 23 Lec 24	Approximation Schemes Approximation Schemes (Contd.) Hardness of Approximation	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Fixed Parameter Tractability Parameterized Complexity Parameterized Complexity (Contd.)	
10	Lec 31 Lec 32 Lec 33	Fixed Parameter Algorithms Techniques of Designing Fixed Parameter Algorithms Techniques of Designing Fixed Parameter	

		Algorithms	
11	Lec 28 Lec 29 Lec 30	Online Algorithms Online Algorithms (Contd.) Online Algorithms (Contd.)	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Competitive Analysis Online Paging Problem k-server Problem	
13	Lec 37 Lec 38 Lec 39	External Memory Algorithms External Memory Algorithms (Contd.) External Memory Algorithms (Contd.)	
14	Lec 40 Lec 41 Lec 42	Advanced Data Structures Linear Models Non-linear Models	

Text and Ref Books:

1. An Introduction to Computational Learning Theory - Michael J. Kearns , Umesh Vazirani; The MIT Press (1994)
2. Algorithm Design (1st Edition) - Jon Kleinberg , ÉvaTardos; Pearson (2012)
3. Randomized Algorithms (1st Edition) - Rajeev Motwani , Prabhakar Raghavan; Cambridge University Press (1995)
4. Probability and Computing: Randomized Algorithms and Probabilistic Analysis - Michael Mitzenmacher, Eli Upfal; Cambridge University Press (2005)

CSE-421 — 3 hours in a week, 3.00 Cr.

Basic Graph Theory

Pre-requisite: None

Rationale:
Provides a framework to model a large set of problems in CS for better mathematical structures and pairwise relations between objects.

Objective:

1. To learn the standard uses of graphs as models and the fundamental theory about graphs with a sense of some of its modern applications.
2. To formulate algorithms to solve problems with graph theories

Course Outcomes (CO):

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

1. Learn the standard uses of graphs as models and the fundamental theory about graphs with a sense of some of its modern applications.
2. Explain and discuss mathematical proofs, including an appreciation of why this is important.
3. Formulate algorithms to solve problems with graph theories

Course Content:

Graphs and their applications, Basic graph terminologies, Basic operations on graphs, Graph representations, Degree sequence and graphic sequence, Paths, cycles and connectivity, Network flow, Euler tours, Hamiltonian cycles Ear decomposition, Trees and counting of trees, Distance in graphs and trees, Graceful labeling, Matching and covering, Planar graphs, Digraphs, Graph coloring, Special classes of graphs.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
Learn the standard uses of graphs as models and the fundamental theory about graphs with a sense of some of its modern applications.	√											
Explain and discuss mathematical proofs, including an appreciation of why this is important.				√								
Formulate algorithms to solve problems with graph theories			√									

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Graphs and their applications	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Basic graph terminologies	
3	Lec 7 Lec 8 Lec 9	Basic operations on graphs	
4	Lec 10 Lec 11 Lec 12	Graph representations	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Degree sequence and graphic sequence	
6	Lec 16 Lec 17 Lec 18	Paths Cycles Connectivity	
7	Lec 19 Lec 20 Lec 21	Network flow	

8	Lec 22 Lec 23 Lec 24	Euler tours Hamiltonian cycles Ear decomposition	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Trees and counting of trees	
10	Lec 31 Lec 32 Lec 33	Distance in graphs Distance in trees	
11	Lec 28 Lec 29 Lec 30	Graceful labeling Matching and covering	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Planar graphs	
13	Lec 37 Lec 38 Lec 39	Digraphs Graph coloring	
14	Lec 40 Lec 41 Lec 42	Special classes of graphs	

Text and Ref Books:

1. Introduction to graph theory - Douglas B West
2. Introduction to Graph Theory - Robin J. Wilson, Pearson Education Asia

CSE-423   3 hours in a week, 3.00 Cr.

Fault Tolerant System

Pre-requisite: None

Rationale:
This course motivates to implement a feature on a system that enables a system to continue with its operations even when there is a failure on one part of the system and helps in fault isolation through various failure detection mechanisms.

Objective:
1. To detect and isolate faults on a system and design accordingly to achieve a fault tolerant system using different fault tolerance design techniques.
2. To test and analyze the faults in order to create a reliable and high performance system.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Discuss, explain and analyze underlying notions of fault tolerance.

2. Model reliability of different types of systems.
3. Recognize defect avoidance and circumvention.
4. Identify methodologies of hardening systems.

Course Content :

Introduction of Fault Tolerant Systems and architectures; Goal and Application of Fault Tolerant computing, Fundamental Definitions, Design techniques to achieve fault Tolerance, Reliability Modeling Using Probability Theory, Fault detection and location in combinational and sequential circuits; Fault test generation for combinational and sequential circuits; Fault modeling; Faults in memory, memory test pattern and reliability; Performance monitoring, self-checking circuits, burst error correction and triple modular redundancy, Defect Avoidance, Defect Circumvention, Shield and Hardening,Yields Enhancement, Degradation Allowance.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Discuss, explain and analyze underlying notions of fault tolerance		√										
2. Model reliability of different types of systems.			√									
3. Recognize defect avoidance and circumvention.		√										
4. Identify methodologies of hardening systems.				√								

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to Fault Tolerant Systems Goals of Fault Tolerant Computing Applications of Fault Tolerant Computing	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Fundamental Definitions Design Techniques to Achieve Fault Tolerance Architecture of Fault Tolerant System	
3	Lec 7 Lec 8 Lec 9	Reliability Modeling using Probability Theory Reliability Modeling using Probability Theory (Contd.) Fault Detection and Location	
4	Lec 10 Lec 11 Lec 12	Fault Detection and Location in Sequential Circuit Fault Detection and Location in Combinational Circuit Fault Modeling	**Class Test 2**
5	Lec 13	Fault Test	

	Lec 14 Lec 15	Fault Test Generation for Sequential Circuit Fault Test Generation for Combinational Circuit	
6	Lec 16 Lec 17 Lec 18	Faults in Memory Memory Test Pattern Memory Test Reliability	
7	Lec 19 Lec 20 Lec 21	Performance Monitoring Performance Monitoring (Contd.) Self-checking circuits	
8	Lec 22 Lec 23 Lec 24	Errors Error Types Error Types (Contd.)	
9	Lec 25 Lec 26 Lec 27	Error Correction Burst Error Burst Error Correction	**Class Test 3**
10	Lec 31 Lec 32 Lec 33	N-modular Redundancy Triple Modular Redundancy Triple Modular Redundancy (Contd.)	
11	Lec 28 Lec 29 Lec 30	Defect Defect Types Defect Avoidance	
12	Lec 34 Lec 35 Lec 36	Defect Avoidance (Contd.) Defect Circumvention Defect Circumvention (Contd.)	
13	Lec 37 Lec 38 Lec 39	Hardening Systems Methods of Hardening Shield Hardening (Contd.)	**Class Test 4**
14	Lec 40 Lec 41 Lec 42	Yields Enhancement Yields Enhancement (Contd.) Degradation Allowance	

Text and Ref Books:

1. Design and Analysis of Fault Tolerant Digital System (1st Edition) - Barry W. Johnson; Addison Wesley (1989)
2. Dependable Computing: A Multilevel Approach - Behrooz Parhami
3. Fault-Tolerant Systems (1st Edition) - Israel Koren, C. Mani Krishna; Morgan Kauffman (2010)

CSE-425 — 3 hours in a week, 3.00 Cr.

Basic Multimedia Theory

Pre-requisite: None

Rationale:

This course motivates to study the architecture, different standards of compressing and coding a multimedia document; database, network and operating system issues, traffic and service issues, security issues and hence apply this knowledge to implement different multimedia applications.

Objective:

1. To apply different techniques and methods for developing secured and high quality multimedia applications for different context.
2. To recognize and analyze different issues - storing, indexing, resource management, scheduling, security etc. of multimedia applications.

Course Outcomes (CO):

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

1. Discuss indexing and storing multimedia data for multimedia document.
2. Explain disk placement, disk scheduling, searching techniques for multimedia document.
3. Discover and apply the knowledge acquired in developing multimedia applications – audio and video conferencing, video on demand, and voice over IP.

Course Content :

Multimedia systems - introduction; Coding and compression standards; Architecture issues in multimedia; Operating systems issues in multimedia - real-time OS issues, synchronization, interrupt handling; Database issues in multimedia - indexing and storing multimedia data, disk placement, disk scheduling, searching for a multimedia document; Networking issues in multimedia - Quality-of-service guarantees, resource reservation, traffic specification, shaping, and monitoring, admission control; Multicasting issues; Session directories; Protocols for controlling sessions; Security issues in multimedia-digital water making, partial encryption schemes for video streams; multimedia applications – audio and video conferencing, video on demand, voice over IP.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Discuss indexing and storing multimedia data for multimedia document.	√											
2. Explain disk placement, disk scheduling, searching techniques for multimedia document.			√									
3. Discover and apply the knowledge acquired in developing multimedia applications – audio and video conferencing, video on demand, and voice over IP.				√								

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to Multimedia Systems Introduction to Multimedia Systems (Contd.) Application of Multimedia Systems	
2	Lec 4 Lec 5 Lec 6	Coding Standards Compression Standards Architecture Issues in Multimedia	
3	Lec 7 Lec 8 Lec 9	Architecture Issues in Multimedia (Contd.) Operating System Issues in Multimedia Real-time OS Issues	**Class Test 1**
4	Lec 10 Lec 11 Lec 12	Synchronization Issues Interrupt Handling Interrupt Handling (Contd.)	
5	Lec 13 Lec 14 Lec 15	Database Issues in Multimedia Indexing Multimedia Data Storing Multimedia Data	
6	Lec 16 Lec 17 Lec 18	Storing Multimedia Data (Contd.) Disk Placement Disk Scheduling	**Class Test 2**
7	Lec 19 Lec 20 Lec 21	Disk Scheduling (Contd.) Searching for a Multimedia Document Networking Issues in Multimedia	
8	Lec 22 Lec 23 Lec 24	Quality-of-Service guarantees Resource Reservation Traffic Specification	
9	Lec 25 Lec 26 Lec 27	Shaping Monitoring Admission Control	**Class Test 3**
10	Lec 31 Lec 32 Lec 33	Multicasting Issues Multicasting Issues (Contd.) Session Directories	
11	Lec 28 Lec 29 Lec 30	Protocols for Controlling Sessions Protocols for Controlling Sessions (Contd.) Security Issues in Multimedia	
12	Lec 34 Lec 35 Lec 36	Security Issues in Multimedia (Contd.) Digital Water Making Partial Encryption Schemes for Video Streams	
13	Lec 37 Lec 38 Lec 39	Multimedia Applications Audio Conferencing Video Conferencing	**Class Test 4**
14	Lec 40 Lec 41 Lec 42	Video on Demand Voice over IP Voice over IP (Contd.)	

Text and Ref Books:

1. Multimedia: Computing, Communications & Applications (US Edition) - Ralf Steinmetz, Klara Nahrstedt; Prentice Hall (1995)

CSE-427 3 hours in a week, 3.00 Cr.

Digital Image Processing

Pre-requisite: None

Rationale:
Introduce the fundamentals of image processing and manipulation of television, medical imaging modalities such as X-ray or ultrasound, photography, security, astronomy and remote sensing.

Objective:

1. To describe image formation and the role human visual system plays in perception of gray and color image data.
2. To explain the basic elements and applications of image processing.
3. To select and analyze image sampling and quantization requirements and implications.
4. To perform Gray level transformations for Image enhancement.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Describe image formation and the role of human visual system in perception of gray and color image data.
2. Explain the basic elements and applications of image processing.
3. Select and analyze image sampling and quantization requirements and implications.
4. Perform Gray level transformations for Image enhancement.

Course Content :

Digital image fundamentals: visual perception, Light and Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Some basic relationships between pixels, Linear and Nonlinear operations; image transforms: First Fourier Transform (FFT), Discrete Cosine Transform (DCT), Karhunen and Loeve Transform (KLT), Wavelet transform and sub-band decomposition; image enhancement in the frequency domain and image restoration techniques, image compression techniques, image compression standards: JPEG,MPEG, H.261, and H.263, Image Segmentation.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Describe image formation and the role of human visual system in perception of gray and color image data.	√											

Explain the basic elements and applications of image processing.	√											
Select and analyze image sampling and quantization requirements and implications.		√										
Perform Gray level transformations for Image enhancement.			√									

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Digital image fundamentals Visual perception Light and Electromagnetic Spectrum	
2	Lec 4 Lec 5 Lec 6	Image Sensing and Acquisition Image Sampling and Quantization Basic relationships between pixels	
3	Lec 7 Lec 8 Lec 9	Linear and Nonlinear operations Image transforms First Fourier Transform (FFT)	**Class Test 1**
4	Lec 10 Lec 11 Lec 12	Discrete Cosine Transform (DCT) Karhunen and Loeve Transform (KLT)	
5	Lec 13 Lec 14 Lec 15	Wavelet Transform	
6	Lec 16 Lec 17 Lec 18	Sub-Band Decomposition	**Class Test 2**
7	Lec 19 Lec 20 Lec 21	Image restoration technique Properties of Noise Estimation of Noise Parameters	
8	Lec 22 Lec 23 Lec 24	Filters Mean Filter Bandpass and Band reject Filter Notch Filter and Inverse Filter	
9	Lec 25 Lec 26 Lec 27	Color Image Processing Fundamentals, Models Smoothing and Sharpening	**Class Test 3**
10	Lec 31 Lec 32 Lec 33	Image compression techniques Coding Redundancy Measuring Image Information	
11	Lec 28 Lec 29 Lec 30	Image compression standards JPEG, MPEG, H.261, and H.26	
12	Lec 34 Lec 35 Lec 36	Image Enhancement in the Frequency Domain	
13	Lec 37 Lec 38 Lec 39	Image Segmentation Detection of Discontinuities Thresholding	**Class Test 4**

14	Lec 40 Lec 41 Lec 42	Edge Linking Boundary Detection	

Text and Ref Books:

1. Digital Image Processing (3rd/2nd Edition) - R. C. Gonzalez and R.E. Woods; Pearson Prentice Hall (2009)

CSE-429 — 3 hours in a week, 3.00 Cr.

Data and Network Security

Pre-requisite: None

Rationale:
To gather brief review of computer crimes and causes, Internet, strategies, crime prevention, security.

Objective:

1. To understand the development of security, traditional encryption, security attacks and the fundamental security objectives
2. To determine and analyze the security objectives, attacks, and models, so is able to recognize the security requirements in real-life cases.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Understand the development of security, traditional encryption, security attacks and the fundamental security objectives
2. Determine the security objectives, attacks, and models, so is able to recognize the security requirements in real-life cases.
3. Analyze the design and implementation issues of a real-life security solution.

Course Content :
Overview, Symmetric cipher, Classical encryption technique, Block cipher and the data encryption standard (DES), Triple DES, Introduction to finite fields, Advanced Encryption Standard, Contemporary Symmetric Ciphers, confidentiality using symmetric encryption public, Key encryption and Hash functions, Public-key Cryptography, RSA algorithm, Key management, Diffie-Hellman key exchange, Other Public Key Cryptosystem, Message Authentication and Hash function, Hash Algorithm, Digital Signatures and Authentication protocols, Network Security practice, Authentication application, Wireless Network Security, Electrical Mail security, IP security, Web security, System security, Intruders, Malicious software and Firewall, Legal and Ethical Aspects.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Understand the development of security, traditional encryption, security attacks and the fundamental security objectives	√											
Determine the security objectives, attacks, and models, so is able to recognize the security requirements in real-life cases.		√										
Analyze the design and implementation issues of a real-life security solution.			√									

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction Symmetric cipher	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Classical encryption technique Block cipher	
3	Lec 7 Lec 8 Lec 9	Data Encryption Standard (DES) Triple DES	
4	Lec 10 Lec 11 Lec 12	Introduction to finite fields Advanced Encryption Standard	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Contemporary Symmetric Ciphers Symmetric Encryption	
6	Lec 16 Lec 17 Lec 18	Key Encryption Hash Functions	
7	Lec 19 Lec 20 Lec 21	Public-key Cryptography RSA Algorithm Key Management	
8	Lec 22 Lec 23 Lec 24	Diffie-Hellman key exchange Public Key Cryptosystem	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Message Authentication and Hash function Hash Algorithm	
10	Lec 31 Lec 32 Lec 33	Digital Signatures Authentication protocols	
11	Lec 28 Lec 29	Network Security practice Authentication application	

	Lec 30	Wireless	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Network Security Electrical Mail security IP security	
13	Lec 37 Lec 38 Lec 39	Web security System security Intruders	
14	Lec 40 Lec 41 Lec 42	Malicious software and Firewall Legal and Ethical Aspects.	

Text and Ref Books:

1. Cryptography and Network Security - William Stallings;
2. Cryptography and Network Security- Behrouz A. Forouzan;

CSE-431 — 3 hours in a week, 3.00 Cr.

Object Oriented Software Engineering

Pre-requisite: None

Rationale:

This course provides in depth concepts, properties, relationships of object driven software, exception handling and reusable library.

Objective:

1. To describe various O-O concepts, their properties, relationships along with model/ represent considering constraints.
2. To design, develop and explain various modeling techniques to model different perspectives of Object-Oriented Software Design.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Describe various O-O concepts along with their applicability contexts.
2. Identify domain objects, their properties, and relationships among them.
3. Model/ represent domain constraints on the objects and (or) on their relationships.
4. Develop design solutions for problems on various O-O concepts.

Course Content:

The object-oriented approach within the context of software engineering, the language, basic (procedural) elements of language: what an Eiffel program is, what the instruction set is, and how to declare and use entities (variables) and routines; The concepts underlying the object-oriented approach: modularity, inheritance, and dynamic binding, case study from the management information-system domain; Environment matters: system configuration, interfacing with external software, and garbage collection. Advanced issues involving exception handling, repeated inheritance, typing problems, and parallelism; object-oriented software engineering process, concentrating on specific guidelines facilitate the translation OOAD to a maintainable Addresses verification and validation (V&V) issues of Eiffel software systems built in a software engineering context; Building reusable libraries; The building of a parallel linear algebra library (Paladin).

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Describe various O-O concepts along with their applicability contexts.	√											
Identify domain objects, their properties, and relationships among them.		√										
Model/ represent domain constraints on the objects and (or) on their relationships.		√										
Develop design solutions for problems on various O-O concepts.			√									

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Object-oriented approach	
2	Lec 4 Lec 5 Lec 6	Basic (procedural) elements of language	
3	Lec 7 Lec 8 Lec 9	Eiffel program Instruction set Entities (variables) and routines;	**Class Test 1**
4	Lec 10 Lec 11 Lec 12	Concepts underlying the O-O approach Modularity	
5	Lec 13 Lec 14 Lec 15	Inheritance Dynamic binding Management information-system domain	
6	Lec 16 Lec 17 Lec 18	Environment matters: system configuration,	**Class Test 2**
7	Lec 19 Lec 20 Lec 21	Interfacing with external software Garbage collection.	
8	Lec 22 Lec 23 Lec 24	Advanced issues involving exception handling	
9	Lec 25 Lec 26 Lec 27	Repeated inheritance Typing problems	
10	Lec 31 Lec 32 Lec 33	Parallelism O-O software engineering process	**Class Test 3**
11	Lec 28 Lec 29 Lec 30	OOAD to a maintainable Addresses verification	
12	Lec 34 Lec 35	OOAD to Address validation (V&V) Issues of Eiffel software systems	**Class Test 4**

	Lec 36		
13	Lec 37 Lec 38 Lec 39	Building reusable libraries	
14	Lec 40 Lec 41 Lec 42	The building of a parallel linear algebra library (Paladin).	

Text and Ref Books:

1. Object-Oriented Software Engineering - Stephen Schach
2. Object Oriented Software Engineering: A Use Case Driven Approach - Ivar Jacobson
3. Object-Oriented Software Engineering: Practical Software Development using UML and Java – Timothy Lethbridge, Robert Laganiere, Robert Laganiere

CSE-433 3 hours in a week, 3.00 Cr.

Artificial Neural Networks and Fuzzy Systems

Pre-requisite: None

Rationale:

Reasoning complex situations by the artificial agents with the help of neural network and fuzzy system provides better performance.

Objective:

1. To develop the skills on neural network theory and fuzzy logic theory and explore the functional components of neural network classifiers or controllers, and the functional components of fuzzy logic classifiers or controllers.
2. To design and implement basic trainable neural network or a fuzzy logic system for a typical control, computing application or biomedical application.

Course Outcomes (CO):

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

1. Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory.
2. Explore the functional components of neural network classifiers or controllers, and the functional components of fuzzy logic classifiers or controllers.
3. Select and implement a basic trainable neural network or a fuzzy logic system for a typical control, computing application or biomedical application.

Course Content:

Biological nervous system: the brain and neurons, Introduction to artificial neural network and fuzzy systems, Theory and application of Artificial neural networks and fuzzy logic; Multi-layer perception: Back propagation algorithm, Self organization map, Radial basis network, Hop field network, Recurrent network, Fuzzy set theory, Failing Adaptive Linear (ADALINE) and Multiple Adaptive Linear (MADALINE) networks, Generating internal representation, Cascade correlation and counter propagation networks, Higher order and bi-directional associated memory, Lyapunov energy function, attraction basin, Probabilistic updates: simulated annealing, Boltzmann machine, Adaptive Resonance Theory (ART) network. ARTI. ART2. Fuzzy ART mapping (ARTMAF) networks. Kohonen feature .l\ Learning Vector Quantization (LVQ) networks, Logic control: Adaptive fuzzy neural network; Genetic algorithm and evolution compacting, Applications to control; Pattern recognition; Nonlinear system modeling, Speech and image processing.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory	√											
Explore the functional components of neural network classifiers or controllers, and the functional components of fuzzy logic classifiers or controllers.		√										
Select and implement a basic trainable neural network or a fuzzy logic system for a typical control, computing application or biomedical application.			√									

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Biological nervous system Brain and neurons	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Introduction to artificial neural network and fuzzy systems	
3	Lec 7 Lec 8 Lec 9	Adaption of Artificial neural networks Fuzzy logic	
4	Lec 10 Lec 11 Lec 12	Multi-layer perception Back propagation algorithm Self-organization map	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Radial basis network Hop field network Recurrent network	
6	Lec 16 Lec 17 Lec 18	Fuzzy set theory Failing Adaptive Linear (ADALINE) Multiple Adaptive Linear (MADALINE)	
7	Lec 19	Generating internal representation	

	Lec 20 Lec 21	Cascade correlation Counter propagation networks	
8	Lec 22 Lec 23 Lec 24	Higher order bi-directional associated memory Lyapunov energy function	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Attraction basin Probabilistic updates: simulated annealing Boltzmann machine	
10	Lec 31 Lec 32 Lec 33	Adaptive Resonance Theory (ART) network. ARTI. ART2.	
11	Lec 28 Lec 29 Lec 30	Fuzzy ART mapping (ARTMAF) Kohonen feature LVQ networks	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Logic control Adaptive fuzzy neural network	
13	Lec 37 Lec 38 Lec 39	Genetic algorithm Evolution compacting Applications to control	
14	Lec 40 Lec 41 Lec 42	Pattern recognition Nonlinear system modeling Speech and image processing.	

Text and Ref Books:

1. Neural Networks and Fuzzy Systems - Shigeo Abe
2. Introduction to Artificial Neural Systems - Jacek M. Zurada
3. Artificial neural systems: foundations, paradigms, applications, and implementations - Patrick K. Simpson

CSE-435 — 3 hours in a week, 3.00 Cr.

Distributed Algorithms

Pre-requisite: None

Rationale:

Execution of algorithms in parallel and distributed settings along with correctness, reliability, security, and performance is very vital for computing.

Objective:

1. To acquire concepts of models, limitations, and fundamentals of message passing and shared memory concurrency, and apply this understanding to example systems and algorithms.
2. Adapt, design algorithms and distinguish for execution in parallel and distributed settings along with correctness, reliability, security, and performance.

Course Outcomes (CO):

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

1. Discuss and account for models, limitations, and fundamental concepts in the area of message passing and shared memory concurrency, and apply this understanding to example systems and algorithms.
2. Adapt, and design algorithms for execution in parallel and distributed settings.
3. Distinguish the algorithms for correctness, reliability, security, and performance.

Course Content:

Models of distributed computing, Synchrony, communication and failure concerns, Synchronous message-passing distributed systems, Algorithms in systems with no failures - Leader Election and Breadth-First Search algorithms, The atomic commit problem, Consensus problems - the Byzantine Generals Problem, Asynchronous message-passing distributed systems, Failure detectors, Logical time and vector clocks, Routing algorithms.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Discuss and account for models, limitations, and fundamental concepts in the area of message passing and shared memory concurrency, and apply this understanding to example systems and algorithms.	√											
Adapt, and design algorithms for execution in parallel and distributed settings.			√									
Distinguish the algorithms for correctness, reliability, security, and performance.		√										

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Models of distributed computing	
	Lec 4 Lec 5 Lec 6	Synchrony communication	
3	Lec 7 Lec 8 Lec 9	Failure concerns	**Class Test 1**
4	Lec 10 Lec 11 Lec 12	Synchronous message-passing	**Class Test 2**
5	Lec 13	Distributed systems	

	Lec 14 Lec 15		
6	Lec 16 Lec 17 Lec 18	Algorithms in systems with no failures - Leader Election	
7	Lec 19 Lec 20 Lec 21	Breadth-First Search algorithms	
8	Lec 22 Lec 23 Lec 24	The atomic commit problem	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Consensus problems - the Byzantine Generals Problem	
10	Lec 31 Lec 32 Lec 33	Asynchronous message-passing of distributed systems	
11	Lec 28 Lec 29 Lec 30	Failure detectors I	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Failure detectors II	
13	Lec 37 Lec 38 Lec 39	Logical time Vector clocks	
14	Lec 40 Lec 41 Lec 42	Routing algorithms	

Text and Ref Books:

1. Distributed Systems - S. Mullender (ed.), Addison-Wesley
2. Introduction to Distributed Algorithms - G. Tel. Cambridge Univ. Press

CSE-437 — 3 hours in a week, 3.00 Cr.

Bioinformatics

Pre-requisite: None

Rationale:

This course motivates to generate all sorts of data that involves generating protein sequence and predicting protein domains to even producing 3D structures of proteins from computer based databases of biological information for bioinformatics experiments.

Objective:

1. To be able to work with the vast amount of biomedical and genomic data using

bioinformatics tools.
2. To analyze the properties of different genome sequences and their alignment from databases using dynamic programming.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Explain and learn the knowledge of basic topics regarding bioinformatics.
2. Define and describe the contents and properties of the most important bioinformatics databases and searches.
3. Enhance the major steps in pairwise and multiple sequence alignment, explain the principle for, and execute pairwise sequence alignment by dynamic programming.

Course Content :
Molecular biology basics: DNA, RNA, genes, and proteins; Genome Rearrangements. Sequence similarity, homology, and alignment. Pair-wise alignment: scoring model, dynamic programming algorithms, heuristic alignment, and pair-wise alignment using Hidden Markov Models. Combinatorial pattern matching: Database Search, Rapid String Matching, BLAST, FASTA; Multiple alignment: scoring model, local alignment gapped and un-gapped global alignment. Motif finding: motif models, finding occurrence of known sites, discovering new sites. Gene Finding: predicting reading frames, maximal dependence decomposition. Analysis of DNA microarray data using hierarchical clustering, model-based clustering, expectation-maximization clustering, Bayesian model selection.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain and learn the knowledge of basic topics regarding bioinformatics.	√											
2. Define and describe the contents and properties of the most important bioinformatics databases and searches.	√											
3. Enhance the major steps in pairwise and multiple sequence alignment, explain the principle for, and execute pairwise sequence alignment by dynamic programming.		√										

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to Bioinformatics Applications of Bioinformatics Molecular Biology Basics	
2	Lec 4 Lec 5	DNA and RNA Genes	**Class Test 1**

	Lec 6	Proteins	
3	Lec 7 Lec 8 Lec 9	Genome Rearrangements Sequence Similarity Homology	
4	Lec 10 Lec 11 Lec 12	Alignment Pair-wise Alignment Scoring Model Pair-wise Alignment Scoring Model (Contd.)	
5	Lec 13 Lec 14 Lec 15	Dynamic Programming Algorithms Dynamic Programming Algorithms (Contd.) Heuristic Alignment	**Class Test 2**
6	Lec 16 Lec 17 Lec 18	Hidden Markov Model Pair-wise Alignment using HMM Pair-wise Alignment using HMM (Contd.)	
7	Lec 19 Lec 20 Lec 21	Combinatorial Pattern Matching Database Search Rapid String Matching	
8	Lec 22 Lec 23 Lec 24	BLAST FASTA Multiple Alignment Scoring Model	
9	Lec 25 Lec 26 Lec 27	Local Alignment Gapped Global Alignment Un-gapped Global Alignment	**Class Test 3**
10	Lec 31 Lec 32 Lec 33	Motif Finding: Motif Models Finding Occurence of Known Sites Discovering New Sites	
11	Lec 28 Lec 29 Lec 30	Gene Finding Predicting Reading Frames Maximal Dependence Decomposition	
12	Lec 34 Lec 35 Lec 36	Analysis of DNA Microarray Data Hierarchical Clustering Hierarchical Clustering (Contd.)	
13	Lec 37 Lec 38 Lec 39	Model Based Clustering Model Based Clustering (Contd.) Expectation Maximization Clustering	**Class Test 4**
14	Lec 40 Lec 41 Lec 42	Expectation Maximization Clustering (Contd.) Bayesian Model Selection Bayesian Model Selection (Contd.)	

Text and Ref Books:

1. 1. An Introduction to Bioinformatics Algorithm (1st Edition)- Neil C. Jones, Pavel A. Pevzner; The MIT Press (2004)

CSE-439 **3 hours in a week, 3.00 Cr.**

Robotics

Pre-requisite: None

Rationale:

This course introduces the fundamentals of robotics design and development, the principles of robot kinematics, dynamics, motion planning, trajectory generation and control as well as plan and research complete robots for various industrial applications.

Objective:

1. To explain the basics of robotic systems, robot design, development process and their vast applications.
2. To specify and analyze the simulation, modeling and drawbacks of a robotic system for an interactive complex environment.

Course Outcomes (CO):

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

1. Explain with the concept development and key components of robotics technologies.
2. Solve problems in spatial coordinate representation and spatial transformation, robot locomotion design, kinematics, motion control, localization and mapping, navigation and path planning.
3. Design and implement a robotic project on a physical mobile robot platform, with tasks involving project specification, algorithm design, software programming, simulation and modeling, control and obstacle avoidance in a complex and interactive environment.

Course Content :

Introduction to robotics, overview of robot mechanisms, dynamics, and intelligent controls, planar and spatial kinematics, and motion planning; mechanism design for manipulators and mobile robots, multi-rigid body dynamics, 3D graphic simulation; control design, actuators, and sensors; wireless networking, task modeling, human-machine interface, and embedded software mechanical design, rigidbody velocity, Jacobean, inverse kinematics, redundant and parallel robots, trajectory control, face control and haptics, Micro and Nano-robotics, mobile robots. Human-robot interaction, Multiagents, fault diagnosis.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Explain with the concept development and key components of robotics technologies.	√											
Solve problems in spatial coordinate representation and spatial transformation, robot locomotion design, kinematics, motion control, localization and mapping, navigation and path planning.		√										
Design and implement a robotic project on a physical mobile robot platform, with tasks involving project specification, algorithm design, software programming, simulation and modeling, control and obstacle avoidance in a complex and interactive environment.			√									

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to Robotics Applications of Robotics Evolution of Robotics	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Overview of Robot Mechanisms Overview of Robot Dynamics Overview of Robot Intelligent Controls	
3	Lec 7 Lec 8 Lec 9	Spatial Descriptions Transformations Introduction to Kinematics	
4	Lec 10 Lec 11 Lec 12	Planar Kinematics Spatial Kinematics Motion Planning	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Mechanism Design for Manipulators Mechanism Design for Mobile Robots Mechanism Design for Mobile Robots (Contd.)	
6	Lec 16 Lec 17 Lec 18	Manipulator Kinematics Inverse Manipulator Kinematics Introduction to Dynamics	
7	Lec 19 Lec 20 Lec 21	Manipulator Dynamics Trajectory Generation Multi-rigid body Dynamics	
8	Lec 22 Lec 23 Lec 24	Linear Control of manipulators Non-Linear Control Manipulators Force Control of Manipulators	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	3D Graphic Simulation 3D Graphic Simulation (Contd.) 3D Graphic Simulation (Contd.)	

10	Lec 31 Lec 32 Lec 33	Control Design Actuators Sensors	
11	Lec 28 Lec 29 Lec 30	Task Modeling, Face Control and Haptics Human-Machine Interface Embedded Software Mechanical Design	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Jacobean Kinematics Inverse Kinematics Redundant and Parallel Robots	
13	Lec 37 Lec 38 Lec 39	Micro Robotics Nano-Robotics Mobile Robots	
14	Lec 40 Lec 41 Lec 42	Human-robot interaction Multiagents Fault Diagnosis	

Text and Ref Books:

1. Introduction to Robotics: Analysis, Control, Applications (2nd Edition) - Saeed B. Niku; Wiley (2010)
2. Introduction to Robotics: Mechanics and Control (3rd Edition) - John J. Craig; Pearson (2004)

CSE-441 3 hours in a week, 3.00 Cr.

Machine Learning

Pre-requisite: NONE

Rationale:
Machine learning provides appropriate learning algorithm to best suit the current need and enhance the learning parameters for maximum performance.

Objective:

1. To learn paradigms in different environmental setting and apply the appropriate learning algorithm to best suit the current need.
2. To enhance the learning parameters to achieve maximum performance.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:
1. Discuss the different learning paradigms in different environmental setting
2. Select and apply the appropriate learning algorithm to best suit the current need.
3. Enhance the learning parameters to achieve maximum performance.

Course Content:

Introduction to Machine Learning; Regression analysis: Logistic Regression, Linear Regression; Supervised and Unsupervised learning; Bayesian Learning; Decision Tree Learning; Rule based learning; Instance based learning; Neural Nets; Support Vector Machine; Genetic Algorithms; Reinforcement learning; Ensemble learning; Hidden Markov Models; Maximum Likelihood Estimates, Parameter Estimation; Computational learning theory.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Discuss the different learning paradigms in different environmental setting.	√											
Select and apply the appropriate learning algorithm to best suit the current need.		√										
Enhance the learning parameters to achieve maximum performance.		√										

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to Machine Learning	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Regression analysis Logistic Regression	
3	Lec 7 Lec 8 Lec 9	Linear Regression	
4	Lec 10 Lec 11 Lec 12	Supervised learning Unsupervised learning	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Bayesian Learning Decision Tree Learning	
6	Lec 16 Lec 17 Lec 18	Rule based learning Instance based learning	
7	Lec 19 Lec 20 Lec 21	Neural Nets	
8	Lec 22 Lec 23 Lec 24	Support Vector Machine Genetic Algorithms	
9	Lec 25	Reinforcement learning	

	Lec 26 Lec 27		**Class Test 3**
10	Lec 31 Lec 32 Lec 33	Ensemble learning	
11	Lec 28 Lec 29 Lec 30	Hidden Markov Models	
12	Lec 34 Lec 35 Lec 36	Maximum Likelihood Estimates	
13	Lec 37 Lec 38 Lec 39	Parameter Estimation	**Class Test 4**
14	Lec 40 Lec 41 Lec 42	Computational learning theory	

Text and Ref Books:

1. Pattern Recognition and Machine Learning - Christopher M. Bishop; Springer
2. Machine Learning - Tom Mitchell, McGraw Hill
3. Pattern Recognition –SergiosTheodoridis and KonstantinosKoutroumbas; Elsevier Inc.

Reference Book(s):

1. Machine Learning, Tom Michael Mitchell
2. Introduction to Machine Learning, Ethem Alpaydin

Option-II

CSE-443 3 hours in a week, 3.00 Cr.

Pattern Recognition

Pre-requisite: None

Rationale:
This course motivates to recognize patterns, regularities and also irregularities in data by using various pattern recognition algorithms and techniques to find useful information for science, business, organizational decisions as well as contributing to the field of machine learning, data mining and artificial intelligence.

Objective:

1. To provide a comprehensive introduction to pattern recognition techniques leading to the ability to understand contemporary terminology, progress, issues, and trends.
2. To specify sectors and context where the application of pattern recognition can provide a fruitful solution.

Course Outcomes (CO):

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

1. Identify areas where pattern recognition techniques can offer a solution.
2. Describe the strength and limitations of some techniques used in pattern recognition for classification, regression and density estimation problems.
3. Conduct, document and present a literature review on a topic related to Machine Learning and Pattern Recognition.
4. Solve problems in regression and classification.

Course Content :

Introduction to pattern recognition, Statistical and Neural Pattern Recognition, Bayesian decision theory, Linear classifiers, Nonlinear classifiers, Parametric estimation techniques; Non-parametric estimation techniques; Template matching, Dynamic programming methods, Correlation methods, Hidden Markov model, Support vector machine, Syntactic pattern recognition, Clustering algorithms, Principle component analysis.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Identify areas where pattern recognition techniques can offer a solution.		√										
2. Describe the strength and limitations of some techniques used in pattern r cognition for classification, regression and density estimation problems.		√										
3. Conduct, document and present a literature review on a topic related to Machine Learning and Pattern Recognition.			√									
4. Sol e problems in regression and classification.			√									

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to Pattern Recognition Importance of Pattern Recognition tatistical and Neural Pattern Recognition	
2	Lec 4 Lec 5 Lec 6	Review of Probability Distributions Review of Probability Distributions (Contd.) Bayesian classifier	**Class Test 1**
3	Lec 7 Lec 8 Lec 9	Bayes Decision Theory Discriminate Functions Decision Surfaces	
4	Lec 10 Lec 11 Lec 12	Bayesian Classifier for Normal Distribution Naïve Bayes Classifier Bayesian Belief Networks	
5	Lec 13 Lec 14 Lec 15	Linear classifiers Discriminate Functions Decision Hyperplanes	
6	Lec 16 Lec 17 Lec 18	Perceptron Algorithm Least Squares Methods Kessler's Construction	**Class Test 2**
7	Lec 19 Lec 20 Lec 21	Nonlinear Classifier Two and Three Layer Perceptrons Back Propagation Algorithm	
8	Lec 22 Lec 23 Lec 24	Template matching Optimal Path Searching Techniques Optimal Path Searching Techniques (Contd.)	
9	Lec 25 Lec 26 Lec 27	Dynamic Programming Methods (Contd.) Dynamic Programming Methods (Contd.) Correlation Methods	**Class Test 3**
10	Lec 31 Lec 32 Lec 33	Context Dependent Classification Observable and Hidden Markov Models Viterbi Algorithm	
11	Lec 28 Lec 29 Lec 30	Problems of HMM Problems of HMM Application of HMM in Speech Recognition	
12	Lec 34 Lec 35 Lec 36	Syntactic Pattern Recognition Syntactic Pattern Recognition (Contd.) Syntactic Pattern Recognition (Contd.)	**Class Test 4**
13	Lec 37 Lec 38 Lec 39	Clustering Algorithms Clustering Algorithms (Contd.) Clustering Algorithms (Contd.)	

14	Lec 40 Lec 41 Lec 42	Support Vector Machine Support Vector Machine (Contd.) Support Vector Machine (Contd.)	

Text and Ref Books:

1. Pattern Classification (2nd Edition) - R. O. Duda, P.E.D. Hart and G. Stork; John Wiley and Sons (2000)
2. Pattern recognition (4th Edition) –Sergios Theodoridis and Konstantinos Koutroumbas; Academic Press (2008)

CSE-444 — 3 hours in alternate week, 0.75 Cr.

Pattern Recognition Sessional

Pre-requisite: None

Rationale:

This course motivates to apply various algorithm and techniques - classification, regression, clustering, neural network, decision tree and other estimation techniques which helps to identify different types of pattern in data that can give required solution and suggestions to real-life problems for various applications.

Objective:

1. To achieve a basic idea about designing and developing pattern recognition applications using different algorithm and techniques.
2. To analyze regular/irregular pattern in data in order to find out potentially useful information.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Use practical knowledge to identify areas where pattern recognition techniques can offer a solution.
2. Conduct, document and present a literature review on a topic related to Machine Learning and Pattern Recognition practically.
3. Solve problems in regression and classification.

Course Content :
Bayes Classifier, Perceptron Algorithm, Pocket Algorithm, Edit Distance, Basic Sequential Algorithmic Scheme, K-Means Clustering algorithm, Support Vector Machine, Neural Network, Decision Tree.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, presentation, project, quiz, viva, lab test.

Assessment Methods & their Weights:

Assessment Method	(100%)
Project	40
Quiz	20
Viva/Presentation	10
Class Participation	10
Report	10
Class performance	10

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Use practical knowledge to identify areas where pattern recognition techniques can offer a solution.						√						
2. Conduct, document and present a literature review on a topic related to Machine Learning and Pattern Recognition practically.								√				
3. Solve problems in regression and classification.									√			

Lecture Schedule

Week	Lecture	Topics
1	Lec 1 Lec 2 Lec 3	Introduction to MATLAB Python Script Project Idea Distribution
2	Lec 4 Lec 5 Lec 6	Introduction to MATLAB (Contd.) Python Script Pro ect Idea Distribution
3	Lec 7 Lec 8 Lec 9	Project Proposal Presentation Project Proposal Presentation (Contd.) Project Proposal Presentation (Contd.)
4	Lec 10 Lec 11 Lec 12	Bayes Classifier Bayes Classifier (Contd.) Home Assignment
5	Lec 13 Lec 14 Lec 15	K-Nearest Neighbour Classification K-Nearest Neighbour Classification (Contd.) Home Assignment
6	Lec 16 Lec 17 Lec 18	Linear Classifiers Linear Classifiers (Contd.) Home Assignment
7	Lec 19 Lec 20 Lec 21	Perceptron Algorithm Perceptron Algorithm (Contd.) Home Assignment
8	Lec 22 Lec 23 Lec 24	Lab Test 1 Lab Test 1 (Contd.) Lab Test 1 (Contd.)

9	Lec 25 Lec 26 Lec 27	Clustering Algorithms Clustering Algorithms (Contd.) Home Assignment
10	Lec 31 Lec 32 Lec 33	Project Update Project Update (Contd.) Project Update (Contd.)
11	Lec 28 Lec 29 Lec 30	Support Vector Machine Support Vector Machine (Contd.) Neural Network
12	Lec 34 Lec 35 Lec 36	Neural Network (Contd.) Decision Tree Decision Tree (Contd.)
13	Lec 37 Lec 38 Lec 39	Quiz Quiz (Contd.) Viva
14	Lec 40 Lec 41 Lec 42	Project Final Submission Project Final Submission (Contd.) Project Final Submission (Contd.)

Text and Ref Books:

1. A Guide to MATLAB for Beginners and Experienced Users (2nd Edition) - Brian R. Hunt Ronald L. Lipsman Jonathan M. Rosenberg with Kevin R. Coombes, John E. Osborn, and Garrett J. Stuck; Cambridge University Press (2006)
2. Sergios Theodoridis Introduction to Pattern Recognition: A Matlab Approach (1st Edition) - Sergios Theodoridis, Aggelos Pikrakis, Konstantinos Koutroumbas and Dionisis Covourous; Academic Press (2010)

CSE-445 — 3 hours in a week, 3.00 Cr.

Digital Signal Processing

Pre-requisite: None

Rationale:
This course discusses the concepts of discrete signal processing and their applications in communications, control and instrumentation.

Objective:

1. To understand the key theoretical principles underpinning DSP in a design procedure through design examples and case studies.
2. To learn how to use a powerful general-purpose mathematical package such as MATLAB to design and simulate Digital Signal Processing systems.
3. To determine the architecture of a digital signal processor and some programming issues in fixed-point digital signal processor in real-time implementation.
4. To design a real-time signal processing algorithms using the latest fixed-point processor.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Explain the key theoretical principles underpinning DSP in a design procedure through this design examples and case study
2. Determine the architecture of a digital signal processor and some programming issues in fixed-point digital signal processor in real-time implementation.
3. Design signal processing algorithms

Course Content :

Introduction to speech, image & data processing; Discrete time signals, sequences; Linear Constant Coefficient difference equation; Sampling continuous time signals; Two dimensional sequences and systems; Z-transform, Inverse Z-transform, H-transform; Frequency domain representation, discrete time systems and signals; Fourier series and Fourier Transform; Parseval's theorem; Equivalent noise definition of bandwidth; Convolution, Correlation and method of numerical integration; Computation of the DFT: Goertzel FFT, Chirp Z-transform algorithms. Two-dimensional filter design, Quantization effects in digital filters.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
Explain the key theoretical principles underpinning DSP in a design procedure through this design examples and case study	√											
Determine the architecture of a digital signal processor and some programming issues in fixed-point digital signal processor in real-time implementation.		√										
Design signal processing algorithms					√							

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction to speech image & data processing	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Discrete time signals Sequences	
3	Lec 7 Lec 8 Lec 9	Linear Constant Coefficient difference equation	
4	Lec 10	Sampling continuous time signals	

	Lec 11 Lec 12		
5	Lec 13 Lec 14 Lec 15	Two dimensional sequences and systems	**Class Test 2**
6	Lec 16 Lec 17 Lec 18	Z-transform Inverse Z-transform H-transform	
7	Lec 19 Lec 20 Lec 21	Frequency domain representation Discrete time systems and signals	
8	Lec 22 Lec 23 Lec 24	Fourier series and Fourier Transform	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Parseval's Theorem	
10	Lec 31 Lec 32 Lec 33	Equivalent Bandwidth Noise Convolution	
11	Lec 28 Lec 29 Lec 30	Correlation Numerical integration	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Computation of the DFT	
13	Lec 37 Lec 38 Lec 39	Goertzel FFT Chirp Z-transform algorithms.	
14	Lec 40 Lec 41 Lec 42	Two-dimensional filter design Quantization effects in digital filters.	

Text and Ref Books:

1. Digital Signal Processing - John G. Proakis & Dimitris Manolakis
2. Discrete-Time Signal processing - Allan Oppenheim & Ronald Schafer
3. Digital Signal Processing-A practical approach - Emmanuel C. Ifeachor Barrie W. Jervis
4. Signals and Systems - Rodger Ziemer & William Tranter

CSE-446 **3 hours in alternate week, 0.75 Cr.**

Digital Signal Processing Sessional

Pre-requisite: None

Rationale:

This course helps to better understanding of dealing with signals and processing signals for getting desired output, removing noise associate with signals.

Objective:

1. To design, simulate and implement digital signal processing systems in MATLAB
2. To design and implement a real-time signal processing algorithms using the latest fixed-point processor.

Course Outcomes (CO):

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

1. Learn how to use a powerful general-purpose mathematical package such as MATLAB to design and simulate Digital Signal Processing systems.
2. Determine the architecture of a digital signal processor and some programming issues in fixed-point digital signal processor in real-time implementation.
3. Design a real-time signal processing algorithms using the latest fixed-point processor.

Course Content:

Speech, image & data processing algorithms; Sampling continuous time signals; Z-transform, Inverse Z-transform, Frequency domain representation, Fourier series and Fourier Transform; Equivalent noise definition of bandwidth; Convolution, Correlation and method of numerical integration; Computation of the DFT: Goertzel FFT, Chirp Z-transform algorithms. Two-dimensional filter design.

Teaching-learning and Assessment Strategy:

Lectures, class performances, lab test, quiz, viva.

Assessment Methods & their Weights:

Assessment Method	(100%)
Lab Test	40
Quiz	20
Viva	10
Class Participation	10
Report	10
Class Assessment	10

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Learn how to use a powerful general-purpose mathematical package such as MATLAB to design and simulate Digital Signal Processing systems.									√			
Determine the architecture of a digital signal processor and some programming issues in fixed-point digital signal processor in real-time implementation.							√					
Design a real-time signal processing algorithms using the latest fixed-point processor.									√			

Lecture Schedule

Week	Lecture	Topics	Remarks
1	Lec 1 Lec 2 Lec 3	Orientation Implementing signal processing algorithm	
2	Lec 4 Lec 5 Lec 6	Sampling continuous time signals	Assignment on sampling
3	Lec 7 Lec 8 Lec 9	Implementing Z-transform, Inverse Z-transform	
4	Lec 10 Lec 11 Lec 12	Problem solving on noise removal using bandwidth	
5	Lec 13	Fourier Transformation of signals	

	Lec 14 Lec 15	Assignment: Chirp Z-transform algorithms	
6	Lec 16 Lec 17 Lec 18	Lab Test	
7	Lec 19 Lec 20 Lec 21	Quiz Viva	

CSE-447 — 3 hours in a week, 3.00 Cr.
Telecommunication Engineering

Pre-requisite: None

Rationale:

This course motivates to design and install equipment used for transmitting wired phone, cellular, cable and broadband data as well as working with copper or fiber optic cabling, complex networks and switching systems in order to enable companies to communicate effectively with customers and deliver high standards of customer service.

Objective:
1. To perceive knowledge regarding different components and techniques of telecommunication system.
2. To specify problems and design various telecommunication system and networks for solving the respective problems.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Demonstrate theoretical and technical knowledge of telecommunications systems associated with LANs, MANs, and WANs.
2. Learn to design, implement, and manage telecommunications systems using voice and data
3. Model and simulate telecommunications systems and networks in order to identify and solve these problems.
4. Acquire the knowledge and expertise in the field of telecommunication hardware.

Course Content :
Introduction: overview of telecommunication; history, evolution, convergence of telecommunication and data networks; National and International regulatory bodies; Basic elements of Telecommunication: Telephone apparatus, microphone, speaker, ringer, pulse and tone dialing mechanism; local and central batteries and advanced systems of power supplies; Transmission media: Characteristics and applications of twisted pairs, coaxial cables and optical fibers, Terrestrial and satellite microwave, radio waves, VSAT; Telephone operating principles:

telephone equipment, description of the modern phone; Telephone switching systems: PSTN, PBX, standards; Basics of communication systems: modulation, multiplexing; Switching system: circuit switching, packet switching; Traffic analysis: Traffic characterization, grades of service, network blocking probabilities, delay system and queuing; Integrated services digital network (ISDN), Digital subscriber loop (DSL), Data communication equipment: Tele-Traffic analysis; Cellular telephony: Frequency reuse, frequency management, channel alignment, handoff strategies, FDMA, TDMA, CDMA and GSM, Introduction to satellite communication, Optical fiber communication, Submarine cables, Digital Radio Microwave, etc.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1.Demonstrate theoretical and technical knowledge of telecommunications systems associated with LANs, MANs, and WANs.	√											
2. Learn to design, implement, and manage telecommunications systems using voice and data.			√									
3. Model and simulate telecommunications systems and networks in order to identify and solve these problems.				√								
4. Acquire the knowledge and expertise in the field of telecommunication hardware.	√											

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction: Overview of Telecommunication History of Telecommunication Evolution of Telecommunication	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Convergence of Telecommunication Data Networks Introduction: Regulatory Bodies	
3	Lec 7 Lec 8 Lec 9	National Regulatory Bodies International Regulatory Bodies International Regulatory Bodies (Contd.)	
4	Lec 10	Basic Elements of Telecommunication, Telephone Apparatus	**Class Test 2**

	Lec 11 Lec 12	Microphone, Speaker and Ringer Pulse and Tone Dialing Mechanism, Local and Central Batteries	
5	Lec 13 Lec 14 Lec 15	Advanced Systems of Power Supplies Transmission Media Characteristics and Applications: Twisted Pairs	
6	Lec 16 Lec 17 Lec 18	Characteristics and Applications: Coaxial Cable Characteristics and Applications: Optical Fibers Terrestrial Microwave	
7	Lec 19 Lec 20 Lec 21	Satellite Microwave VSAT Radio Waves	
8	Lec 22 Lec 23 Lec 24	Telephone Operating Principles Telephone Equipment Description of a Modern Phone	
9	Lec 25 Lec 26 Lec 27	PSTN, PBX Standards Modulation Multiplexing	**Class Test 3**
10	Lec 31 Lec 32 Lec 33	Switching System Circuit Switching Packet Switching	
11	Lec 28 Lec 29 Lec 30	Traffic Characterization Traffic Analysis Grades of Service	
12	Lec 34 Lec 35 Lec 36	ISDN DSL Cellular Telephony	
13	Lec 37 Lec 38 Lec 39	FDMA, CDMA TDMA, GSM Introduction to Satellite Communication	**Class Test 4**
14	Lec 40 Lec 41 Lec 42	Optical Fibre Communication Submarine Cables Digital radio Microwave	

Text and Ref Books:

1. Introduction to Telecommunication: Voice, Data and the Internet (1st Edition) – Marion Cole; Prentice Hall (2010)
2. Essential Guide to Telecommunications (5th Edition) - Annabel Z. Dodd; Prentice Hall (2012)
3. Optical Fiber Communication: Principles and Practice (3rd Edition) – John M Senior; Pearson (2010)
4. Modern Digital and Analog Communication System (4th Edition) – B P Lathi; Oxford (2011)

CSE-448 **3 hours in a week, 3.00 Cr.**
Telecommunication Engineering Sessional

Pre-requisite: None

Rationale:

This course aims provide hands on practice to design and install equipment used for transmitting wired phone, cellular, cable and broadband data as well as working with copper or fiber optic cabling, complex networks and switching systems in order to enable companies to communicate effectively with customers and deliver high standards of customer service.

Objective:
1. To perceive knowledge regarding different components and techniques of telecommunication system.
2. To specify problems and design various telecommunication system and networks for solving the respective problems.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Demonstrate theoretical and technical knowledge of telecommunications systems associated with LANs, MANs, and WANs.
2. Learn to design, implement, and manage telecommunications systems using voice and data
3. Model and simulate telecommunications systems and networks in order to identify and solve these problems.
4. Acquire the knowledge and expertise in the field of telecommunication hardware.

Course Content :
Introduction: overview of telecommunication; history, evolution, convergence of telecommunication and data networks; National and International regulatory bodies; Basic elements of Telecommunication: Telephone apparatus, microphone, speaker, ringer, pulse and tone dialing mechanism; local and central batteries and advanced systems of power supplies; Transmission media: Characteristics and applications of twisted pairs, coaxial cables and optical fibers, Terrestrial and satellite microwave, radio waves, VSAT; Telephone operating principles: telephone equipment, description of the modern phone; Telephone switching systems: PSTN, PBX, standards; Basics of communication systems: modulation, multiplexing; Switching system: circuit switching, packet switching; Traffic analysis: Traffic characterization, grades of service, network blocking probabilities, delay system and queuing; Integrated services digital network (ISDN), Digital subscriber loop (DSL), Data communication equipment: Tele-Traffic analysis; Cellular telephony: Frequency reuse, frequency management, channel alignment, handoff strategies, FDMA, TDMA, CDMA and GSM, Introduction to satellite communication, Optical fiber communication, Submarine cables, Digital Radio Microwave, etc.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, presentation, class tests, final exam.

Assessment Methods & their Weights:

Assessment Method	(100%)
Project	40
Quiz	20
Viva/Presentation	10
Class Participation	10
Report	10
Class Assessment	10

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1.Demonstrate theoretical and technical knowledge of telecommunications systems associated with LANs, MANs, and WANs.										√		
2. Learn to design, implement, and manage telecommunications systems using voice and data.											√	
3. Model and simulate telecommunications systems and networks in order to identify and solve these problems.												√
4. Acquire the knowledge and expertise in the field of telecommunication hardware.												√

Lecture Schedule

Week	Lecture	Topics
1	Lec 1 Lec 2 Lec 3	Introduction: Overview of Telecommunication History of Telecommunication Evolution of Telecommunication
2	Lec 4 Lec 5 Lec 6	Convergence of Telecommunication Data Networks Introduction: Regulatory Bodies
3	Lec 7 Lec 8 Lec 9	National Regulatory Bodies International Regulatory Bodies International Regulatory Bodies (Contd.)
4	Lec 10	Basic Elements of Telecommunication, Telephone Apparatus

	 Lec 11 Lec 12	Microphone, Speaker and Ringer Pulse and Tone Dialing Mechanism, Local and Central Batteries
5	Lec 13 Lec 14 Lec 15	Advanced Systems of Power Supplies Transmission Media Characteristics and Applications: Twisted Pairs
6	Lec 16 Lec 17 Lec 18	Characteristics and Applications: Coaxial Cable Characteristics and Applications: Optical Fibers Terrestrial Microwave
7	Lec 19 Lec 20 Lec 21	Satellite Microwave VSAT Radio Waves
8	Lec 22 Lec 23 Lec 24	Telephone Operating Principles Telephone Equipment Description of a Modern Phone
9	Lec 25 Lec 26 Lec 27	PSTN, PBX Standards Modulation Multiplexing
10	Lec 31 Lec 32 Lec 33	Switching System Circuit Switching Packet Switching
11	Lec 28 Lec 29 Lec 30	Traffic Characterization Traffic Analysis Grades of Service
12	Lec 34 Lec 35 Lec 36	ISDN DSL Cellular Telephony
13	Lec 37 Lec 38 Lec 39	FDMA, CDMA TDMA, GSM Introduction to Satellite Communication
14	Lec 40 Lec 41 Lec 42	Optical Fibre Communication Submarine Cables Digital radio Microwave

Text and Ref Books:

1. Introduction to Telecommunication: Voice, Data and the Internet (1st Edition) – Marion Cole; Prentice Hall (2010)
2. Essential Guide to Telecommunications (5th Edition) - Annabel Z. Dodd; Prentice Hall (2012)
3. Optical Fiber Communication: Principles and Practice (3rd Edition) – John M Senior; Pearson (2010)
4. Modern Digital and Analog Communication System (4th Edition) – B P Lathi; Oxford (2011)

CSE-449 **3 hours in a week, 3.00 Cr.**

Mobile and Ubiquitous Computing

Pre-requisite: None

Rationale:

This course motivates to enable computing technologies in such a way where computing is allowed to appear anytime and everywhere by studying affordances, limitations, necessary protocols, user interfaces, framework design etc. of such computing systems in order to implement them for different applications.

Objective:

1. To identify different features that helps to develop a mobile, personalized and context independent computing system.
2. To analyze the different properties and requirements that influences the development of a mobile and ubiquitous computing system.

Course Outcomes (CO):

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

1. Describe mobile wireless communication technologies and explain their functioning.
2. Explain the fundamental trade-offs related to resource limitations and communication needs in mobile communication and sensing systems.
3. Demonstrate an understanding of the range of novel applications based upon mobile systems as well as their particular requirements

Course Content :

Introduction - Evolution of mobile computing systems, Affordances of mobile systems (ubiquitous connectivity, personalization, context awareness), Constraints of the mobile platform (wireless quality, battery limitations, UI limitations, sensing accuracy).Network and Transport Protocol for Wireless Networks, Mobile IP and Variants of TCP; Distributed Systems platforms for Mobile Computing, Proxy Based Architectures, Service Discovery, Interaction Platforms; File System support for Mobile Computing; Development in Context-aware and Ubiquitous computing; Smart Embedded devices, Information Appliance and Wearable computers; Sensing and Context Acquisition in Ubiquitous Computing; Proximity-based Networking, Communication protocol for Wireless Sensor Networks; Human Interaction in Ubiquitous Computing

Environments, Tangible User Interfaces, Privacy and Security. Technological Component of Location Based Service (LBS)-WAP, GPS, Cell Based Location, 3G wireless, VXML, SMS-MMS, Personal Area Networks (802.11, Bluetooth, IRFIDs), Micro-Electro- Mechanical (MEMES), Recommender systems (Collaborative Filtering, Intelligent Agents).Android Framework, and Application structure.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Describe mobile wireless communication technologies and explain their functioning.	√											
Explain the fundamental trade-offs related to resource limitations and communication needs in mobile communication and sensing systems.		√										
Demonstrate an understanding of the range of novel applications based upon mobile systems as well as their particular requirements.	√											

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction Evolution of Mobile Computing Systems Affordances of Mobile Systems	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Constraints of the Mobile Platform Network Protocol for Wireless Networks Transport Protocol for Wireless Networks	
3	Lec 7 Lec 8 Lec 9	Mobile IP Variants of TCP Distributed Platforms for Mobile Computing	
4	Lec 10 Lec 11	Proxy Based Architectures Service Discovery	**Class Test 2**

	Lec 12	Interaction Platforms	
5	Lec 13 Lec 14 Lec 15	File System Support for Mobile Computing Development of Context Aware Computing Development of Ubiquitous Computing	
6	Lec 16 Lec 17 Lec 18	Smart Embedded Device Information Appliance Wearable Computers	
7	Lec 19 Lec 20 Lec 21	Sensing Acquisition Context Acquisition Proximity Based Networking	
8	Lec 22 Lec 23 Lec 24	Proximity Based Networking (Contd.) Communication Protocol for Wireless Sensor Network Human Interaction in Ubiquitous Computing Environment	
9	Lec 25 Lec 26 Lec 27	Tangible User Interfaces Privacy and Security Privacy and Security (Contd.)	**Class Test 3**
10	Lec 31 Lec 32 Lec 33	Components of LBS-WAP Components of GPS Cell-based Location Service	
11	Lec 28 Lec 29 Lec 30	3G Wireless VXML SMS-MMS	
12	Lec 34 Lec 35 Lec 36	Personal Area Network 802.11 and Bluetooth IRFIDs	
13	Lec 37 Lec 38 Lec 39	Micro-electro-mechanical (MEMES) Android Framework Android Application Structure	**Class Test 4**
14	Lec 40 Lec 41 Lec 42	Recommender System Collaborative Filtering Intelligent Agents	

Text and Ref Books:

1. Context-Aware Mobile and Ubiquitous Computing for Enhanced Usability: Adaptive Technologies and Applications (1st Edition) –Dragan Stojanovic; Information Science Reference (2009)
2. Fundamentals of Mobile and Pervasive Computing (1st Edition) - Frank Adelstein,

   Sandeep KS Gupta, Golden Richard III and Loren Schwiebert; McGraw-Hill (2004)

3. Handbook on Mobile and Ubiquitous Computing: Status and Perspective (1st Edition) - Laurence T.

Yang, EviS Yukur and Seng W. Loke; CRC Press (2013)

CSE-450 **3 hours in alternate week, 0.75 Cr.**

Mobile and Ubiquitous Computing Sessional

Pre-requisite: None

Rationale:

This course motivates to use mobile communication and sensing systems based on devices which are equipped with sensors that enable the inference of the surrounding context, including the position, activity, and the environment of the user and emphasize on developing deeper understanding of the functioning of mobile wireless networks, mobile sensing, pervasive computing and applications of mobile systems.

Objective:

1. To demonstrate understanding of the technical, commercial and social issues relating to ubiquitous communications and the basics of wireless communications.
2. To develop simple wireless web applications.

Course Outcomes (CO):

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

1. Demonstrate practical skills in developing mobile sensing applications.
2. Design and create mobile application in team base with presentation.
3. Explain the range of novel applications based upon mobile systems as well as their particular requirements.

Course Content :

Evolution of mobile computing systems, Affordances of mobile systems, Network and Transport Protocol for Wireless Networks, Mobile IP and Variants of TCP, Proximity based Networking, Communication protocol for Wireless Sensor Networks.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, presentation, viva, quiz, project.

Assessment Methods & their Weights:

Assessment Method	(100%)
Project	40
Quiz	20
Viva/Presentation	10
Class Participation	10
Report	10
Class Assessment	10

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Demonstrate practical skills in developing mobile sensing applications.						√						
2. Design and create mobile application in team base with presentation.									√			
3. Explain the range of novel applications based upon mobile systems as well as their particular requirements.							√					

Lecture Schedule

Week	Lecture	Topics
1	Lec 1	Introduction to Mobile and Ubiquitous Computing
	Lec 2	Affordances of Mobile Systems
	Lec 3	Constraints of Mobile Platform
2	Lec 4	Wireless Fundamentals
	Lec 5	Introduction to Mobile OS - iOS, Android
	Lec 6	Android Programming
3	Lec 7	Discussion of Project Proposal
	Lec 8	Discussion of Project Proposal (Contd.)
	Lec 9	Discussion of Project Proposal (Contd.)
4	Lec 10	Android Programming -
	Lec 11	Android Framework
	Lec 12	Android Application Structure

5	Lec 13 Lec 14 Lec 15	UI components and Layouts Notification Manager and Listeners Home Assignment
6	Lec 16 Lec 17 Lec 18	Presentation on the project proposal Presentation on the project proposal Submission of a report
7	Lec 19 Lec 20 Lec 21	Local- Area Wireless Interfaces on Smartphones Details of IEEE 802.11 and Bluetooth Lab Assignment
8	Lec 22 Lec 23 Lec 24	Mobile Sensing Strategies Mobile Sensing Strategies (Contd.) Home Assignment
9	Lec 25 Lec 26 Lec 27	Show Project Update Show Project Update (Contd.) Show Project Update (Contd.)
10	Lec 31 Lec 32 Lec 33	Sensor Sampling Best Practices in Sensing Sensing position, Activity, Environment.
11	Lec 28 Lec 29 Lec 30	Communication Management in Android Java Sockets Data transfer with Android
12	Lec 34 Lec 35 Lec 36	Show Project Update Show Project Update (Contd.) Show Project Update (Contd.)
13	Lec 37 Lec 38 Lec 39	Wireless Traffic Analysis from Large Scale Data sets Call Data Record Home Assignment: Case Study
14	Lec 40 Lec 41 Lec 42	Viva Submission of Final Project Project Presentation

Text and Ref Books:

1. Handbook on Mobile and Ubiquitous Computing: Status and Perspective (1st Edition) - Laurence T. Yang, EviS Yukur and Seng W. Loke; CRC Press (2013)
2. Android Studio 3.0 Development Essentials (1st Edition) - Android 8 Edition; CreateSpace Independent Publishing Platform (2017)

CSE-451 **3 hours in a week, 3.00 Cr.**

Simulation and Modeling

Pre-requisite: None

Rationale:

This course motivates to enable a substitute of physical experimentation that is often utilized when conducting experiments on a real system which is impossible or impractical, often because of cost or time and instead uses mathematical knowledge and computer's computation power to solve real-world problems reasonably and in a time efficient manner.

Objective:

1. To recognize different parameters and variables that affects a system's simulation.
2. To design a model for a particular dataset and analyze a system's behaviour for real life problems.

Course Outcomes (CO):

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

1. Define basic concepts in modeling and simulation (M&S).
2. Classify various simulation models and give practical examples for each category.
3. Construct a model for a given set of data and motivate its validity.

Course Content :

Simulation modeling basics: systems, models and simulation; Classification of simulation model; Steps in a simulation study; Concepts in discrete-event simulation: event scheduling vs. process interaction approaches, Time-advance mechanism, organization of a discrete-event simulation model; continuous simulation models; Combined discrete-continuous models; Monte Carlo simulation; Simulation of queuing systems. Building valid and credible simulation models: validation principles and techniques, statistical procedures (or comparing real-world observations and simulation outputs, input modeling; Generating random numbers and random variants; Output analysis. Simulation languages; Analysis and modeling of some practical systems, Random

Number Generator, Random Variables, Probability Distribution.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, presentation, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcome (PO)**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Define basic concepts in modeling and simulation (M&S).	√											
2. Classify various simulation models and give practical examples for each category.		√										
3. Construct a model for a given set of data and motivate its validity.			√									

Lecture Schedule

Week	**Lecture**	**Topics**	**Class Test**
1	Lec 1 Lec 2 Lec 3	Introduction to Simulation Applications of Simulation System and System Environment	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Attributes of a System Types of Models Components and Organization of a Discrete Event Simulation Model	
3	Lec 7 Lec 8 Lec 9	Single Server Queuing System Performance Measure Event Routines	
4	Lec 10 Lec 11 Lec 12	Review Of Basic Probability And Statistics PDF And CDF Properties Of Random Variables	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Covariance and Correlation Jointly Continuous Random Variables Simulation of Inventory System	
6	Lec 16 Lec 17 Lec 18	Continuous Simulation Predator-Prey Model Useful Probability Distributions	

7	Lec 19 Lec 20 Lec 21	Parameterization of Continuous Distributions Continuous Probability Distribution Continuous Probability Distribution (Contd.)	
8	Lec 22 Lec 23 Lec 24	Discrete Probability Distribution Discrete Probability Distribution (Contd.) Monte Carlo Simulation	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Monte Carlo Simulation (Contd.) Generating Random Variables Random Variable Method: Inverse Transform	
10	Lec 31 Lec 32 Lec 33	Random Variable Method: Composition Random Variable Method: Convolution Random Variable Method: Acceptance - Rejection	
11	Lec 28 Lec 29 Lec 30	Random Variable Method: Acceptance - Rejection (Contd.) Mathematical Problems For Inverse Method Generating Random Variates	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Acceptance-Rejection Method For Generating Random Variates Sample Variance And Mean Central Limit Theorem	
13	Lec 37 Lec 38 Lec 39	Mathematical Problems of Central Limit Theorem Confidence Interval Test of Hypothesis And its Error	
14	Lec 40 Lec 41 Lec 42	Markov's Inequality and Chebyshev's Inequality Combined Discrete-Continuous Simulation Validation and Verification Of Simulation Model	

Text and Ref Books:

1. Simulation Modeling and Analysis (5th Edition) - Law A. M., Kelton W. D.; McGraw Hill (2014)
2. Computer Aided Modeling and simulation - J. A. Spriet
3. Computer Simulation and Modeling - R. S. Lehman
4. System Simulation - G. Cordon

3 hours in alternate week, 0.75 Cr.

CSE-452
Simulation and Modeling Sessional

Pre-requisite: None

Rationale:

This course motivates to design various models to solve real-world problems using mathematics, computer programming language, computation power etc. and analyze the behaviour of a system for different types of dataset to provide a reasonable decision regarding the performance of a system in a cost and time effective manner.

Objective:

1. To design a model for a physical experimentation using different programming languages on different platforms.
2. To analyze the the characteristics of the simulation result basing on different sets of data and test its validity.

Course Outcomes (CO):

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

1. Generate and test random number variants and apply them to develop simulation models.
2. Select and analyze output data produced by a model and test the validity of the model.
3. Construct a model for a given set of data and motivate its validity.

Course Content :
Simulation modeling basics: systems, models and simulation, Classification of simulation model, Steps in a simulation study, Single Server Queuing System, Inventory Management System, Monte Carlo Method, Pure Pursuit Problem, Probability Distribution Fitting, Random Number Generation, Hypothesis Testing.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, lab test, quiz, viva.

Assessment Methods & their Weights:

Assessment Method	(100%)
Lab Test	40
Quiz	20
Viva	10
Class Participation	10
Report	10
Class Assessment	10

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Generate and test random number variants and apply them to develop simulation models.										√		
2. Select and analyze output data produced by a model and test the validity of the model.											√	
3. Construct a model for a given set of data and motivate its validity.									√			

Lecture Schedule

Week	Lecture	Topics	Remarks
1	Lec 1 Lec 2 Lec 3	Simulation Modeling Basics Systems, Models and Simulation Types Sequence of Simulation Study	
2	Lec 4 Lec 5 Lec 6	Single Server Queuing System Lab Assignment Home Assignment	
3	Lec 7 Lec 8 Lec 9	Single Server Queuing System (Contd.) Lab Assignment Home Assignment	
4	Lec 10 Lec 11 Lec 12	Inventory Management System Lab Assignment Home Assignment	

5	Lec 13 Lec 14 Lec 15	Inventory Management System (Contd.) Lab Assignment Home Assignment	
6	Lec 16 Lec 17 Lec 18	Monte Carlo Method Lab Assignment Home Assignment	
7	Lec 19 Lec 20 Lec 21	Monte Carlo Method (Contd.) Lab Assignment Home Assignment	
8	Lec 22 Lec 23 Lec 24	Pure Pursuit Problem Lab Assignment Home Assignment	
9	Lec 25 Lec 26 Lec 27	Pure Pursuit Problem (Contd.) Lab Assignment Home Assignment	
10	Lec 31 Lec 32 Lec 33	Probability Distribution Fitting Lab Assignment Home Assignment	
11	Lec 28 Lec 29 Lec 30	Probability Distribution Fitting (Contd.) Lab Assignment Home Assignment	
12	Lec 34 Lec 35 Lec 36	Random Number Generation Lab Assignment Home Assignment	
13	Lec 37 Lec 38 Lec 39	Hypothesis Testing Lab Assignment Home Assignment	
14	Lec 40 Lec 41 Lec 42	Lab Test Quiz Viva	

Text and Ref Books:

1. Discrete-Event System Simulation (5th Edition) - Jerry Banks; Prentice Hall (2009)

CSE-453 3 hours in a week, 3.00Cr.

Data Ware-housing and Data Mining

Pre-requisite: NONE

Rationale:

For better data analysis, visualization and decision making concepts of data ware housing and data mining plays vital role.

Objective:

1. To evaluate accuracy of models/ algorithms, discover and measure interesting patterns from different kinds of databases of clustering, classification, association finding, feature selection and visualization to real world data.

2. To identify problems profitably be addressed via data mining methods.

Course Outcomes (CO):

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

1. Decide and evaluate models/ algorithms with respect to their accuracy.

2. Discover and measure interesting patterns from different kinds of databases. Apply the techniques of clustering, classification, association finding, feature selection and visualization to real world data.

3. Learn to identify problems that can profitably be addressed via data mining methods.

Course Content:

Introduction; Data warehousing and OLAP technology for data mining; Data preprocessing; Data mining
primitives, languages and systems; Data visualization techniques; Data Cube computation and multidimensional data analysis; Descriptive data mining: characterization and comparison; Association analysis; Classification and prediction; Cluster analysis; Mining complex types of data; Applications and trends in data mining.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, class tests, final exam.

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Decide and evaluate models/ algorithms with respect to their accuracy		√										
Discover and measure interesting patterns from different kinds of databases. Apply the techniques of clustering, classification, association finding, feature selection and visualization to real world data.			√									
Learn to identify problems that can profitably be addressed via data mining methods.		√										

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Introduction	**Class Test 1**
2	Lec 4 Lec 5 Lec 6	Data warehousing and OLAP technology for data mining	
3	Lec 7 Lec 8 Lec 9	Data preprocessing	
4	Lec 10 Lec 11 Lec 12	Data mining primitives, languages and systems	**Class Test 2**
5	Lec 13 Lec 14 Lec 15	Data Visualization Techniques	
6	Lec 16 Lec 17 Lec 18	Data Cube computation	
7	Lec 19 Lec 20 Lec 21	Multidimensional data analysis	
8	Lec 22 Lec 23 Lec 24	Descriptive Data mining	**Class Test 3**
9	Lec 25 Lec 26 Lec 27	Characterization and comparison	

10	Lec 31 Lec 32 Lec 33	Association analysis	
11	Lec 28 Lec 29 Lec 30	Classification and prediction	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Cluster analysis	
13	Lec 37 Lec 38 Lec 39	Mining complex types of data	
14	Lec 40 Lec 41 Lec 42	Applications and trends in data mining	

Text and Ref Books:

1. Data Mining: Concepts and Techniques - Jiawei Han, MichelineKamber, and Jian Pei, (Morgan Kaufmann)
2. Data Mining and Data Warehousing - Bharat BhushanAgarwal, SumitPrakashTayal
3. Data Warehousing, Data Mining, and OLAP - Alex Berson and Stephen J. Smith

CSE-454 3 hours in alternate week, 0.75 Cr.

Data Ware-housing and Data Mining Sessional

Pre-requisite: None

Rationale:

Implementing data analysis methods, visualization and decision making concepts of data ware housing and data mining.

Objective:

1. Gain a working knowledge of the strengths and limitations of modern data mining methods (algorithms).
2. Learn to identify problems that can profitably be addressed via data mining methods.
3. Learn how to set up data for data mining experiments.

Course Outcomes (CO):

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

1. Gain a working knowledge of the strengths and limitations of modern data mining methods (algorithms).
2. Learn to identify problems that can profitably be addressed via data mining methods.

3. Learn how to set up data for data mining experiments.

Course Content:
Data warehousing and OLAP technology, Data preprocessing, Data visualization techniques, Data Cube computation and multidimensional data analysis, Association analysis; Classification and prediction; Cluster analysis; Mining complex types of data.

Teaching-learning and Assessment Strategy:
Lectures, class performances, assignments, lab tests, quiz, viva.

Assessment Methods & their Weights:

Assessment Method	(100%)
Lab Test	40
Quiz	20
Viva	10
Class Participation	10
Report	10
Class Assessment	10

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
Gain a working knowledge of the strengths and limitations of modern data mining methods (algorithms).	√											
Learn to identify problems that can profitably be addressed via data mining methods.		√										
Learn how to set up data for data mining experiments.			√									

Lecture Schedule

Week	Lecture	Topics	Remarks
1	Lec 1 Lec 2 Lec 3	Orientation lab Practical on Data warehousing	
2	Lec 4 Lec 5 Lec 6	Implementing Data preprocessing techniques	Assignment

3	Lec 7 Lec 8 Lec 9	Implementing Data visualization techniques Implementing association analysis	Assignment
4	Lec 10 Lec 11 Lec 12	Practice on Classification and prediction;	Lab Test 1
5	Lec 13 Lec 14 Lec 15	Practice on Cluster analysis	Assignment
6	Lec 16 Lec 17 Lec 18	Final Lab Test	
7	Lec 19 Lec 20 Lec 21	Final Quiz Viva	

Text and Ref Books:

1. Data Mining: Concepts and Techniques - Jiawei Han, Micheline Kamber, and Jian Pei, (Morgan Kaufmann)
2. Data Mining and Data Warehousing - Bharat Bhushan Agarwal, Sumit Prakash Tayal