DAYANANDA SAGAR UNIVERSITY

SCHOOL OF ENGINEERING

SCHEME & SYLLABUS
FOR
BACHELOR OF TECHNOLOGY (B.Tech)

COMPUTER SCIENCE & ENGINEERING
(Cyber Security)

(1st to 8th Semester)

With effect from 2021-22)

DAYANANDA SAGAR UNIVERSITY

(A State Private University under the Karnataka Act No. 20 of 2013)

Approved By UGC & AICTE, New Delhi.

VISION

To be a centre of excellence in education, research & training, innovation & entrepreneurship and to produce citizens with exceptional leadership qualities to serve national and global needs.

MISSION

To achieve our objectives in an environment that enhances creativity, innovation and scholarly pursuits while adhering to our vision.

VALUES

The Pursuit of Excellence

A commitment to strive continuously to improve ourselves and our systems with the aim of becoming the best in our field.

Fairness

A commitment to objectivity and impartiality, to earn the trust and respect of society.

Leadership

A commitment to lead responsively and creatively in educational and research processes.

Integrity and Transparency

A commitment to be ethical, sincere and transparent in all activities and to treat all individuals with dignity and respect.

SCHOOL OF ENGINEERING

SCHOOL OF ENGINEERING

(Hosur Main Road, Kudlu Gate, Bengaluru-560 068)

Approved By UGC & AICTE, New Delhi.

VISION

To transform life through Excellence and Innovation in Engineering Education and Research with an emphasis on Sustainable, Inclusive Technology and Global needs.

MISSION

To Develop School of Engineering at Dayananda Sagar University, as Center of Excellence by imparting Quality Education and Research to generate highly Competent, Skilled and Humane manpower to face emerging Technological, Scientific and Social challenges with Ethics, Integrity, Credibility and Social concern.

LEADERSHIPS

Sl. No	Name	Position
1	Dr. D. Hemachandra Sagar	Chancellor, DSU
2	Dr. D. Premachandra Sagar	Pro Chancellor, DSU
	Mr. Galiswamy	Secretory
3	Dr. K.N.Balasubramanya Murthy	Vice Chancellor, DSU
4	Prof. Janardhan R	Pro Vice Chancellor, DSU
5	Dr. Amith R Bhatt	Pro Vice Chancellor, DSU
6	Dr. Puttamadappa C	Registrar, DSU
7	Dr. Uday Kumar Reddy	Dean, SOE, DSU
8	Dr. Banga M K	Dean - Research, DSU
9	Dr. B V N Ramakumar	Professor and Chairman Department of Aerospace Engineering
10	Dr. Jayavrinda Vrindavanam	Professor and Chairman, Department of CSE (Artificial Intelligence and Machine Learning)
11	Dr. Girisha G S	Professor and Chairman, Department of Computer Science and Engineering
12	Dr. Kiran B. Malagi	Professor and Chairman, Department of CSE (Cyber Security)
13	Dr. Shaila S G	Professor and Chairman, Department of CSE (Data Science)
14	Dr M Shahina Parveen	Professor and Chairperson Department of Computer Science & Technology
15	Dr. Theodore Chandra S	Professor and Chairman, Department of ECE
16	Dr. Vinayak B Hemadri	Professor and Chairman Department of Mechanical Engineering
17	Dr. Vasanthi Kumari P	Chairperson & Professor Department of Computer Applications

GOVERNING REGULATIONS FOR

BACHELOR OF TECHNOLOGY (B. TECH) – 2021

PREAMBLE

The School of Engineering under Dayananda Sagar University (DSU) provides Science & Technology based education leading to the development of high caliber engineers suitable for Industry and Scientific Organization. The curriculum focuses on knowledge-based course work integrated with skill development as a part of training. It equally helps in inculcating the scientific temper for the lifelong processes of learning. At the Under Graduate level, a candidate goes through the foundation courses in Science, Humanities & Engineering. Each department ensures that the courses cover both the core & electives courses, as required. Provision for Institutional elective help the candidates to acquire interdisciplinary knowledge base or specialize significantly in an area outside the parent discipline

DEFINITIONS OF KEY WORDS

(i) **Academic Year:** Two consecutive odd, even semesters and a summer term for make up if required.

(ii) **Course:** Usually referred to as a subject, a course may consist of any of Lecture/Tutorials/Practical /Seminar/Mini project/Project work.

(iii) **Credit:** A unit by which the course work is measured. One credit is equivalent to one hour of lecture or one hour of tutorial or two hours of laboratory/practical/ workshop practice per week.

(iv) **Credit Point:** It is the product of grade point and number of credits per course.

(v) **Cumulative Grade Point Average (CGPA):** It is the measure of overall cumulative performance over all semesters. It is expressed upto two decimal places.

(vi) **First Attempt:** If a candidate has completed all formalities of academic requirement in a term and become eligible to attend the examinations and attend all the end semester examinations, such attempt shall be considered as first attempt.

(vii) **Grade Point:** It is a numerical weight allotted to each letter grade on a 10-point scale.

(viii) **Letter Grade:** It is an index of the performance in a said course. Grades are denoted by alphabets.

(ix) **Programme:** An educational activity leading to award a Degree or Certificate.

(x) **Semester Grade Point Average:** It is a measure of performance during a semester. It shall be expressed up to two decimal places.

(xi) **Transcript:** Based on the grades earned, a grade certificate shall be issued after every semester to the candidate registered

(xii) **Failure:** It is the case of appearing for Semester End Examinations, but fails to obtain minimum passing marks in Semester End Examinations.

(xiii) **Detain:** It is the case of not satisfying the eligibility criteria w.r.t Attendance /Internal Assessment in each course to appear for Semester End Examination.

(xiv) **Audit Course:** A course to be taken by the student without benefit of a grade or a credit.

(xv) **Not Fit For The Program (NFFTP):** It is the failure of satisfying the criteria laid down by regulations to continue the program of study, which leads to the termination from the University

RULES AND REGULATIONS

UG 1 All B.Tech programmes offered by the University shall be governed by the DSU B.Tech Rules and Regulations – 2021.

UG 2 The B. Tech. rules and regulations shall be applicable to any new discipline(s) that may be introduced in future.

UG 3 A candidate shall become eligible for the award of the B.Tech. Degree after fulfilling all the academic requirements as prescribed by the B.Tech. Rules and Regulations of DSU.

UG 4. ELIGIBILITY FOR ADMISSION

UG 4.1. Admission to First Year Bachelor of Technology shall be open to candidates who have passed the second year Pre-University or XII standard or equivalent examination recognized by the University.

UG 4.2. The candidate shall have studied and passed English as one of the courses and secured not less than forty five percent (45%) marks in aggregate with Physics and Mathematics as compulsory courses, along with any one of the following courses, namely, Chemistry, Bio- Technology, Computer Science, Biology and Electronics. Eligibility shall be 40% in optional courses in case of candidates belonging to SC/ST and OBC candidates from Karnataka.

UG 4.3. Admission to II year /III Semester Bachelor of Technology under Lateral entry shall be open to the candidates who have passed diploma or equivalent

UG 4.4. Admission to II year /III Semester Bachelor of Technology under Lateral entry shall be open to the candidates who have passed diploma or equivalent

UG 4.5. Diploma candidates seeking admission under Lateral entry shall take up bridge courses as prescribed in the Scheme of Teaching.

UG 4.6. Admission to II year /III Semester Bachelor of Technology shall be open to candidates who have passed B. Sc. degree from a recognized University or equivalent as recognized by the University and secure not less than 45% marks in aggregate (including all semesters). Eligibility shall be 40% in case of candidates belonging to SC/ST and OBC candidates from Karnataka.

UG 4.7. B.Sc. Graduates seeking admission under Lateral entry shall take up bridge Courses as prescribed in the Scheme of Teaching.

UG 5. ACADEMIC SESSION

UG 5.1. Each academic session is divided into two semesters of approximately sixteen Weeks duration and a summer term: an odd semester (August -December), an even semester (January - May) and summer term (Make-up term) June-July.

UG 5.2. The approved schedule of academic activities for a session, inclusive of dates for registration, mid-semester and end-semester examinations, vacation breaks, shall be laid down in the Academic Calendar for the session.

UG 6. CHANGE OF BRANCH

UG 6.1. Normally a candidate admitted to a particular branch of the undergraduate programme will continue studying in that branch till completion.

UG 6.2. However, in special cases, the University may permit a candidate to change from one branch of studies to another after the first two semesters. Such changes will be permitted, in accordance with the provisions laid down hereinafter.

UG 6.3. Only those candidates will be considered eligible for change of branch after the second semester, who have completed all the credits required in the first two semesters of their studies in their first attempt, without having to pass any course requirement in the summer term examination.

UG 6.4. Applications for a change of branch must be made by intending eligible candidates in the prescribed form. The academic section will call for applications at the end of second semester of each academic year and the completed forms must be submitted by the last date specified in the notification.

UG 6.5. Candidates may enlist their choices of branch, in order of preference, to which they wish to change over. It will not be permissible to alter the choices after the application has been submitted.

UG 6.6. Change of branch shall be made strictly in the order of merit of the applicants. For this purpose, the CGPA obtained at the end of the second semester shall be considered. In case of a tie, SGPA of second semester followed by SGPA of first semester shall decide the tie.

UG 6.7. The applicants may be allowed a change in branch, strictly in order of merit, course to the limitation that the strength of a branch should not fall below the existing strength by more than ten percent and should not go above the sanctioned strength by more than ten percent. The minimum class strength of 75% should be maintained, while considering the change of branch.

UG 6.8. All changes of branch made in accordance with the above rules shall be effective from the third semester of the applicants concerned. No change of branch shall be permitted after this.

UG 7. COURSE STRUCTURE

UG 7.1. Medium of instruction, examination and project reports shall be in English except in case of any language audit courses.

UG 7.2. Teaching of the courses shall be reckoned in credits: Credits are assigned to the Courses based on the following general pattern:

(a) One credit for each lecture period.
(b) One credit for each tutorial period.
(c) One credit per two hours for each Laboratory or Practical or work shop session.
(d) Credits for seminar, mini project, project as indicated in the scheme/curriculum of teaching.

UG 7.3. In order to qualify for a B. Tech. degree of the University, a candidate is required to complete the credit requirement as prescribed in the scheme/curriculum for a particular programme.

UG 7.4. The program of a study consists of the following components:

(i) Humanities and Social Sciences including Management courses
(ii) Basic Science courses
(iii) Engineering Science courses
(iv) Professional core courses
(v) Open Electives
(vi) Project work, seminar and internship
(vii) Mandatory/Audit Courses

UG 7.5. Every B. Tech. Programme shall have a curriculum and syllabi for the courses approved by the Board of Governors. Board of Studies will discuss and recommend the syllabi of all the under graduate courses offered by the department from time to time before sending the same to the Academic Council. Academic Council will consider the proposals from the Board of Studies and make recommendations to the Board of Management and Board of Governors for consideration and approval. For all approved courses, the copyright shall be with DSU.

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UG 8. REGISTRATION

UG 8.1. Every candidate is required to register for approved courses through the assigned Faculty Advisor at the end of previous semester or first week of the current semester, as notified by the Academic Calendar.

UG 8.2. The Dean may cancel the registration of one or more courses if they are found to violate some rules or if there are restrictions imposed due to disciplinary reasons.

UG 8.3. The student is permitted to drop a course/s from the registered courses, within 4 weeks after the start of the Semester/Year as notified in the academic calendar, with the permission of Faculty Advisor and Chairperson / Dean / Principal of the respective School/College and no mention will be made in the grade card for dropped courses.

UG 8.4. The student is permitted to withdraw course/s from the registered courses, within 4 weeks before the start of the Semester/Year End Examinations as notified in the academic calendar, with the permission of Faculty Advisor and Chairperson / Dean / Principal of the respective School / College and Grade "W" will be awarded for course/s that were withdrawn.

UG 8.5. For the courses with "W" grade, the students should re-register subsequently when offered, either in MOOCS or in-class or summer term and fulfil the passing criteria to secure a grade in that course for change from "W" grade.

UG 8.6. Only those candidates shall be permitted to register who have:

(a) The academic eligibility to move to higher semesters (UG 9 & UG 11)
(b) Cleared all University, Hostel and Library dues and fines (if any) of the previous semesters,
(c) Paid all required advance payments of University and Hostel dues for the current semester,
(d) Not been debarred from registering on any specific ground.
(e) A minimum CGPA of 4 in the previous semesters

UG 9. EXAMINATION: ASSESSMENT CRITERIA & ELIGIBILITYFOR PROGRESSION

Every student shall be assessed for eligibility to higher semester through Continuous Internal Assessment (CIA) and Semester End Examination (SEE) as prescribed.

UG 9.1. The Continuous Internal Assessment (CIA), shall normally be conducted by the assessment components spread through the running semester; the components of CIA may be tests, mid-term exam, quiz, term paper, simulation-based problem solving, open-book test, solving open-end problems, mini-projects, seminars, viva-voce, awarding marks for attendance and such activities that enhance original thinking of students. The Course instructor shall announce the detailed methodology for conducting the various components of CIA together specifying component-wise weightages right in the commencement of each semester.

UG 9.2. The Semester End Examinations (SEE), shall be conducted at the end of each semester. The SEE components may be a closed or open book examination, project demo, viva-voce, and/or a portfolio presentation.

UG 9.3. A and SEE shall respectively have 60:40 percent weightage. The Vice-Chancellor, on the recommendations of the Dean of Faculty and Department Chair, in exceptional cases, may approve the variation in this weightage ratio.

UG 9.4. The performance of a student with respect to a course in a semester shall be the combined score of marks/points, he/she secures in CIA and SEE, put together. A minimum of securing 40% marks, combining both the CIA with SEE marks secured with respect to a course, shall entail the student a PASS in the course. The Vice-Chancellor, in such cases where the entire class has fared poorly in the course, upon receiving a representation by the students / department, and based on the recommendations of the committee constituted for the purpose, may review the criterion of 40%.

UG 9.5. ATTENDANCE ELIGIBILITY

UG 9.5.1. Candidates are required to attend all the classes (Lectures, Tutorials, Practical, Workshop Practice, etc.) for which they have been registered.

UG 9.5.2. The candidate shall not be allowed to appear for the end semester examination if his/her attendance falls below 85% in each course and shall be awarded a "NE" grade in that course.

UG 9.5.3. A provision for condonation of 10% of the attendance by the Vice-Chancellor on the specific recommendation of the chairman of the department and Dean, showing reasonable cause such as:

(a) Any medical emergencies/ illness where the candidate requires rest for the specified number of days certified by a Government Doctor only /any death in the family (near and dear ones).

(b) If the student represents the University in Sports/ Cultural Activities/Extra-curricular activities/Co-curricular activities.

(c) If a student presents a Paper in National/ International Conferences or attends any recognized Workshops/Seminars.

UG 9.5.4. If the period of leave is for a short duration (less than two weeks), prior application for leave shall have to be submitted to the Chairman of the Department concerned stating fully the reasons for the leave requested for along with supporting document(s). Such leave will be granted by the Chairman of the Department. However, the student shall comply with 9.5.2 and 9.5.3. of regulations.

UG 9.5.5. If the period of absence is likely to exceed two weeks, a prior application for grant of leave will have to be submitted through the Chairman of the Department to the Dean with supporting documents in each case. The decision to grant leave shall be taken by the Dean on the recommendation of the Chairman of the Department. However, the student shall comply with 9.5.2 and 9.5.3. of regulations.

UG 9.5.6. It shall be the responsibility of the candidate to intimate the concerned course instructor(s) regarding his/her absence before availing the leave.

UG 9.6. CONTINUOUS INTERNAL ASSESSMENT

UG 9.6.1. Candidate shall participate in all components of Continuous Internal Assessment (CIA) to become eligible to take up the Semester End Examination or else 'NE' grade shall be awarded. However, the Vice-Chancellor, under exceptional circumstances on the recommendations of Dean of Faculty and Department Chair, may exempt a student from participation in CIA component/s and permit taking up SEE.

UG 9.6.2. There shall be no marks improvement of Continuous Internal Assessment; however, the withdrawal and re-registering of the course shall be permitted.

UG 9.6.3. Continuous Evaluation consists of:

UG 9.6.3.1. Under normal circumstances for theory courses, total CIA weightage shall be a total of 60%, put together all components with varying weightages; Under exceptional circumstances with the approval of the Vice-Chancellor on the recommendation of Dean of the School, the weightage of CIA may be lower/higher than 60%.
The components of CIA may be tests, mid-term exam, quiz, term paper, simulation-based problem solving, open-book test, solving open-end problems, mini-projects, seminars, viva-voce, awarding marks for attendance and such activities that enhance original thinking of students.

UG 9.6.3.2. Under normal circumstances for the practical courses (laboratory, workshops, and any such hands-on activity), total CIA weightage shall be a total of 60%, put together all components with varying weightages; Under exceptional circumstances with the approval of the Vice-Chancellor on the recommendation of Dean of the School, the weightage of CIA may be lower/higher than 60%.
CIA may have components such as conduction of an experiment, record writing, viva-voce, tests, simulation, mid-term exam, quiz, demo, term paper, mini-projects, seminars, marks for attendance and activities which enhances original thinking of students.

UG 10. GRADING

UG 10.1. There shall be continuous assessment of a candidate's performance throughout the semester and grades shall be awarded by the concerned course instructor and/or the appropriate committee appointed for this purpose on the following basis.

UG 10.2. The grading will normally be based on CIA and SEE.

UG 10.3. Practical Courses/ Work Shop Practice: The evaluation will be based on instructor's continuous internal assessment, a test and end semester examination.

UG 10.4. The weightage assigned to different components of continuous internal assessment will be announced by the concerned instructor(s) in the beginning of the semester

UG 10.5. The results of performance of the candidates in the Continuous Internal assessment Test shall be announced by the instructors.

UG 10.6. In case of seminar, evaluation will be as determined by the grade awarding Committee (as per the Program scheme).

UG 10.7. Mini project /projects will be based on Continuous evaluation by Guide(s) and Semester End Examination (as per the Program scheme)

UG 10.8. The results of performance of the candidates shall be announced by the Controller of Examinations.

UG 10.9. METHOD OF AWARDING LETTER GRADES

UG 10.9.1. Relationships among Grades, Grade points and % of marks are listed in Table1.

UG 10.10. DESCRIPTION OF GRADES

UG 10.10.1. Table 1 shows the relationships among the grades, grade points and percentage of marks.

Table 1: Grade, Points, Grade Description and % of marks

GRADE	GRADE POINTS	DESCRIPTION	% MARKS
O	10	Outstanding	90 to 100
A+	9	Excellent	80 to 89
A	8	Very Good	70 to 79
B+	7	Good	60 to 69
B	6	Above Average	55 to 59
C	5	Average	50 to 54
P	4	Pass	40 to 49
F	0	Fail	< 40
AP	-	Audit Pass	-
AF	-	Audit Fail	-
IC	-	In Complete	-
NE	-	Not Eligible	-
W	-	Withdrawn	-

UG 10.10.2. A student will have to ensure a minimum CGPA of 4, to become eligible for the award of the degree.

UG 10.10.3. A candidate shall have to repeat all courses in which he/she obtains 'F' Grades until a passing grade is obtained.

UG 10.10.4. An IC grade denotes incomplete performance in any Theory and/or Practical Assessment. It may be awarded in case of absence on medical grounds or other special circumstances for SEE. Requests for IC grade should be made at the earliest but not later than the last day of SEE.

UG 10.10.5. The student can appear for the course/s with IC grade, when exams are conducted subsequently by the University for those Courses.

UG10.11. EVALUATION OF PERFORMANCE

UG10.11.1. The performance of a candidate shall be evaluated in terms of the Semester Grade Point Average (SGPA) which is the Grade Point Average for a semester, Cumulative Grade Point Average (CGPA) which is the Grade Point Average for all the completed semesters.

UG 10.11.2. The Earned Credits (EC) are defined as the sum of course credits for courses in which candidates have been awarded grades between O to P. (Table 1)

UG 10.11.3. Points earned in a semester = (Course credits X Grade point) for Grades O - P

UG 10.11.4. The SGPA is calculated on the basis of grades obtained in all courses, except audit courses and courses in which F grade or below, registered for in the particular semester.

$$\text{SGPA} = \frac{\text{Points secured in the semester (O} - \text{P Grades)}}{\text{Credits registered in the semester, excluding audit}}$$

UG 10.11.5. The CGPA is calculated on the basis of all pass grades, except audit courses.

$$\text{CGPA} = \frac{\text{Cumulative points secured in all the passed courses (O} - \text{P Grades)}}{\text{Cumulative registered credits, excluding audit}}$$

UG 10.12. WITHHOLDING OF GRADES

UG 10.12.1. Grades shall be withheld when the candidate has not paid his/her dues or when there is a disciplinary action pending against him/her

UG 10.13. CONVERSION OF CGPA INTO PERCENTAGE

UG 10.13.1. Conversion formula for the conversion of CGPA into percentage is
Percentage of Marks Scored = (CGPA Earned − 0.75) × 10

UG 11. PROMOTION CRITERIA AND ENROLLMENTS TO HIGHER SEMESTERS

UG 11.1. During registration to the higher semesters, the following criteria/conditions for promotion, shall be satisfied.

UG 11.1.1. A student shall 'Not Eligible' (NE) for writing SEE if he/she does not comply to the minimum prescribed attendance in any course that carry a credit.
Students shall register afresh for such course/s, whenever offered next, to meet the attendance requirements and secure a pass grade, subsequently in that course/s.

UG 11.1.2. In a semester (ODD / EVEN), a student is deemed to be Not Eligible (NE) if he/she does not satisfy minimum attendance requirements criteria in a credit course.
If this course happens to be a prerequisite to a connected course in the subsequent semester, then the student shall not be permitted to register for that connected course until he / she secures pass grade in the prerequisite course by complying to the minimum attendance requirement when the prerequisite course is offered next (either during summer term or regular semester).

UG 11.1.3. A student shall be permitted to register for FOUR credited courses or to a total of 16 credits whichever is higher along with pending audit courses, if any, during a summer term by paying the prescribed course registration fee per credit notified by the university from time to time.

UG 11.1.4. A student shall be permitted to register for FOUR credited courses or to a total of 16 credits whichever is higher along with pending audit courses, if any, during a summer term by paying the prescribed course registration fee per credit notified by the university from time to time.

UG 11.1.5. Candidates who secure 'F' grade in any courses in regular semester or summer term shall secure PASS grade in such course/s either in the subsequent summer term examination or shall repeat in the next appropriate semester whenever it is/they are offered, i.e. odd semester courses during odd semesters examinations and even semester courses during even semester examinations, respectively.

UG 11.2. In case of failure in Practical/Workshop practice course the candidate in any semester may clear it in the subsequent summer term examination or semester examination.

UG 11.3. In case a candidate fails in Practical/ Workshop practice he/she shall register when it is offered next either in the summer term or subsequent semester, as the case may be.

UG 11.4. Candidates may add and drop course(s) with the concurrence of the Faculty Advisor, and under intimation to the concerned course instructors and the academic section provided this is done within the date mentioned in the Academic Calendar.

UG 11.5. SUMMER TERM & MAKEUP EXAMINATIONS

UG 11.5.1. A summer term program may be offered by a department and with the approval of the Dean.

UG 11.5.2. Summer term courses will be announced by the Academic Affairs Office at the end of the even semester and before the commencement of the end semester examination. A candidate will have to register for summer term courses by paying the prescribed fees within the stipulated time in the announcement.

UG 11.5.3. The total number of contact hours in any summer term program will be the same as in the regular semester course. The assessment procedure in a summer term course will also be similar to the procedure for a regular semester course.

UG 11.5.4. Candidates granted semester drop by the Board of Governors, on medical ground, shall be allowed to clear the concerned courses in summer term course and subject to conditions as stated under clauses 11.5.1, 11.5.2.and 11.5.3.

UG 11.5.5. The Candidates with "NE" grade shall register for summer term by paying the prescribed fees.

UG 11.5.6. Candidates who are awarded 'F' grades in regular semester examinations have the option to register for the concerned courses in summer term examinations to the conditions as stated under clauses 11.5.1, 11.5.2.and 11.5.3above, or they can re-sit for subsequent semester/summer term examination only.

UG 11.5.7. Provision for make-up exam shall be available to the students who might have missed to attend the Semester / Annual end examinations of one or more courses for exceptional cases arising out of natural calamities / medical emergencies / death of a member in the family, with the permission of Faculty Advisor and Chairperson / Dean / Principal of the respective School/College. All such cases have to be exclusively to be approved by the Vice-Chancellor and ratified in the Academic Council / BOM / BOG. All such courses approved for makeup examinations are awarded a transitory grade "IC" (incomplete grade)

UG 11.5.8. The makeup examinations shall be held as notified in the academic calendar or through an exclusive notification duly approved by the Vice-chancellor.

UG 12. DURATION OF THE PROGRAMME

UG 12.1. Normally a candidate should complete all the requirements for under graduate programme in four years. However, academically weaker candidates who do not fulfil some of the requirements in their first attempt and have to repeat them in subsequent semesters may be permitted up to eight consecutive years (from the first year of registration) to complete all the requirements of the degree.

UG 12.2. Normally a candidate under lateral entry should complete all the requirements for undergraduate programme in three years. However, academically weaker candidates who do not fulfil some of the requirements in their first attempt and have to repeat them in subsequent semesters may be permitted up to six consecutive years (from the second year registration) to complete all the requirements of the degree.

UG 13. TERMINATION FROM THE PROGRAMME

UG 13.1. A candidate may also be compelled to leave the Program in the University on disciplinary grounds.

UG 13.2. On having been found to have produced false documents or having made false declaration at the time of seeking admission.

UG 13.3. On having been found to be pursuing regular studies and/or correspondence courses (leading to degree or diploma) in any other college, university or an educational institution simultaneously.

UG 13.4. On having been found to be concurrently employed and performing duty or carrying out business in contravention to academic schedules of the University and without seeking approval from the University.

UG 13.5. If a student fails to earn a pass grade even after 4 attempts such a student is terminated from the university on the grounds of NOT FIT FOR THE PROGRAM (NFFTP).

UG 13.6. If a student secures a CGPA less than 4.0, 4 times during entire duration of the program of study, such a student is terminated from the university on the grounds of NOT FIT FOR THE PROGRAM (NFFTP).

UG 13.7. However, if the student appeals for reconsideration of termination from the university under NFFTP rule by providing the guanine reasons to the Vice-Chancellor through the Dean of Faculty, then the Vice-Chancellor may consider constituting a committee for the purpose of review and provide 2 additional attempts on the recommendations of the committee.

UG 14. TEMPORARY WITHDRAWAL FROM THE UNIVERSITY

UG 14.1.1. He/she applies to the University within at least 6 weeks of the commencement of the semester or from the date he last attended his/her classes whichever is later, stating fully the reasons for such withdrawal together with supporting documents and endorsement of his/her guardian.

UG 14.1.2. The University is satisfied that, counting the period of withdrawal, the candidate is likely to complete his/her requirements of the B. Tech. Degree within the time limits specified in Clause 12.1 or 12.2 above.

UG 14.1.3. There are no outstanding dues or demands in the University/Hostel/Department/ Library.

UG 14.1.4. Normally, a candidate will be permitted only one such temporary withdrawal during his/her tenure as a candidate of the undergraduate programme.

UG 15. TRANSFER OF CANDIDATES

UG 15.1. Transfer of candidates from higher education institutions outside University shall be considered at the beginning of Third and Fifth Semesters but subject to confirmation of equivalence.

UG 15.2. The candidates shall apply for equivalence with the No-objection for admission to DSU from the University where they are perusing their study.

UG 15.3. The candidates must have passed in all courses in the earlier semesters prior to transfer.

UG 16. ELIGIBILITY FOR THE AWARD OF B. TECH. DEGREE

A candidate shall be declared to be eligible for the award of B. Tech. degree if he/she has:

UG 16.1. Completed all the credit requirements for the degree with a CGPA 4.0 or higher at the end of the programme.

UG 16.2. Satisfactorily completed all the mandatory audit courses.

UG 16.3. No dues to the University, Department, Hostels.

UG 16.4. No disciplinary action pending against him/her.

UG 17. AWARD OF DEGREE

The award of B. Tech. degree must be recommended by the Academic Council and approved by the Board of Management and Board of Governors of the DSU.

UG 18. CONDUCT AND DISCIPLINE

UG 18.1. Candidates shall conduct themselves within and outside the precincts of the University in a manner befitting the candidates of an institution of national importance. The University has a separate ordinance Code and Conduct of Candidates which is applicable to all candidates of the University.

UG 19. REPEAL AND SAVINGS

Notwithstanding anything contained in these Regulations, the provisions of any guidelines, orders, rules or regulations in force at the University shall be inapplicable to the extent of their inconsistency with these Regulations. The Academic Council,

Board of Management and Board of Governors of Dayananda Sagar University may revise, amend or change the regulations from time to time.

UG 20. INTERPRETATION

Any questions as to the interpretation of these Regulations shall be decided by the University, whose decision shall be final. The University shall have the powers to issue clarifications to remove any doubt, difficulty or anomaly which may arise during the implementation of the provisions of these regulations

Department of Computer Science and Engineering (Cyber Security)

VISION

Ignite and nurture young learners to provide a sustainable, humane, and research-centric educational platform in the domain of cybersecurity for building a robust, resilient, and attack-free digital universe.

MISSION

1. Provide committed and competent faculty and educational infrastructure to impart the theoretical and practical foundation of cybersecurity in the emanating youth.
2. Establish MoUs and Centre of Excellences (CoEs) with Information Technology Sector to provide industry-ready cybersecurity graduates with research instinct imbibed for the sustainable development of young learners
3. Build collaborative and teamwork-centric project-oriented learning environment, to address global challenges whilst preserving human and ethical values.
4. Encourage young minds to educate society to restore nationwide human safety and security in digital world.

FACULTY LIST

Sl No	Name of the Faculty	Designation
1	Dr. Kiran B. Malagi	Associate Professor and Chairperson CSE (Cyber Security)
2	Dr. Durbadal Chattaraj	Associate Professor
3	Naveen Kulkarni	Assistant Professor
4	Sharanabasappa Tadkal	Assistant Professor
5	Ranjima P	Assistant Professor

PROGRAM OUTCOMES (PO'S):

A graduate of Computer Science and Engineering (Cyber Security) program will demonstrate:

- **PO1. Engineering knowledge:** Apply the information of arithmetic, science, engineering fundamentals, associate degreed an engineering specialization to the answer of advanced engineering issues.
- **PO2. Problem analysis:** Identify, formulate, review analysis literature, and analyse complicated engineering issues reaching corroborated conclusions mistreatment initial principles of arithmetic, natural sciences, and engineering sciences.
- **PO3. Design/development of solutions:** Design solutions for advanced engineering issues and style system elements or processes that meet the required wants with applicable thought for the general public health and safety, and therefore the cultural, societal, and environmental concerns.
- **PO4. Conduct investigations of complex problems:** Use analysis-based information and research ways as well as style of experiments, analysis and interpretation of information, and synthesis of the knowledge to supply valid conclusions.
- **PO5. Modern tool usage:** Create, select, and apply acceptable techniques, resources, associate degreed fashionable engineering and IT tools as well as prediction and modelling to advanced engineering activities with an understanding of the restrictions.
- **PO6. The engineer and society:** Apply reasoning familiar by the discourse information to assess social group, health, safety, legal and cultural problems and therefore the resulting responsibilities relevant to the skilled engineering apply.
- **PO7. Environment and sustainability:** Understand the impact of the skilled engineering solutions in social and environmental contexts, and demonstrate the information of, and want for property development.

- **PO8. Ethics:** Apply moral principles and decide to skilled ethics and responsibilities and norms of the engineering follow.
- **PO9. Individual and team work:** Function effectively as a private, and as a member or leader in numerous groups, and in multidisciplinary settings.
- **PO10. Communication:** Communicate effectively on advanced engineering activities with the engineering community and with society at giant, such as, having the ability to grasp and write effective reports and style documentation, build effective shows, and provides and receive clear directions.
- **PO11. Project management and finance:** Demonstrate information and understanding of the engineering and management principles and apply these to one's own work, as a member ANd leader in an passing team, to manage comes and in multidisciplinary environments.
- **PO12. Life-long learning:** Recognize the necessity for, and have the preparation and talent to interact in freelance and l ife-long learning within the broadest context of technological amendment.

PSOs

1. Ability to understand, analyse and develop computer programs in the areas related to networking, cryptography, web development and database management by adhering software development life cycle.
2. Graduate students will be able to develop data, resource, and asset protection strategies for organizations, processes, peoples, and individuals through Cybersecurity-centric skills.

SCHEME - B.TECH – 2021-22 ONWARDS

I SEM - CHEMISTRY CYCLE

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/ P	C	SEM	COURSE CODE
1	101-105 & 121-123	21EN1101	LINEAR ALGEBRA AND CALCULUS	CR	3	1	–	–	4	*	***
2	101-105 & 1 121-123	21EN1102	ENGINEERING CHEMISTRY	CR	3	–	2	–	4	*	***
3	101-105 & 121-123	21EN1103	BASIC ELECTRICAL ENGINEERING	CR	3	–	–	–	3	*	***
4	101-105 & 121-123	21EN1104	ELEMENTS OF MECHANICAL ENGINEERING	CR	2	–	2	–	3	*	***
5	101-105 & 121-123	21EN1105	FUNDAMENTALS OF PROGRAMMING	CR	3	–	4	–	5	*	***
6	101-105 & 121-123	21EN1106	ENVIRONMENTAL SCIENCES	CR	2	–	–	–	2	*	***
7	101-105 & 121-123	21EN1107	KANNADA KALI/MANASU	CR	1	–	–	–	1	*	***
					17	01	08	––	22		

CR — Credit, AU — Audit, L — Lecture, T — Tutorial, P — Practical, S/P — Seminar/Project, C — No. of Credits

SCHEME - B.TECH – 2021-22 ONWARDS

I SEM - PHYSICS CYCLE

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/ P	C	SEM	COURSE CODE
1	101-105 & 121-123	21EN1101	LINEAR ALGEBRA AND CALCULUS	CR	3	1	–	–	4	*	***
2	101-105 & 121-123	21EN1108	ENGINEERING PHYSICS	CR	3	–	2	–	4	*	***
3	101-105 & 121-123	21EN1109	BASIC ELECTRONICS	CR	3	–	2	–	4	*	***
4	101-105 & 121-123	21EN1110	ENGINEERING GRAPHICS AND DESIGN	CR	1	–	4	–	3	*	***
5	101-105 & 121-123	21EN1111	ENGINEERING MECHANICS	CR	2	–	–	–	2	*	***
6	101-105 & 121-123	21EN1112	BIOLOGICAL SCIENCES	CR	2	–	–	–	2	*	***
7	101-105 & 121-123	21EN1113	TECHNICAL COMMUNICATION	CR	2	–	–	–	2	*	***
8	101-105 & 121-123	21EN1114	DESIGN THINKING	CR	–	–	2	–	1	*	***
					16	01	10	––	22		
9	101-105 & 121-123	21AU0004	CONSTITUTION OF INDIA AND ETHICS	AU	02	––	––	––	––	*	***

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SCHEME - B.TECH – 2021-22 ONWARDS

II SEM - CHEMISTRY CYCLE

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	COURSE CODE
1	101-105 & 121-123	21EN1201	TRANSFORMS AND DIFFERENTIAL EQUATIONS	CR	3	1	–	–	4	*	***
2	101-105 & 1 121-123	21EN1102	ENGINEERING CHEMISTRY	CR	3	–	2	–	4	*	***
3	101-105 & 121-123	21EN1103	BASIC ELECTRICAL ENGINEERING	CR	3	–	–	–	3	*	***
4	101-105 & 121-123	21EN1104	ELEMENTS OF MECHANICAL ENGINEERING	CR	2	–	2	–	3	*	***
5	101-105 & 121-123	21EN1105	FUNDAMENTALS OF PROGRAMMING	CR	3	–	4	–	5	*	***
6	101-105 & 121-123	21EN1106	ENVIRONMENTAL SCIENCES	CR	2	–	–	–	2	*	***
7	101-105 & 121-123	21EN1107	KANNADA KALI/MANASU	CR	1	–	–	–	1	*	***
					17	01	08	––	22		

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SCHEME - B.TECH – 2021-22 ONWARDS

II SEM - PHYSICS CYCLE

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/ P	C	SEM	COURSE CODE
1	101-105 & 121-123	21EN1201	TRANSFORMS AND DIFFERENTIAL EQUATIONS	CR	3	1	–	–	4	*	***
2	101-105 & 121-123	21EN1108	ENGINEERING PHYSICS	CR	3	–	2	–	4	*	***
3	101-105 & 121-123	21EN1109	BASIC ELECTRONICS	CR	3	–	2	–	4	*	***
4	101-105 & 121-123	21EN1110	ENGINEERING GRAPHICS AND DESIGN	CR	1	–	4	–	3	*	***
5	101-105 & 121-123	21EN1111	ENGINEERING MECHANICS	CR	2	–	–	–	2	*	***
6	101-105 & 121-123	21EN1112	BIOLOGICAL SCIENCES	CR	2	–	–	–	2	*	***
7	101-105 & 121-123	21EN1113	TECHNICAL COMMUNICATION	CR	2	–	–	–	2	*	***
8	101-105 & 121-123	21EN1114	DESIGN THINKING	CR	–	–	2	–	1	*	***
					16	01	10	––	22		
9	101-105 & 121-123	21AU0004	CONSTITUTION OF INDIA AND ETHICS	AU	02	––	––	––	––	*	***

CR – Credit, AU – Audit, L – Lecture, T – Tutorial, P – Practical, S/P – Seminar/Project, C – No. of Credits

SCHEME - B.TECH – 2021-22 ONWARDS
III SEM - COMPUTER SCIENCE & ENGINEERING (CYBER SECURITY)

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	COURSE CODE
1	123	21CS2301	DISCRETE MATHEMATICAL STRUCTURES	CR	3	-	-	-	3	*	***
2	123	21CS2302	DATA STRUCTURES	CR	3	-	-	-	3	*	***
3	123	21CS2303	DIGITAL ELECTRONICS & LOGIC DESIGN	CR	3	-	-	-	3	*	***
4	123	21CS2304	FULL STACK DEVELOPMENT	CR	2	-	2	-	3	*	***
5	123	21CS2305	COMPUTATIONAL THINKING WITH PYTHON	CR	2	-	2	-	3	*	***
6	123	21CY2301	COMPUTER NETWORKS	CR	3	-	-	-	3	*	***
7	123	21CS2307	DATA STRUCTURES LAB	CR	-	-	2	-	1	*	***
8	123	21CS2308	DIGITAL ELECTRONICS & LOGIC DESIGN LAB	CR	-	-	2	-	1	*	***
9	123	21CS2309	MANAGEMENT AND ENTREPRENEURSHIP	CR	2	-	-	-	2	*	***
10	123	21CS2310	LIBERAL STUDIES – I	CR	1	-	-	-	1	*	***
					19	**-**	**08**	**-**	**23**		

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SCHEME - B.TECH – 2021-22 ONWARDS

IV SEM - COMPUTER SCIENCE & ENGINEERING (CYBER SECURITY)

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	COURSE CODE
1	123	21CS2401	PROBABILITY AND STATISTICS	CR	3	-	-	-	3	*	***
2	123	21CS2402	DESIGN AND ANALYSIS OF ALGORITHMS	CR	3	-	-	-	3	*	***
3	123	21CS2403	PRINCIPLES OF MICROPROCESSORS AND COMPUTER ORGANIZATION	CR	4	-	-	-	4	*	***
4	123	21CS2404	FINITE AUTOMATA AND FORMAL LANGUAGES	CR	3	-	2	-	4	*	***
5	123	21CS2405	SOFTWARE ENGINEERING AND PROJECT MANAGEMENT	CR	3	-	-	-	3	*	***
6	123	21CY2401	CRYPTOGRAPHY AND NETWORK SECURITY	CR	3	-	-	-	3	*	***
7	123	21CS2407	DESIGN AND ANALYSIS OF ALGORITHMS LAB	CR	-	-	2	-	1	*	***
8	123	21CY2402	CRYPTOGRAPHY AND NETWORK SECURITY LABORATORY	CR	-	-	2	-	1	*	***
9	123	21CS2409	SPECIAL TOPICS – I	CR	-	-	-	4	2	*	***
10	123	21CS2410	LIBERAL STUDIES – II	CR	1	-	-	-	1	*	***
					20	**-**	**6**	**4**	**25**		

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SCHEME - B. TECH – 2021-22 ONWARDS

V SEM - COMPUTER SCIENCE & ENGINEERING (CYBER SECURITY)

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR/ AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	COURSE CODE
1	123	21CY3501	DATABASE MANAGEMENT SYSTEM	CR	3	-	-	-	3	*	***
2	123	21CY3502	CYBER FORENSIC AND CYBER LAW	CR	3	-	-	-	3	***	***
3	123	21CY3503	OPERATING SYSTEMS	CR	3	1	-	-	4	*	***
4	123	21CY3504	MACHINE LEARNING FOR CYBER SECURITY	CR	3	-	-	2	4	IV	PROBABILITY AND STATISTICS
5	123	21CY35XX	PROFESSIONAL ELECTIVE-1	CR	3	-	-	-	3	*	AS INDICATED IN ELECTIVE LIST
6	123	21OEXXXX	OPEN ELECTIVE-1 FUNDAMENTAL OF CYBER SECURITY	CR	3	-	-	-	3	*	***
7	123	21CY3505	DATABASE MANAGEMENT SYSTEM LAB	CR	-	-	2	-	1	*	***
8	123	21CY3506	OPERATING SYSTEMS LAB	CR	-	-	2	-	1	*	***
9	123	21CY3507	SPECIAL TOPICS -II	CR	-	-	-	4	2	*	***
					18	**1**	**4**	**6**	**24**		

V SEM- PROFESSIONAL
ELECTIVE – I

SL	COURSE CODE	COURSE TITLE	SCHEME OF TEACHING				
			L	T	P	S/ P	C
1	21CY3508	OOPS WITH JAVA	3	-	-	-	03
2	21CY3509	DATA WARFARE	3	-	-	-	03
3	21CY3510	INTERNET OF THINGS	3	-	-	-	03
4	21CY3511	MICROCONTROLLERS AND EMBEDDED SYSTEMS	3	-	-	-	03

SCHEME - B.TECH – 2021-22 ONWARDS
VI SEM - COMPUTER SCIENCE & ENGINEERING (CYBER SECURITY)

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	COURSE CODE
1	123	21CY3601	ETHICAL HACKING	CR	3	1	-	-	4	*	***
2	123	21CY3602	DIGITAL IMAGE PROCESSING	CR	3	-	-	-	3	*	***
	123	21CY3603	CLOUD APPLICATION DEVELOPMENT	CR	3	-	2	-	4	*	***
4	123	21CY36XX	PROFESSIONAL ELECTIVE-2	CR	3	-	-	-	3	*	AS INDICATED IN ELECTIVE LIST
5	123	21CY36XX	PROFESSIONAL ELECTIVE-3	CR	3	-	-	-	3	*	
6	123	21OEXXXX	OPEN ELECTIVE-2 FUNDAMENTAL OF CRYPTOGRAPHY	CR	3	-	-	-	3	*	***
7	123	21CY3604	ETHICAL HACKING LAB	CR	-	-	2	-	1	*	***
8	123	21CY3605	DIGITAL IMAGE PROCESSING LAB	CR	-	-	2	-	1	*	***
					18	**1**	**06**	**0**	**22**		

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VI SEM-PROFESSIONAL
ELECTIVE – II

SL	COURSE CODE	COURSE TITLE	SCHEME OF TEACHING				
			L	T	P	S/P	C
1	21CY3606	OPERATING SYSTEM SECURITY	3			-	03
2	21CY3607	PROACTIVE SECURITY TOOLS	3			-	03
3	21CY3608	IOT AND BIG DATA SECURITY	3			-	03

VI SEM-PROFESSIONAL
ELECTIVE – III

SL	COURSE CODE	COURSE TITLE	SCHEME OF TEACHING				
			L	T	P	S/P	C
1	21CY3609	DATA MINING AND ANALYSIS	3			-	03
2	21CY3610	CYBER SECURITY PROGRAMS AND POLICIES	3			-	03
3	21CY3611	MOOC COURSE	3			-	03

SCHEME - B.TECH – 2021-22 ONWARDS
VII SEM - COMPUTER SCIENCE & ENGINEERING (CYBER SECURITY)

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR/ AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	COURSE CODE
1	123	21CY47XX	Professional Elective – 4	CR	3	-	-	-	3	*	AS INDICATED IN ELECTIVE LIST
2	123	21CY47XX	Professional Elective – 5	CR	3	-	-	-	3	*	
3	123	21OEXXXX	Open Elective-3 FUNDAMENTAL OF NETWORK SECURITY	CR	3	-	-	-	3	*	***
4	123	21CY4701	Project Phase – I / Internship	CR	-	-	-	6	3	*	***
					09			**06**	**12**		

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VII SEM-PROFESSIONAL
ELECTIVE – IV

SL	COURSE CODE	COURSE TITLE	SCHEME OF TEACHING				
			L	T	P	S/P	C
1	21CY4702	VULNERABILITY ANALYSIS AND PENETRATION TESTING	3			-	03
2	21CY4703	QUANTUM CRYPTOGRAPHY AND COMMUNICATION	3			-	03
3	21CY4704	WIRELESS NETWORK SECURITY	3			-	03

VII SEM-PROFESSIONAL
ELECTIVE – V

SL	COURSE CODE	COURSE TITLE	SCHEME OF TEACHING				
			L	T	P	S/P	C
1	21CY4705	DATA PRIVACY	3			-	03
2	21CY4706	EMBEDDED SYSTEM SECURITY	3			-	03
3	21CY4707	PATTERN RECOGNITION	3			-	03

SCHEME - B.TECH – 2021-22 ONWARDS

VIII SEM - COMPUTER SCIENCE & ENGINEERING (CYBER SECURITY)

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR/ AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	COURSE CODE
1	123	21CY48XX	Professional Elective – 6	CR	3	-	-	-	3	*	AS INDICATED IN ELECTIVE LIST
2	123	21CY4801	Project Phase – II	CR	-	-	-	12	6	*	***
3	123	21CY4802	Internship	CR	-	-	-	6	3		
					03	**-**	**-**	**18**	**12**		

CR – Credit, AU – Audit, L – Lecture, T – Tutorial, P – Practical, S/P – Seminar/Project, C – No. of Credits

VIII SEM-PROFESSIONAL
ELECTIVE – VI

SL	COURSE CODE	COURSE TITLE	SCHEME OF TEACHING				
			L	T	P	S/P	C
1	21CY4803	RISK MANAGEMENT	3			-	03
2	21CY4804	MOBILITY SECURITY	3			-	03
3	21CY4805	BIOMETRIC SECURITY	3			-	03

COURSE CODE	COURSE TITLE	L	T	P	S/P	C
21EN1101	LINEAR ALGEBRA AND CALCULUS	3	1	–	–	4

COURSE LEARNING OBJECTIVES:

1. To understand the basic concepts of linear algebra to illustrate its power andutility through applications to science and Engineering.
2. To study the basic concepts of vector spaces, linear transformations, matricesand inner product spaces in engineering.
3. To discuss the algebraic as well as geometric perspectives pretained to thecourse.
4. To learn the basic functions represented in a variety of ways: graphical, numerical, analytical, or verbal.
5. To develop an appreciation of calculus as a coherent body of knowledge andas a human accomplishment.
6. To understand the meaning of the definite integral both as a limit of Riemannsums and as the net accumulation of a rate of change.
7. To understand the relationship between the derivative and the definite integralas expressed in both parts of the Fundamental Theorem of Calculus.

COURSE OUTCOME:

At the end of this course the students are expected to

1. Determine the reasonableness of solutions, including sign, size, relative accuracy, and units of measurement.
2. Apply thhe abstract concepts of matrices and system of linear equationsusing decomposition methods
3. Explain the basic notion of vector spaces and subspaces
4. Apply the concept of vector spaces using linear transforms which is used in computer graphics and inner product spaces.
5. Analyze functions using limits, derivatives, and integrals.
6. Recognize the appropriate tools of calculus to solve applied problems.

COURSE CONTENT: Total: 52 Hours

Module-1

LINEAR EQUATIONS AND VECTOR SPACES

Introduction - Row reduction and echelon forms- Gaussian-Elimination - Solution setsof linear equations – LU decomposition - Inverse of a matrix by Gauss Jordan method,Linear spaces – Subspaces - Linear independence – Span - Bases and Dimensions. Self Learning Component: Algebra of Matrices.

Module-2

LINEAR TRANSFORMATIONS AND ORTHOGONALITY

Linear transformations – Basic properties - Invertible linear transformation - Matricesof linear transformations - Vector space of linear transformations– Orthogonal Vectors - Projections onto Lines - Projections and - The Gram- Schmidt Orthogonalization process.

Self Learning Component: Examples of vector spaces and subspaces, Rank of a matrix.

Module-3

EIGEN VALUES AND EIGEN VECTORS

Introduction to Eigen values and Eigen vectors - Characteristic equation -Diagonalization of a Matrix- Diagonalization of symmetric matrices - Quadratic forms
- Singular Value Decomposition - QR factorization.

Self Learning Component: Determinant and Properties of Eigen values and Eigenvectors

Module-4

DIFFERENTIAL CALCULUS

Taylor's Theorem- Taylor's series – Maclaurin Series- Indeterminate forms and L- Hospital's Rule-Partial Differentiation – Total derivative-Chain Rule of Partial Differentiation-Differntiation of Implicit function, Euler's Theorem on homogeneous function- Jacobian- Maxima and Minima of functions of two variables-Taylor's Theorem.

Self Learning Component: Functions and graphs, Limits and Continuity, Differentiation

Module-5

INTEGRAL CALCULUS

Reduction formula-Improper integrals- Beta and Gamma integrals-Double integration-Change of order of integration-triple integration.

TEXT BOOK(S)

1. D C Lay, S R Lay and JJ McDonald, Linear Algebra and its Applications, PearsonIndia, Fifth edition.
2. Linear Algebra and its Applications by Gilbert Strang, 4 th Edition, Thomson Brooks/Cole, Second Indian Reprint 2007.
3. G.B. Thomas, Maurice T Weir and Joel Hass Thomas's Calculus ,12th Edition, PearsonIndia.

REFERENCE BOOKS

1. Introduction to Linear Algebra, Gilbert Strang, 5th Edition, Cengage Learning (2015).
2. Higher Engineering Mathematics by B S Grewal, 42 nd Edition, Khanna Publishers.
3. Elementary Linear Algebra, Stephen Andrilli and David Hecker, 5th Edition, AcademicPress (2016)
4. Contemporary linear algebra, Howard Anton, Robert C Busby, Wiley 2003
5. B.S. Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, 2014.
6. Introductory Linear Algebra- An applied first course, Bernard Kolman and David, R.Hill, 9th Edition, Pearson Education, 2011.

COURSE CODE	COURSE TITLE	L	T	P	S/P	C
21EN1102	ENGINEERING CHEMISTRY	3	–	2	–	4

COURSE LEARNING OBJECTIVES:

- The Theory Course intends to provide chemical concepts most relevant to engineering students and demonstrate them in an applied context.
- The student is exposed to the principles required to understand important contemporary topics like alternate energy sources, corrosion control, polymer technology, phase equilibria nanomaterials and green chemistry and catalysis.
- The underlying theme is to emphasize on applications of these concepts to realworld problems

COURSE OUTCOME:

• Appreciate the basic principles of electrochemistry, use of different types of electrodes in analysis and evaluate cell potential for different cell reactions.

• Know construction, working and applications of various energy storage devices such as batteries, fuel cells and supercapacitors.

• Understand basic principles of corrosion and apply suitable techniques for corrosioncontrol. Also know the technological importance and processes involved in metal finishing.

• Know the synthesis, structure –property relationship and applications of commercially important polymers and polymer composites. Understand properties and applications of nanomaterials. Also learn the principles of green chemistry for a sustainable and eco-friendly world.

COURSE CONTENT: Total: 40 Hours

Theory –Syllabus

Module-1

Chemical Energy Source:

Introduction to energy; Fuels - definition, classification, importance of hydrocarbons as fuels; Calorific value-definition, Gross and Net calorific values (SI units). Determination of calorific value of a solid / liquid fuel using Bomb calorimeter. Numerical problems on GCV & NCV. Petroleum cracking-fluidized catalytic cracking.Reformation of petrol. octane number, cetane number, anti-knocking agents, power alcohol, Biodiesel & Biogas.

Solar Energy:

Thermal energy: Photovoltaic cells- Introduction, definition, importance, working of PV cell. Solar grade silicon physical and chemical properties relevant to photo-voltaics, doping of silicon by diffusion technique.

Module-2

Energy Science and Technology

Single electrode potential - Definition, origin, sign conventions. Standard electrodepotential-Definition-Nernst equation expression and its Applications. EMF of a cell-

Definition, notation and conventions. Reference electrodes– Calomel electrode, Ag/AgCl electrode. Measurement of standard electrode potential. Numerical problems on EMF. Ion-selective electrode- glass electrode

Battery technology: Basic concepts including characteristics of anode, cathode, electrolyte and separator. Battery characteristics. Classification of batteries–primary, secondary and reserve batteries. State of the art Batteries-Construction working andapplications of Zn-air, Lead acid battery, Nickel-Metal hydride and Lithium ion batteries.

Introduction to fuel cells, types of fuel cells. Construction, working and application ofMethanol-Oxygen fuel cell.

Module-3 Corrosion Science:

Definition, Chemical corrosion and Electro-chemical theory of corrosion, Types of corrosion, Differential metal corrosion, Differential aeration corrosion (pitting and water line corrosion), Stress corrosion. Corrosion control, Metal coatings- Galvanization, Tinning and its disadvantages. Cathodic protection of Corrosion: Sacrificial anode method and current impression method. Surface Modification Techniques:

Definition, Technological importance of metal finishing. Significance of polarization, decomposition potential and over-voltage in electroplating processes, Electroless Plating. Distinction between electroplating and Electroless plating, advantages of electroless plating. Electroless plating of copper.

Module-4

High Polymers: Introduction to polymers, Glass transition temperature, structure and property relationship. Synthesis, properties and applications of Teflon. PMMA. Elastomers - Deficiencies of natural rubber and advantages of synthetic rubber. Synthesis and application of silicone rubber, Conducting polymers-Definition, mechanism of conduction in polyacetylene. Structure and applications of conductingPolyaniline.

Nanotechnology: Introduction, properties, synthesis by sol-gel. Fullerenes, Carbon nanotubes, dendrimers and nano-composites

Module-5

Water Technology:

Impurities in water. Hardness of Water: Types of Hardness and determination of totalhardness of water by using disodium salt of ethylenediaminetetraacetic acid method,Potable water treatment by Electro dialysis and Reverse Osmosis. Water analysis- Biochemical oxygen demand and Chemical oxygen demand. Determination of COD.Numerical problems on COD. Sewage treatment.

Instrumental Methods of Analysis: Instrumental methods of analysis, Principles of spectroscopy-Beer's Lamberts law, Difference between spectrometer and spectrophotometer, Potentiometry, Conductometry (Strong acid against strong base,weak acid against strong base, mixture of strong acid and a weak acid against strongbase).

TEXT BOOK(S)

1. Dr. S. Vairam, Engineering Chemistry, Wiley-India Publishers, 2017,
2. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015

REFERENCE BOOK(S)

1. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi,2015.
2. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

List of Laboratory/Practical Experiments activities to be conducted: 28 Hrs

Volumetric Analysis and Preparations

1. Evaluation of quality of water in terms of total hardness by Complexometic titration.
2. Determination of Chemical Oxygen Demand (COD) of the given industrial wastewater sample.
3. Determination of Alkalinity of the given water sample
4. Preparation of MgO nanoparticles by solution combustion method (Demonstration experiment) and spectrometric analysis.
5. Electroless plating of copper (Demo experiment)
6. Preparation of Polyaniline (Demo experiment)

Instrumental methods of Analysis

1. Potentiometric titration–Estimation of FAS using standard $K_2Cr_2O_7$ solution.
2. Conductometric estimation of hydrochloric acid using standard sodium hydroxide solution
3. Determination of viscosity coefficient, surface tension, density of a given liquid
4. Colorimetric estimation of copper in a given solution
5. Determination of Pka of given weak acid.
6. Determination of calorific value of coal/oil using Bomb calorimeter (Group

REFERENCE BOOKS:

1. Dayanada Sagar University laboratory manual.
2. J. Bassett, R.C. Denny, G.H. Jeffery, Vogels, Text book of quantitative inorganic analysis, 4^{th} Edition.

COURSE CODE	COURSE TITLE	L	T	P	S/P	C
21EN1103	BASIC ELECTRICAL ENGINEERING	3	–	–	–	3

COURSE LEARNING OBJECTIVES:

This course enables students:

- To impart basic knowledge of electrical quantities such as current, voltage, powerand energy
- To distinguish between passive and active electrical components
- To explain the general structure of electrical power system
- To define basic laws of electric circuit and to solve related problems
- To understand basics of earthing, protective devices and wiring
- To introduce concepts, analogies and laws of magnetic circuits
- To learn the working principle, construction and characteristics of various DC machines
- To study the construction, principle of operation and types of transformers
- To understand the working principles of measuring equipment.

COURSE OUTCOME:

- Explain the basic knowledge about the Electric and Magnetic circuits.
- Applying basic laws and determine various circuit parameters in AC and DC Circuits.
- Analyze the working of various Electrical Machines.
- Explain the construction, basic principle of operation, applications and determine performance parameters of various measuring instruments
- Outline the knowledge of Green Energy, Electrical Safety Rules & standards COURSE

CONTENT: Total: 45 Hours

Module -1

ELECTRICAL CIRCUIT CONCEPTS

Voltage and current sources: independent, dependent, ideal and practical; V-I relationships of resistor, ohm's law, inductor, and capacitor; types of electrical circuits,voltage and current divider rule, Kirchhoff's laws, Peak, average and rms values of acquantities; apparent, active and reactive powers; phasor analysis, Power factor, impedance and admittance, power and energy in electrical elements, introduction to3 phase systems

Module -2

MAGNETIC CIRCUIT CONCEPTS

Basics of magnetic circuits, laws of magnetism, magnetic field, magnetic lines of force,permeability, Electromagnetic Fields: Relation between field theory and circuit theory;numerical on capacitance calculations, Biot-Savart's law, Ampere's law, Curl, Faraday's law, Lorentz force, Inductance, Self and Mutual inductance of simple configurations.

Module-3

DC Machines and Transformers

Dc Machines: Basic principles of electromagnetic energy conversion, Construction, operation, characteristics, performance, of dc generators and motors, testing of dc machines, applications, Transformers: Construction, working principle, equivalent circuit, voltage regulation, efficiency, Auto-transformers

Module-4

SI units, systematic and random errors in measurement, expression of uncertainty - accuracy and precision index, propagation of errors. General working principles andconstruction of indicating instruments. Electro-magnetic Instruments for the measurement of current, voltage, power and energy. Instruments for the measurement of power factor, frequency, Potentiometers. CRO, Calibration of instruments; importance, procedures and standards

Module-5

POWER STATION PRACTICES, ECONOMICS, AND GREEN ENERGY CONCEPTS

Energy generation-Conventional generation of electrical energy using thermal, hydro,nuclear and, non-conventional sources of energy; overview on green energy technology, load forecasting, electricity tariffs, power factor improvement, power plant economics, Overview on electrical safety standards in industries

Text Books

1. D.P.Kothari and I.J. Nagrath, "Basic Electrical Engineering", 4th Edition, Tata McGrawHill, 2010
2. B.L Thereja and A.K Thereja, "A text book of Electrical Technology (Vol III) (Transmission, distribution, and Utilization)", 23rd Edition, S Chand and Company.

Reference Books

1. Clayton Paul, Syed A Nasar and Louis Unnewehr, 'Introduction to Electrical Engineering', 2nd Edition, McGraw-Hill, 1992
2. P.S. Dhogal, 'Basic Electrical Engineering – Vol. I& II', 42nd Reprint, McGraw-Hill, 2012.
3. A. K Sawhney, A course in Electrical and Electronic Measurements andInstrumentation Dhanpat Rai & Co. (P) Limited January 2015
4. NPTEL - https://nptel.ac.in/courses/108/108/108108076/

COURSE CODE	COURSE TITLE	L	T	P	S/P	C
21EN1104	ELEMENTS OF MECHANICAL ENGINEERING	2	–	2	–	3

COURSE LEARNING OBJECTIVES:

The objectives of the Course are to:

- Introduce different ways power generation using renewable and non-renewable energy resources
- Understand thermodynamic cycles for power generation
- Explain materials used for engineering applications
- Learn transmission of power using Gear & Belt Drives
- Understand manufacturing process like metal cutting, welding and Foundry
- Introduce mechatronics, PLC, instrumentation & control systems
- Explain rapid prototyping, 3D printing and electric mobility
- Develop skills to use tools, machines, and measuring instruments

COURSE OUTCOMES:

- Identify various renewable and non-renewable energy resources
- State laws of thermodynamics used for energy conversion
- Compare power transmission using gear and belt drives
- Select different manufacturing methods like metal cutting, joining and foundry
- Construct different types of fitting, welding, sheet metal, turning models
- Demonstrate working of engines, turbines, pumps, 3D printing; wood working, foundry & smithy operations

COURSE CONTENT: Total: 28 Hours

Module-1

Energy Conversion

Renewable & Nonrenewable energy resources: Introduction to Steam, Hydro & Nuclear power plants, solar, wind and biomass energy based power plants, Effect of power generation on environment Thermodynamics: First and second laws of thermodynamics, Efficiency, COP, Carnot theorem, Numericals

Module-2

Prime Movers & Pumps

Gas and Vapour cycles: Carnot, Otto, Diesel, Brayton, Rankine & Refrigeration cycles Prime movers: 4 stroke- petrol and Diesel engines, Gas turbines-open and closedCycle, steam turbines-Impulse and reaction, Numericals.

Introduction to pumps: Working of centrifugal and reciprocating

Module-3

Materials & Mechanical Design

Materials: Introduction to ferrous, non-ferrous & composites, Stress-strain diagrams,Mechanical Properties for materials
Mechanical Design: Introduction, Simple Stresses and strains, Elastic constants,Power Transmission: Gear & Belt Drives, Numerical problems

Module-4

Manufacturing Processes
Metal cutting: Introduction, classification of machine tools, basic operations on lathe,drilling, shaper, milling, grinding, introduction to CNC machining
Joining Processes: Welding- classification, gas, arc, laser & friction welding, brazingand soldering
Foundry: Basic terminology, Types of patterns, sand moulding

Module-5

Advanced Technologies in Mechanical Engineering
Mechatronics: Introduction, Mechatronics, PLC, Instrumentation & control systemsRobotics: Introduction, Robot anatomy, configurations, Sensors, applications
Rapid prototyping & 3D Printing: Introduction & applications, powder-based additivemanufacturing processes
Electric Mobility: Introduction, electric, hybrid and autonomous vehicles

List of Laboratory/Practical Experiments activities to be conducted: 28 Hrs

1. Fitting Shop- Simple exercises involving fitting work-Dove tail.
2. Welding Shop- Simple butt and Lap welded joints using arc welding
3. Sheet-metal Shop- Fabrication of tray, Making Funnel complete with soldering
4. Lathe machining on plain and step turning

Demonstration of:

1. Pelton wheel and Francis turbine
2. 4 stroke petrol and diesel engines
3. Lathe, milling, drilling, grinding & CNC milling machines and wood turning lathe
4. Foundry and smithy operations
5. 3D printing parts

Industrial Visit- Report making

Text books:

1. Nag P K (2017). “Basics and applied thermodynamics”, Second edition, Tata McGrawHill, New Delhi.
2. P.N. Rao (2018). “Manufacturing Technology-Foundry, Forming and Welding”,Volume 1, 4th Edition, Tata McGraw Hill Publishing Co Ltd.
3. P.N. Rao (2018). “Manufacturing Technology- Metal Cutting and Machine Tools”, Volume 2, 4th Edition, Tata McGraw Hill Publishing Co Ltd.

REFERENCES:

1. El –Wakil M. M (2017). “Power plant technology”, Tata McGraw Hill edition, New Delhi.
2. Larminie J, Lowry J (2017). “Electric vehicle technology explained”, John Wiley and &Sons Ltd. USA.
3. William D. Callister and David G. Rethwisch (2011). “Fundamentals of MaterialsScience and Engineering: An Integrated Approach”, John Wiley & Sons; 4th Edition.

COURSE CODE	COURSE TITLE	L	T	P	S/P	C
21EN1105	FUNDAMENTALS OF PROGRAMMING	3	–	4	–	5

COURSE LEARNING OBJECTIVES:

- To develop student competence in writing clear, correct, and maintainable programs that implement known algorithms.

COURSE OUTCOMES:

- Express algorithms learned implicitly in school explicitly in algorithmic form and calculate the number of basic operations (exact or upper bound).
- Trace the execution of short programs/code fragments involving fundamental programming constructs.
- Write a short program/code fragment for a given task using fundamental programming constructs.
- Debug a short program/code fragment with fundamental programming constructs manually, and debug more complex code using a modern IDE andassociated tools.
- Design a large program, conduct a personal code review, and contribute to a small-team code review focused on common coding errors and maintainability using a provided checklist.

COURSE CONTENT: Total: 56 Hours

Module-1

BASICS AND OVERVIEW OF C

Introduction to Problem Solving using Algorithms and Flowchart: Key features of Algorithms: Sequence, Decision, Repetition with examples. Background, structure of C program, keywords, Identifiers, Data Types, Variables, Constants, Input / Output statements, Operators (Arithmetic, relational, logical, bitwise etc.), Expressions,Precedence and Associativity, Expression Evaluation, Type conversions. ConditionalBranching Statements-if and switch statements, iterative statements (loops)-while, for, do-while statements, Loop examples, Nested loops, break, continue, go to statement.

Module-2

ARRAYS AND STRINGS

Arrays: Introduction, declaration & initialization of array, reading and writing array elements, Operations on array: Traversal, searching, sorting. Declaration and Initialization of two-dimensional arrays. Matrix Operations (addition, subtraction,multiplication, transpose) using two-dimensional array.

Strings: Definition, declaration, initialization, and representation. String handling functions and character handling functions.

Module-3

POINTER AND FUNCTIONS

Pointers: Definition and declaration and initialization of pointers. Accessing values using pointers. Accessing array elements using pointers.
Functions: Definition and declaration. Built-in functions and User-defined functions. Categories of functions with example. Pointers as function arguments, array as function argument, Call-by-value and call-by-reference. Recursion.

Module-4

STRUCTURES AND UNIONS

Structures: Purpose and usage of structures. Declaration of structures. Assignment with structures. Structure variables and arrays. Nested structures. Student andemployee database implementation using structures.
Unions: Declaration and initialization of a union. Difference between structures and unions. Example programs.

Module-5

DYNAMIC MEMORY ALLOCATION AND FILES

Memory allocation in C programs: Dynamic memory allocation, memory allocation process, allocating a block of memory, releasing the used space, altering the size ofallocated memory.
Files: Defining, opening and closing of files. Input and output operations.

List of Laboratory/Practical Experiments activities to be conducted :
1. Design a C program to Swapping of two numbers. (Simple Expressions).
2. Design a C program to Convert Celsius to Fahrenheit.
3. Design a C program to find the simple interest as per the below conditions(Simple expressions, Integer division issues (data loss), Explicit typecasting, when p, t, r are integers and si is float.
4. Design a C program to find the largest of 3 numbers. a) Using if and no else. (Conditionals) b) Using nested if. (conditionals and Boolean expressions) c) Using Ladder if else if d) Using Ternary operator.
5. Design a program that takes three coefficients (a, b, and c) of a Quadratic equation (ax2+bx+c=0) as input and compute all possible roots.
6. Design a C program to read the vehicle type (Use c or C for car, b or B for bus, t or T for Tempo for vehicle type) and Duration of customer vehicle

parked in parking slot. Parking fare is calculated as per the rates given below: print the total parking charges.

Vehicle	First Rate	Second Rate
Car	Rs 20/hr for first 2hr	Rs 30/hr for next
Bus	Rs 40/hr for first 2hr	Rs 50/hr for next
Tempo	Rs 30 /hr for first 2hr	Rs 40/hr for next

7. a Write a program to calculate the factorial of a given number.
b Write a program using four functions to check if the given number is apalindrome.

8. a Sum of natural numbers (sum(n) = n + sum(n-1);).
b. Write a program to calculate Power of a number ($b^n = b * b^{n-1}$).

9. Write a program to calculate nth fibonacci number given first two numbers in the series.

Inputs	n	Output
0,1	3	2
1,5	4	11
2,4	7	42
8,1	5	19
3,5	6	34

10. a Write a program using four functions to check if the given number is a palindrome.
b. Write a program to calculate GCD of two numbers.

11. Write a program to emulate a calculator with the following operations:Addition, Subtraction, Multiplication, Division – using functions, switch and break.)

12. Write a program using four functions to compute the sine of a value using Taylor's series approximation - pass by value.

13. Write a program to find the sum of n different using four functions andarrays.
Use the following function prototype:void
input(int n, int a[n]);
int add(int n, int a[n]);
void output(int n, int a[n],int sum) and main().

14. Write a program to add two matrices using separate function for input, add matrices, display_matrix and main function.

15. String handling:
a) Write a function to reverse the string in reverse and display it. (Strings))

b) Write a function to concatenate the two strings without using strcat.(Strings) c) Write a function to find the length of the string.
16. Write a program using Bubble sort technique to sort an array of integer elements .(Sorting technique, Const array arguments.)
17. Write a program to search an array of elements of data type requested by the user for a given item using binary search algorithm. (Searching technique, Const array arguments).
18. Write a program with functions to add and multiply two complex numbers.Define a structure Complex to represent a complex number. The main function should call other functions for the purposes of input, computations and display. (Structs as arguments).
19. Write a program to add n fractions using function.
20. Define a structure, student, to store the following data about a student: rollno (integer), name (string) and marks(integer) . Your program must contain the following functions: (Array of Structures). (5 marks) · A function to read the students data. · A function to display records of each student. · A function to sort the records of student RankWise · A function print all students details · A function to search student details by Rollno · A function to print the names of the students having the highest testscore

TEXT BOOKS:

1. Brian W. Kernigham and Dennis M. Ritchie, (2012) “The C Programming Language”,2nd Edition, PHI.
2. Reema Thareja, "Programming in C". Oxford University Press, Second Edition, 2016

REFERENCES:

1. R. S Bichkar, “Programming with C and Data Structure”, University Press, 2014
2. Behrouz A. Forouzan, Richard F. Gilberg, “Computer Science - A StructuredApproach Using C”,Cengage Learning, 2007
3. Brian W. Kernigham and Dennis M. Ritchie, “The C Programming Language”, 2nd Edition, PHI, 2012
4. Vikas Gupta, “Computer Concepts and C Programming”, Dreamtech Press 2013.

COURSE CODE	COURSE TITLE	L	T	P	S/P	C
21EN1106	ENVIRONMENTAL SCIENCES	2	–	–	–	2

COURSE LEARNING OBJECTIVES:

- To understand the concepts of ecosystem, energy and non-renewable energy resources
- To learn water quality aspects requirement and water safety plans
- To explain solid waste and sewage management
- To create awareness of noise, air & land pollution and knowledge of the currentissues and pollution endangering life on earth
- To learn environmental laws and regulations
- To understand environmental protection protocols and regulations

COURSE OUTCOMES

- Analyse basic concepts that govern environmental quality, atmosphericprinciples and environmental standards
- Compare different Energy resource and their environmental implications
- Identify different types of pollution, waste streams
- Identify different natural and manmade disasters and prevention
- Apply the process of environmental impact assessment and implications ofIndian Environment Laws

COURSE CONTENT: Total: 28 Hours

Module-1

Basic Concepts of Environment

Scope and importance of environmental studies, Definition of environment- comprehensive understanding of environment, Basic concepts: Xenobiotic, natural &anthropogenic; why are we concerned? Types of xenobiotics: Chemical, Physical, Biological pollutants; Hazard & Risk, Eco-kinetic & Bio-kinetic Properties of a xenobiotic, Dose-Response Relationships-chronic and acute effects, Environmental Standards: AAQS, TLV's, Appraisal, Assessment & Abatement (Recognition, Evaluation & Control) of pollutants- Structure of Atmosphere; Atmospheric inversions, Environmental System.

Air Pollution: Criteria pollutants — Ozone, Particulate Matter, Carbon Monoxide, Nitrogen, Oxides, Sulphur Dioxide, Lead; SMOG & Air-pollution episodes

Aerosols: Primary & Secondary pollutants, Acid Rain Cycle.Module-2

Water Treatment

Hydrosphere, Lentic and Lotic Water Systems, Fresh Water as a resource; Rain Water Harvesting, Treatment of potable water, Waste water- Characteristics, Municipal Sewage Water and Treatment.

Waste Management

Types of Wastes: Municipal Solid Waste, Hazardous Waste, Nuclear Waste, Electronic Waste, Biomedical Waste, Solid Waste Management: Landfills, composting
Water Standards

Module-3

Energy

Types of energy: Conventional sources of energy, fossil fuel, Coal, Nuclear based, Solar, wind, sea-Tidal Wave energy, Geo-Thermal, Non-conventional sources of Energy, Biofuels - biomass, biogas, Natural Gas; Hydrogen as an alternative future source of energy.

Module-4

Disasters & Management
Definition, origin and classification. Natural (Earthquakes, landslides, floods, Cyclones), Man-made disasters (biological, chemical, nuclear, radiological explosions) — definition, causes and management and/or mitigation strategies; Bhopal & ChernobylDisasters, Environment & Health - Occupational Health Hazards, Occupational Diseases, Epidemics, Pandemics, Endemics (Fluoride, Arsenic)
Principles and Significance of SanitationModule-

5

Environmental Impact Assessment (EIA) and Indian acts and regulations

Principles of EIA, Indian Acts and Rules, Wildlife (Protection) Act 1972. Water Act — 1974(Rules 1975), Forest Conservation Act 1980 (Rules 2003), Air Act -1981 (Rules 1982, 1983), Environment Protection Act, 1986

TEXT BOOKS:

1. Benny Joseph (2005). "Environmental Studies", Tata McGraw — Hill Publishing Company Limited, New Delhi.
2. R.J.Ranjit Daniels and Jagadish Krishnaswamy (2009). "Environmental Studies".Wiley India Private Ltd., New Delhi.

REFERENCES:

1. P.Aarne Vesilind, Susan M.Morgan, Thomson (2008). "Introduction to Environmental Engineering" (2008), Thomson learning, Second Edition, Boston.
2. R. Rajagopalan (2005). "Environmental Studies — From Crisis to Cure" Oxford University Press, New Delhi.
3. R. J. Ranjit Daniels and Jagadish Krishnaswamy (2014). "Environmental Studies"(2014), Wiley India Pvt Limited, New Delhi.

COURSE CODE	COURSE TITLE	L	T	P	S/P	C
21EN1107`	KANNADA KALI	1	–	–	–	1

COURSE OBJECTIVES:

- To introduce Kannada language & culture to Non – Kannada speakers.
- To train them to communicate in colloquial Kannada with connivance

COURSE OUTCOMES:

- The learners can communicate in Kannada & acquaint themselves withKannada culture

COURSE CONTENT

- Introduction to Karnataka & Kannada Culture.
- Evolution of Kannada.
- Introduction to Kannada Alphabets.
- Introduction to Kannada Numbers.
- Kannada words, sentences & phrase making for colloquial communication.

REFERENCE BOOKS:

1. Kannada Kali –Dr. Lingadevaru Halemane
2. Kannada Paatagalu– Editor: Dr. Chandrashekara Kambara.
3. SLN Sharma & K Shankaranarayana "Basic Grammar", Navakarnataka Publications.
4. Spoken Kannada. Publication: Kannada Sahitya Parishat Bengaluru.

COURSE CODE	COURSE TITLE	L	T	P	S/P	C
21EN1201	TRANSFORMS AND DIFFERENTIAL EQUATIONS	3	1	–	–	4

COURSE LEARNING OBJECTIVES:

1. To provide the basic concepts and necessary fundamentals to formulate,solve and analyze engineering problems.
2. To discuss the theoratic as well as geometric perspectives.
3. To understand the Fourier Series and Laplace Transform to solve real world problems.
4. To make strong foundation of the integral transforms and their inverses.
5. To understand the basic concepts of ODE and PDE to illustrate its power andutility through applications to science and Engineering.

COURSE OUTCOME:

At the end of this course the students are expected to

1. Apply Laplace transform and its inverse to solve differential and integral equations.
2. Represent the periodic functions using Fourier series.
3. Use Fourier transforms and its inverse in practical applications of engineering problems.
4. Apply transform techniques to analyze continuous-time and discrete-time
5. Solve engineering problems using the principles of solution of differential equations.
6. Solve ordinary differential equations using Laplace transform.
7. Apply the partial differential equation for solving engineering problems.

COURSE CONTENT: Total: 52 hours

Module-1

LAPLACE TRANSFORM AND INVERSE LAPLACE TRANSFORM

Basic concepts, Laplace transform of basic functions-Linearity and First shifting theorem, Laplace transforms of derivatives and integrals, Second shifting theorem, Initial and Final value theorems, Some basic transforms, Inverse Laplace transform, Convolution theorem, Applications to differential equations.

Self-Learning Component: Differentiation of functions

Module-2

FOURIER SERIES

Fourier Series, Dirichlet’s conditions, Euler’s Formulae, Fourier series of discontinuousfunctions, Even and odd functions, Change of interval, Parseval's theorem, Complex form of Fourier series

Self-Learning Component: Basic definitions of series, examples

Module-3

FORIER TRANSFORM AND INVERSE FOURIER TRANSFORM

Fourier transform and Fourier's integral theorem, Fourier cosine integral, Fourier sine integral, Basic properties of Fourier transform.

Self-Learning Component: Basic definitions and properties of integration

Module-4

ORDINARY DIFFERENTIAL EQUATION

Basic definitions-First order first degree differential equations-Non homogeneous equations reducible to Homogeneous Form-Exact differential equations-Bernaulliequation-Linear differential equations of second order with variable coefficients- Second order D.E with constant coefficients.

Self-Learning Component: Basic definitions of differential equation and examples

Module-5

PARTIAL DIFFERENTIAL EQUATION s

Formation of partial differential equation –Solutions of partial differential equation — Linear equations of the first order- Charpit's Method-Rules for finding the complementary function-Finding the particular integral-Method of separation of variables-Heat equation- Wave equation –Laplace equation

Self-Learning Component: Geometrical interpretation of Partial Differential equation

TEXT BOOKS

1. B.V Ramana, Higher Engineering Mathematics, Mc Graw Hill education India Pvt ltd,31st edition
2. B.S. Grewal , Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, 2014.
3.G.B.Thomas, Maurice T Weir and Joel Hass Thomas's Calculus ,12th Edition, PearsonIndia.

REFERENCE BOOKS

1. P. P. G. Dyke, An introduction to Laplace transform and Fourier Series, 4th Edition, Springer (2004).
2. Mathematical Methods by T.K.V. Iyengar, B.Krishna Gandhi, S.Ranganatham and M.V.S.S.N.Prasad S. Chand publication.
3. Erwin Kreyzsig, Advanced Engineering Mathematics, Wiley, 10th edition.
4. Stanley J. Farlow, Partial Differential Equations for Scientists and Engineers.

COURSE CODE	COURSE TITLE	L	T	P	S/P	C
21EN1108	ENGINEERING PHYSICS	3	–	2	–	4

COURSE LEARNING OBJECTIVES:

- To introduce the basic concepts of Quantum mechanics which are essential in understanding and solving problems in engineering,
- To review different types of Engineering materials –Electronic, electrical, mechanical and Magnetic materials Properties and their applications inScience and Engineering.
- To understand Band structure of solids, Semiconductors and electrical conductivity of SC's, and their applications.
- To explain semiconductor devices like LED, Photodiode and Solar cell and Semiconductor BJT.
- To explain Thin-film Phenomena, Thin-film fabrication Process and their applications in engineering.
- To learn how to fabricate Nano materials by using Top-down and Bottom –up approach& To review Nano science and technology and its practical applications in biology, engineering and medicine.

COURSE OUTCOME:

- Describe the concepts of Quantum mechanics and applications of Schrodinger time independent wave equation in one dimensions.
- Discuss the different engineering materials such as Electronic, electrical and mechanical materials properties and their applications in engineering
- Illustrate Semiconductors , Semiconductor devices like Photo diode, LED,Solar cell and BJT and its applications
- Classify Lattice parameters of different crystalline solids by using X-ray diffraction methods and Summarize theoretical background of laser, construction and working of different types of lasers and its applications inscience and engineering
- Interpret Basic concepts of Thin films and Thin film deposition processes andtheir applications leads to Sensors and engineering devices
- Discuss Nano materials, Properties and fabrication of Nano materials by usingTop-down and Bottom –up approach's-Applications for Science and technology

COURSE CONTENT: Total: 42 Hours

Module-1

Quantum Mechanics: Foundations of quantum theory, Wave function and its

properties, de-Broglie hypothesis, Heisenberg Uncertainty principle. One dimensional time independent Schrodinger wave equation, Eigen values and Eigen functions. Applications: one dimensional motion of an electron in a potential-well.
LASER PHYSICS: Introduction to lasers. Conditions for laser action. Requisites of a Laser system Principle, Construction and working of Nd-YAG and , Semiconductor Laser.Application of Lasers in Defense (Laser range finder), Engineering (Data storage) andApplications of Lasers in medicine

Module-2

Semiconductor Physics: Band structure, Fermi level in intrinsic and extrinsic semiconductors, Density of energy states in conduction and valence bands of a semiconductor (Mention the expression), Expression for concentration of electrons in conduction band (Derivation), Hole concentration in valance band (Mention the expression),Intrinsic carrier concentration Conductivity of semiconductors.
Semiconducting devices for optoelectronics applications: Principle and working of LED, photodiode, Solar cell,BJT and Numericals

Module-3

Introduction to Engineering materials: Classification of Engineering Materials such as Conductors, Semiconductors, Insulators. Electrical conductivity of metals and Semiconductors. Effect of temperature, composition on resistivity of materials.
Dielectrics: Introduction –Dielectric polarization– Dielectric Polarizability, Susceptibility and Dielectric constant-types of polarizations: Electronic and Ionic (Quantitative), Orientation polarizations (qualitative) — Lorentz Internal field — Claussius-Mossoti equation – Applications of Dielectrics. Numericals.

Module-4

Crystallography: Lattice, unit cell, lattice parameters, crystal systems, Bravais lattices, Packing fraction for SCC,BCC and FCC crystal systems. Introduction to Miller Indices.Determination of Crystal structure by Miller Indices. Expression for Inter-planardistance. X-ray diffraction, Bragg's law and Determination of Crystal structure by Powder method. Numericals
Mechanical Engineering Materials — mechanical properties: stress- strain curve for different materials. Introduction to Tensile strength, Compressive strength, Ductility, Toughness, Brittleness, Impact strength, Fatigue, Creep. Testing of engineering materials: Hardness Tests: Brinell and Vickers hardness test- (4 hours)

Module-5

Thin films technology: Introduction to thin-films-Advantages of thin-films over bulk materials. Thin film deposition processes- Physical vapour deposition (Thermalevaporation technique, and sputtering technique) process, Applications of Thin films.

Nano Science &technology: Introduction to Nano materials, Classification of nano materials, Size dependent properties of materials, Top-down and Bottom-up

approach- Ball-milling and Photolithography, Process. Fundamental Principles of Bio-Physics &Applications of Nano technology in Biology and Engineering.

LABORATORY EXPERIMENTS

List of Experiments:

1. I-V characteristics of a Zener Diode
   I–V Characteristics of a Zener diode in forward and reverse bias condition(Module 2)
2. Planck's constant
   Measurement of Planck's constant using LED(Module 2)3.Transistor characteristics
   Input and output characteristics of a NPN transistor in C-E configuration(Module2)
4. Dielectric constant
   Determination of dielectric constant of a dielectric material (Module 2)
5. Torsional Pendulum
   Determination of moment of inertia of a circular disc using torsional pendulum
6. Diffraction grating
   Determination of wavelength of a laser light using diffraction grating (Module4)
7. LCR series and parallel resonance
   Study the frequency response of a series and parallel LCR circuit (Module 3)
8. Band gap energy
   Determination of energy gap of an intrinsic semiconductor (Module 2)

TEXT BOOKS

1. S. M. Sze, Semiconductor devices, Physics and Technology, Wiley.Publishing
2. Engineering Physics (2019), DSU Pearson, New Delhi

REFERENCE BOOKS

1. M. Young (1977), Optics & Lasers An Engineering Physics approach, Springer
2 K.L. Chopra, Thin film Phenomena, McGraw Hill, New York.
3. S. O. Pillai (2018), Solid State Physics, revised edition, New Age International Publishers, New Delhi
4. M N Avadhanulu, P G Kshirsagar, TVS Arun Murthy (2018), A textbook of Engineering Physics, S Chand, New Delhi.

COURSE CODE	COURSE TITLE	L	T	P	S/P	C
21EN1109	BASIC ELECTRONICS	3	–	2	–	4

COURSE OBJECTIVES

This course enables students:

• To introduce the concepts of fundamentals of semiconductor devices with the basic knowledge of the flow of current in semiconductor devices such as diodes and transistors

• To Explain the characteristics of various semiconductor devices and the concept ofIntegrated circuits

• To understand the principles of electronic circuits for operations of energy conversions from AC to DC, noise removal and building the required power supply

• To understand how a particular electronic device can increase the power of a signaland also to be acquainted with gain calculations

• To implement the Boolean functions and to realize basic logic gate operations and logic functions

• To understand the basics of communication system, to modify the characteristics ofcarrier signals according to the information signals

• To study the fundamentals of electromagnetic waves

• To identify and understand the different blocks present in transmitter and receiver.

• To describe various parameters of Op-Amp, its characteristics and specifications.

• To understand the various applications of Op-Amp.

COURSE OUTCOMES

- Explain the fundamentals of semiconductor devices, analog and digital circuits
- Design and analyze the behavior of analog and digital circuits.
- Outline the overview of communication systems and oscillators.
- Solve various kinds of numerical problems
- Develop the analog and digital circuits using simulation tool COURSE

CONTENT: Total: 45 Hours

Module-1

Semiconductor Diodes Semiconductor materials- intrinsic and extrinsic types, Ideal Diode. Terminal characteristics of diodes: p-n junction under open circuit condition, p-n junction under forward bias and reverse bias conditions, p-n junction in breakdown region, Zener diode, Series voltage regulator, Rectifier Circuits: Half waveand full wave, Reservoir and smoothing circuits.

Module-2

Transistors - Introduction, Transistor construction, operation and characteristics; Configuration types: Common base and common emitter configuration, Active region operation of transistor, Transistor amplifying action, Biasing the BJT: fixed bias, emitter feedback bias, collector feedback bias and voltage divider bias, Transistor as a

switch: cut-off and saturation modes. Field Effect Transistors: Construction and characteristics of n-channel JFET, Types of power amplifiers: Class A operation, ClassB operation, Class AB operation.

Module-3 Operation Amplifier

Ideal Op-amp, Differential amplifier: differential and common mode operation common mode rejection ratio (CMRR), Practical op-amp circuits: inverting amplifier, non-inverting amplifier, comparator, summing amplifier, integrator, differentiator. The concept of positive feedback, Oscillator circuits using op amps: RC phase shift oscillator, wein bridge oscillator.

Module-4

Communication system - The radio frequency spectrum, electromagnetic waves, A simple CW transmitter and receiver, modulation, demodulation, AM transmitter, FM transmitter, Tuned radio frequency receiver, Superheterodyne receiver. RF amplifiers, AM demodulators.

Module-5

Digital circuits - Logic functions, Switch and lamp logic, logic gates, combinational logic, bistables/flipflops, application of Flipflops, Integrated circuit logic devices: introduction to Microprocessor and microcontrollers (Architecture), Related Problems.

TEXT BOOKS

1. Electronic Devices and Circuit Theory: Robert L Boylestad and Louis Nashelsky, Pearson Education, Eleventh Edition, 2013.
2. Electronic Circuits: Fundamentals and applications, Michael Tooley, Elsevier, Third edition, 2006

REFERENCE BOOKS

1. David A Bell, Electronic Devices and Circuits, PHI, 5th edition, 2007.
2. Millman & Halkias, Electronics Devices and Circuits, McGraw Hill, second edition,2010
3. Modern Digital and Analog Communication Systems by B.P.Lathi. Oxford UniversityPress, Fourth edition, 2010
4. NPTEL- https://nptel.ac.in/courses/122/106/122106025/
5. Virtual Labs- http://vlabs.iitkgp.ac.in/be/

COURSE CODE	COURSE TITLE	L	T	P	S/P	C
21EN1110	ENGINEERING GRAPHICS & DESIGN	1	–	4	–	3

COURSE OBJECTIVES:

- To create awareness and emphasize the need for Engineering Graphics
- To understand the principles of geometrical curves and construct manually
- To learn using professional CAD software for construction of geometry
- To construct orthographic projection of points, lines, planes and solids
- To develop the lateral surfaces of solids
- To construct isometric projections of planes and solids
- To create simple engineering 3D components and assembly

COURSE OUTCOMES

- Identify usage of instruments, dimensioning & tolerances, conventions and standards related to working drawings
- Construct points, lines, planes and solids using orthographic projectionsprinciples
- Construct geometries of planes and solids using isometric projection principles
- Develop section of solids for different planes of inclination
- Construct lateral surfaces of solids using geometry development principles
- Create associative models at the component and assembly levels for productdesign

COURSE CONTENT: Total 70 hours

Module-1

Introduction: Fundamentals, Drawing standard - BIS, dimensioning, Lines, lettering,scaling of figures, symbols and drawing instruments, Introduction to orthographic &perspective projection. Types of projections, Principles of Orthographic projection Plain & Miscellaneous Curves: Construction of ellipse, parabola, hyperbola, Construction of Tangent and Normal at any point on these curves. Construction ofCycloid, Epicycloid and Hypocycloid, Involute of a circle. Construction of Tangent andNormal at any point on these curves.

Module-2

Projection of Points and Lines: Projections of points located in same quadrant anddifferent quadrants. Projection of straight lines inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method.

Projection of planes: Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by change of position method.

Module-3

Projection of Solids: Projection of solids such as prisms, pyramids, cone, cylinder,tetrahedron, Projections of solids with axis perpendicular and parallel to HP and VP,

solids with axis inclined to one or both the planes, suspension of solids.

Module-4
Sections of Solids: Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other, obtaining true shape of section. Development of Surfaces: Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

Module-5
Isometric Projection: Principles of isometric projection, isometric scale, Isometric projections of simple solids and truncated solids – Prisms, pyramids, cylinders, cones,combination of two solid objects in simple vertical positions, Conversion of orthographic views into isometric projection and vice versa

Module-6
Computer Aided Design: Introduction to computer aided drafting and tools to makedrawings. Layout of the software, standard tool bar/menus and description, drawingarea, dialog boxes and windows, Shortcut menus, setting up and use of Layers, layersto create drawings, customized layers, create, zoom, edit, erase and use changingline lengths through modifying existing lines (extend/lengthen) and other commandsDemonstration of a simple team design project: Product Design- Introduction, stages,Design Geometry and topology of engineered components creation of engineeringmodels and their presentation in standard 3D view. Use of solid-modeling software forcreating associative models at the component and assembly levels; include: simplemechanical components-bolts, nuts, couplings; simple civil fixtures -windows, doors,bath, sink, shower, etc. Applying colour coding to the components.

TEXT BOOKS:

1. Gopalakrishna, K. R. and Sudheer Gopala Krishna (2015). "Computer AidedEngineering Drawing", Subash Publishers, Bangalore, India.
2. Bhatt N.D. (2019). "Engineering Drawing", 53rd Edition, Charotar Publishing House, Gujarat, India.

REFERENCES:

1. Dhananjay .A .J, (2018). "Engineering Drawing with Introduction to AutoCAD", Tata McGraw-Hill Publishing Company Ltd.

COURSE CODE	COURSE TITLE	L	T	P	S/P	C
21EN1111	ENGINEERING MECHANICS	2	–	2	–	3

COURSE OBJECTIVES:

- Explain different types of forces and couples, resolution of forces and couples, equilibrium conditions and related theorems
- Explain concepts of friction and their relevance in Engineering problems
- Describe centroid, center of gravity and differences between them, area moment of inertia, examples of planar objects and computations for them
- Describe Trusses and its classification, assumptions in analysis of trusses, forcesin members in a truss
- Calculate various dynamic quantities of translational motion and projectile motion
- Explain principles of dynamics in plane motion analysis

Course Outcomes

- Analyze structure using free body diagrams and principle of statics
- Analyze structures using concept of equilibrium conditions considering effect of frictional forces
- Calculate the centroid and moment of inertia of composite geometricalsections
- Compute axial forces in members of determinate truss
- Analyze plane kinematics and kinetics of particles/rigid bodies COURSE

CONTENT: Total 28 hours

Module-1

Introduction to Engineering Mechanics

Introduction to Engineering Mechanics, Force Systems Basic concepts, Particle Equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, CoplanarConcurrent Forces, Resultant- Moment of Forces and its Application; Couples and Resultant of force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium.

Module-2

Friction

Introduction, Types of friction, Limiting friction, Cone of Friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, Ladder friction, related problems.

Module-3

Centroid, Centre and gravity and Moment of inertia

Introduction, Centroid of simple figures from first principle, centroid of compositesections; Centre of Gravity and its implications; Area moment of inertia Definition,

Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertiaof circular plate, Cylinder, Cone.

Module-4

Analysis of Trusses

Introduction, Classification of trusses, Equilibrium in two and three dimension; Methodof Sections; Method of Joints; To determine if a member is in tension or compression;Simple Trusses; Zero force members.

Module-5

Dynamics

Introduction, Rectilinear motion; Plane curvilinear motion (rectangular path, and polarcoordinates); Projectile motion, Relative and constrained motion; Basic terms, general principles in dynamics; Types of motion, Instantaneous Centre of rotation in plane motion and simple problems; D Alembert's principle and its applications in plane motion and connected bodies.5

TEXT BOOKS:

1. Irving H. Shames (2006), "Engineering Mechanics", 4th Edition, Prentice Hall publications.
2. A. Nelson (2009), "Engineering Mechanics: Statics and dynamics", Tata McGraw Hill publications.

REFERENCES:

1. R.C. Hibbler (2006), "Engineering Mechanics: Principles of Statics and Dynamics", Pearson Press.
2. Bansal R.K (2010), "A Text Book of Engineering Mechanics", Laxmi Publications.
3. H.J. Sawant, S.P Nitsure (2018), "Elements of Civil Engineering and Engineering Mechanics", Technical Publications.

COURSE CODE	COURSE TITLE	L	T	P	S/P	C
21EN1112	BIOLOGICAL SCIENCES	2	–	–	–	2

COURSE OBJECTIVES

1. To familiarize the student with the structure and function of important components of biological systems and cellular processes.
2. Biological systems and processes will be analyzed from an engineering perspective, with an emphasis on how these can be re-designed for industrialprocesses and commercial products.

COURSE OUTCOMES

1. Student understands biological systems
2. Student gets the engineering aspects from biological systems

COURSE CONTENT: Total 28 hours

Biology in the 21st Century: The new world in the post genome era. Past, present andfuture of our society, industry and life style: impact of discoveries and technological innovations in biology. Challenges and excitement of research in biology and bioengineering. Bioengineering as an emerging science at the intersection of biology,engineering, physics and chemistry.

Career opportunities in biotechnology, biomedical engineering, pharmaceutical industry, agro-biotechnology and in the diverse areas of basic science and medical research. Emerging trends of collaboration between industry and academia for development of entrepreneurship in biotechnology.

Quantitative views of modern biology. Importance of illustrations and building quantitative/ qualitative models. Role of estimates. Cell size and shape. Temporal scales. Relative time in Biology. Key model systems - a glimpse.

Management and transformation of energy in cells. Mathematical view - binding, gene expression and osmotic pressure as examples. Metabolism. Cell communication. Genetics. Eukaryotic genomes. Genetic basis of development. Evolution and diversity. Systems biology and illustrative examples of applications of Engineering in Biology.

TEXT BOOKS:

1. R. Phillips, J. Kondev and J. Theriot, Physical Biology of the Cell, Garland Science Publishers. 2008. 1st edition.
2. J. B. Reece, L. A. Urry, M. L. Cain, S. A. Wasserman, P.V.Minorsky, and R.B.Jackson. Campbell Biology, Benjamin Cummings publishers. 2010. 9th edition.

COURSE CODE	COURSE TITLE	L	T	P	S/P	C
21EN1113	TECHNICAL COMMUNICATION	2	–	–	–	2

COURSE LEARNING OBJECTIVES:

The objectives of the Course are:

- To improve students lexical, grammatical competence
- To enhance their communicative skills
- To equip students with oral and appropriate written communicationskills
- To inculcate students with employability and job search skills
- To achieve proficiency in English
- To develop professional communication skills
- To create interest among the students about a topic by exploring thoughts and ideas
- To enable students with good use of tenses
- To learn the use of body language and improve verbal message
- To equip with Types of Teams and Leadership styles to developmanaging skills in corporate world.
- To acquire skills for placement

COURSE OUTCOMES

- Explain communication and types of Communication: Managerial, Corporate, Technical & Organizational Communication.
- Distinguish Listening and hearing. Demonstrate various aspects of speaking.Discuss Word formation and types.
- Write a report, essay. Minutes of Meeting. Evaluate current issues and debate
- Use Leadership skills and Team building. Solve Tense exercise.
- Write a job application and CV.
- Discuss topic and speak on the spot. Interpret data

COURSE CONTENT:

Module-1

Language Skills & Communication and Types of Communication.

Definitions. Communication process diagram. Types of Communication: Managerial,Corporate, Technical & Organizational Communication.

Barriers to effective Communication.

Listening: Types & its Importance. Difference between hearing & listening.Speaking: Different aspects of Effective Speaking.

Reading: Extensive and intensive.

Word Formation and Types of Word Formation.Word Family.

Module-2
Group Discussion and Writing Skills
Report Writing: Importance. Steps for Report Writing.
Group Discussion: Definition, How GD helps in Student Life & Corporate Life.Minutes of Meeting: Importance; Steps for writing MOM in Organizations.

Module-3
Team &Team Building; Leadership Styles & Tenses.Teams:
Definition, Importance, Types of Team; TEAM BUILDING:
Approaches to team building, Characteristics of Effective Teams,
Creating Effective Teams Key Team Roles, Team Processes, Interpersonal Processesin Teams, Task and maintenance leadership, Team Dynamics, Team cohesiveness, Decision Making in Teams, Diversity, Characteristics of "High Performance Teams," Principles of Effective Teamwork, Turning Individuals into Team Players, Teams and Quality Management, Relationship between team working and innovation in organization.
Leadership: Styles of Leadership; Characteristics of a good leader, Influence ofdifferent forces on leadership
LAB BASED: Tenses: Types of tenses, structure & usage. (Exercises based on tenses)

Module-4
JOB APPLICATION, RESUME, COVER LETTER & Data Interpretation.JOB Application, Covering Letter; Resume/CV Writing; Difference between Job Application & Resume.
Writing Covering letter and Resume.

Module-5
DATA Interpretation-Tables, Bar-graph, Pie chart & Flowchart.
(Theoretical as well as Numerical).

Activities:

1. Activities on Fundamentals of Inter-personal Communication and Building Vocabulary –Starting a conversation — responding appropriately and relevantly – using the right body language – Role Play in different situationsand Discourse Skills- using visuals – Synonyms and antonyms, word roots,one-word substitutes, prefixes and suffixes, study of word origin, business vocabulary, analogy, idioms and phrases, collocations and usage of vocabulary.
2. Activities on Group Discussion , Interview Skills and Debate– Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation- Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference and video-conference and Mock Interviews-Critical thinking skills in debate,

analytical research , organize thoughts, note-taking skills, effective speechcomposition and delivery and team work

REFERENCE BOOKS

1. Chauhan, Gajendra S., L. Thimmesha and Smita, Kashiramka (2019). TechnicalCommunication, Cengage Learning, New Delhi.
2. Bailey, Stephen. Academic Writing: A Handbook for International Students. Routledge, 5th Edition.
3. Kumar, Shiv K., Nagarajan,Hemalatha. (2007).Learn Correct English – ABook of Grammar, Usage and Composition.
4. Raman, Meenakshi, Sharma, Sangeeta. (2009). Technical Communication.Oxford University Press.
5. English Vocabulary in Use. (2008) Cambridge University Press.

COURSE CODE	COURSE TITLE	L	T	P	S/P	C
21EN1114	DESIGN THINKING	–	–	2	–	1

COURSE OBJECTIVES:

- Introduce students to a discipline of design thinking that enhances innovation activities in terms of value creation, speed, and sustainability
- Learn application of design methods and tools on real world problem
- To impart knowledge and skills to use various workbenches in Autodesk Fusion360.
- To provide hands-on training in virtual modeling and table-top modeling.
- Application of design thinking, design methods and tools on real world problem.

Course Outcomes

- Apply the design thinking principles and recognize the significance ofinnovation
- Develop creative ideas through design criteria & brainstorming sessions
- Sketch various part models related to engineering field using Autodesk Fusion360
- Evaluate project on ideation & generate solution
- Construct table top models using card board and clay

COURSE CONTENT: Total 28 hours

Module-1 Design
Thinking
Introduction, Phases of design thinking, Design thinking: an iterative and non-linearprocess.

Module-2
Scope and Morphology of Design Process
Creativity and Idea Generation, Concept Development, Testing and Prototyping,Brainstorming & decision making.

Module-3
Design Communication and Presentation
Types of design communications, Barriers and Difficulties in Communication

Module-4
Project on Ideation
Generation of Solution from Students for Problem Brief Generated. Brainstormingsession with students on example problem.

Module-5
Project on Creativity
Table-top modelling: Using paper and cardboard based modelling, clay modelling.

TEXT BOOKS:

1. C. L. Dym and Patrick Little (2015). "Engineering Design- A Project Based Introduction", John Wiley.
2. N. Cross (2021). "Engineering Design Methods: Strategies for Product Design", John Wiley.

REFERENCES:

1. Tim Brown (2019). "Change by Design: How Design Thinking Transforms Organizationsand Inspires Innovation", Harper Business.
2. Bruce Hannington and Bella Martin (2015). "Universal Methods of Design: 100 Ways to Research Complex Problems, Develop Innovative Ideas, and Design Effective Solutions", Rockport Publishers.

COURSE CODE	COURSE TITLE	L	T	P	S/P	C
21AU0004	CONSTITUTION OF INDIA & ETHICS	2	–	–	–	–

Course objectives

1. To provide basic information about Indian constitution.
2. To identify individual role and ethical responsibility towards society.

Course outcomes

At the end of the course student will be able

- Understand state and central policies, fundamental duties
- Understand Electoral Process, special provisions
- Understand powers and functions of Municipalities, Panchayats and Cooperative Societies,
- Understand Engineering ethics and responsibilities of Engineers

Introduction to the Constitution of India, The Making of the Constitution andSalient features of the Constitution. Preamble to the Indian Constitution Fundamental Rights & its limitations.
Directive Principles of State Policy & Relevance of Directive Principles StatePolicy fundamental Duties.
Union Executives – President, Prime Minister Parliament Supreme Court of India.
State Executives – Governor Chief Minister, State Legislature High Court of State.
Electoral Process in India, Amendment Procedures, 42nd, 44th, 74th, 76th, 86th&91st Amendments.

Special Provision for SC & ST Special Provision for Women, Children & Backward Classes Emergency Provisions.

Powers and functions of Municipalities, Panchyats and Co – Operative Societies.

Text Books:

1. Brij Kishore Sharma,"Introduction to the Constitution of I$_6$n$_9$dia", PHI LearningPvt. Ltd., New Delhi, 2011.
2. Durga Das Basu: "Introduction to the Constitution on India", (Students Edn.) PrenticeHall, 19th / 20th Edn., 2001

Reference Books:

1. M.V.Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**21CS2301**					
TITLE OF THE COURSE	**DISCRETE MATHEMATICAL STRUCTURES**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- Solve problems using relations and generating functions.
- Understand and Construct mathematical arguments.
- Use propositional and predicate logic in knowledge representation and program verification.
- Develop recursive algorithms based on mathematical induction.
- Know essential concepts in graph theory and related algorithms.
- Apply knowledge of discrete mathematics in Elementary Number Theory and problem solving.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Classify functions, basic set theory relations.	L4
CO2	Demonstrate the correctness of an argument using propositional and predicate logic, laws and truth tables.	L2
CO3	Compare and differentiate graphs in different geometries related to edges.	L4
CO4	Apply mathematical induction, counting principles, recursion, elementary number theory.	L3
CO5	Apply and solve Euclidean Division Algorithm and Chinese Remainder Theorem.	L3

COURSE CONTENT:	
MODULE 1	**8Hrs**
RELATIONS AND FUNCTIONS: Relation and Types of relations, Closure Properties, Equivalence Relations, Partial Ordering Relations, n-ary relations, Functions: one-to-one, onto and invertible functions, sequences, indexed classes of sets, recursively defined functions, cardinality Counting Principles: Permutation, combination, the pigeon hole principle, inclusion-exclusion principle Self – Learning Component: Set theory definition and Properties	
MODULE 2	**8Hrs**
LOGIC: Propositions and truth tables, tautologies and contradictions, logical equivalence, algebra of propositions, logical implications, predicate logic, theory of inference for propositional logic and predicate logic. Introduction to Predicate Calculus.	
MODULE 3	**8Hrs**

NUMBER THEORY: Properties of Integers: Introduction, order and inequalities, absolute value, mathematical induction, division algorithm, divisibility, primes, greatest common divisor, Euclidean algorithm, fundamental theorem of arithmetic, congruence relation, congruence equations and Chinese Reminder Theorem (CRT).	
MODULE 4	**7Hrs**
GRAPH THEORY: Graphs and multi-graphs, sub-graphs, isomorphic and homomorphic graphs, paths, connectivity, Euler and Hamilton paths, labelled and weighted graphs, complete, regular and bipartite graphs, planar graphs.	
MODULE 5	**8Hrs**
TREES AND GRAPH COLORING: Trees: Definitions-properties - fundamental theorems of trees-rooted trees-binary trees-spanningtrees. Coloring of planar graphs, Chromatic Number- Chromatic partitioning- The four Color Problem-Five-color.	

TEXT BOOKS:

1. K. H. Rosen, Discrete Mathematics & its Applications, 7th Ed., Tata McGraw-Hill, 2007.
2. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice Hall India (PHI).

REFERENCES:

1. M.Huth and M. Ryan, Logic in Computer Science, Cambridge University N.Press, 2004.

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**21CS2302**					
TITLE OF THE COURSE	**DATA STRUCTURES**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	**	***	***

COURSE OBJECTIVES:

- To introduce the concept of data structure and its applications
- To introduce C language concepts required for data structures
- To design data structure operations to solve problems
- To introduce applications of data structures
- To introduce non-primitive data structures
- To analyse the complexity of a data structure
- To introduce static and dynamic memory allocation using C language
- To explain linear data structures – stack, queue, linked list
- To explain non-linear data structures – trees and graphs

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's TaxonomyLevel
CO1	Outline basic C program design for data structures	L2
CO2	Implement stack & queue data structure and their applications	L3
CO3	Apply concepts of dynamic memory allocation to real-timeProblems	L3
CO4	Implement tree data structure and its applications	L3
CO5	Implement graph data structure and its applications	L3
CO6	Outline the concepts of file structures	L2

COURSE CONTENT:	
MODULE 1	**7Hrs**
INTRODUCTION TO DATA STRUCTURES: Definition, Types, C Pointers, C Structure, Arrays, Representation of Linear Array in Memory,Array Operations (Insertion, Deletion, Search and Traversal), Single Dimensional Arrays, TwoDimensional Arrays, Function Associated with Arrays, Arrays as Parameters, Recursive Functions.	
MODULE 2	**9Hrs**
INTRODUCTION TO STACK AND QUEUE: **Stack:** Definition, Array Representation of Stack, Operations Associated with Stacks- Push & Pop, Applications of Stack: Recursion, Polish expressions, Conversion of Infix to Postfix, Infix to Prefix, Postfix Expression Evaluation, Tower of Hanoi. **Queue:** Definition, Representation of Queues, Operations of Queues, Priority Queues, CircularQueue.	

MODULE 3	9Hrs
DYNAMIC DATA STRUCTURE: **Linked List:** Types, Introduction to Singly Linked lists: Representation of Linked Lists in Memory,Traversing, Searching, Insertion & Deletion from Linked List. Doubly Linked List,Operations on Doubly Linked List (Insertion, Deletion, Traversal). Applications: Polynomial Representation & Basic Operations, Stack & Queue Implementation using Linked Lists.	
MODULE 4	**8 Hrs**
TREES & GRAPHS: **Trees:** Basic Terminology, Binary Trees and their Representation, Complete Binary Trees, BinarySearch Trees, Operations on Binary Trees (Insertion, Deletion, Search & Traversal), Application:Expression Evaluation. **Graphs:** Terminology and Representations, Graphs & Multigraphs, Directed Graphs, Sequential Representation of Graphs, Adjacency Matrices, Graph Transversal	
MODULE 5	**6 Hrs**
FILE STRUCTURES: Physical storage media, File Organization, Linked Organization of File, Inverted File, Organization Records into Blocks, Sequential Blocks, Indexing & Hashing	

TEXT BOOKS:

1. A M Tannenbaum, Y Langsam, M J Augentien "Data Structures using C", Pearson, 2013
2. R.L. Kruse, B.P. Leary, C.L. Tondo, "Data Structure and Program Design in C" PHI

REFERENCES:

1. Horowitz Anderson-Freed, and Sahni, "Fundamentals of Data structures in C", 2nd Edition, Orient Longman, 2008
2. Data Structures and Algorithm analysis in C by Mark Allen Weiss, Published by Addison Wesley (3rd Indian Reprint 2000).
3. D E Knuth, The Art of Computer Programming, Volume 1, Addison-Wesley Publishing, 2013

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**21CS2303**					
TITLE OF THE COURSE	**DIGITAL ELECTRONICS & LOGIC DESIGN**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- To understand various number systems and conversion from one to other number systems
- To introduce basic postulates of Boolean algebra
- To manipulate expressions into POS or SOP form.
- To introduce the methods for simplifying Boolean expressions like K-Map and Quine Mclusky
- To understand the concept of don't care conditions and how they can be used to further optimize the logical functions
- To design simple combinational circuits such as multiplexers, decoders, encoders
- To understand the differences between combinational and sequential Logic circuits
- To familiar with basic sequential logic component-SR Latch
- To understand the basics of various types of memories.
- To present the working of various Flip- Flops (T flip-flop, D flip-flop, R-S flip-flop, JK flip-flop)
- To get familiarized with State Diagram, State Table, State Assignment
- To design combinational circuits using programmable logic devices.
- To design sequential circuits such as different types of Counters, Shift Registers

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Demonstrate the knowledge of binary number systems, Logic families, Boolean algebra and logic gates	L2
CO2	Analyze different methods used for simplification of Boolean expressions	L4
CO3	Design combinational logic circuits using combinational logic elements	L3
CO4	Design combinational circuits using Programmable Logic Devices	L3
CO5	Analyze sequential logic elements in the design of synchronous and asynchronous systems	L4
CO6	Design sequential systems composed of standard sequential modules, such as counters and registers	L3

COURSE CONTENT:	
MODULE 1	**9Hrs**
NUMBER SYSTEMS: BCD number representation, Unsigned and signed number representation, Binary arithmetic. **BOOLEAN ALGEBRA AND SIMPLIFICATION:** Laws of Boolean algebra, Theorems of Boolean algebra, Boolean/Switching functions and their implementation. **SIMPLIFICATION OF BOOLEAN EXPRESSIONS AND FUNCTIONS:** Canonical forms, Sum-of-Products Method, Truth Table to Karnaugh Map, Karnaugh Simplifications, Don't-care Conditions. Product-of-sums Method, Product-of-sums simplifications, Simplification by Quine-McClusky Method.	
MODULE 2	**8Hrs**
DESIGN OF COMBINATIONAL LOGIC CIRCUITS: Modular combinational logic elements- Multiplexers and Demultiplexers, Decoders, Magnitude comparator, BCD converter, Encoders, Priority encoders.	
MODULE3	**9Hrs**
INTRODUCTION TO SEQUENTIAL CIRCUITS: Introduction to Sequential Circuits. Combinational Vs sequential circuits, Clock, Clock Triggering, Memory elements and their excitation functions – Latches, T flip-flop, D flip-flop, R-S flip-flop. JK flip-flop and their excitation requirements, State diagram, state table and state equation	
MODULE 4	**6 Hrs**
REGISTERS Registers-Types of Registers, Serial In - Serial Out, Serial In - Parallel out, Parallel In - Serial Out, Parallel In –Parallel Out, Universal Shift Register. Applications of Shift Registers	
MODULE 5	**7 Hrs**
COUNTERS, PROGRAMMABLE LOGIC: Ring, Johnson counters, Design of synchronous and asynchronous Counters Programmable Logic Arrays, Design of Combinational Circuits using Programmable Logic Devices (PLDs):	

TEXT BOOKS :

1. M. Morris Mano and Michael D. Ciletti, "Digital Design", 6th Edition,N.Pearson Education, 2018
2. Donald.P. Leach, Albert Paul Malvino & Goutam Saha: Digital Principles and Applications, 8thEdition, Tata McGraw Hill, 2015

REFERENCES:

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1. D Sudhaker Samuel: Illustrative Approach to Logic Design, Sanguine-Pearson, 2010.
2. Charles H. Roth: Fundamentals of Logic Design, Jr., 7th Edition, Cengage Learning, 2014
3. John M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**21CS2304**					
TITLE OF THE COURSE	**FULL STACK DEVELOPMENT**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	2	**-**	**2**	**-**	**26+26**	**3**

Prerequisite Courses			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

1. Understand the major areas of web programming
2. To gain the skill into web applications and development.
3. To create website using HTML5, CSS3, JavaScript.
4. Server-Side Scripting using Node.JS, Express JS and Mongo dB

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's TaxonomyLevel
CO1	Know the fundamentals of front end web technologiesusing HTML 5 and CSS3	L1
CO2	Apply Cascading Style Sheets and XHTML to the ideaof a web application.	L3
CO3	Comprehend the principles of client-side programming andunderstand how to use JavaScript to implement them in order tocreate dynamic web sites.	L3
CO4	Implementing the principles of server side programming usingNode.js, Mongo dB	L3
CO5	Applying the Node.js framework -Express.JS to create web applications faster and smarter	L3

COURSE CONTENT:	
MODULE 1: Markup Language (HTML5)	**4 Hrs**
Introduction to HTML and HTML5 - Formatting and Fonts -Commenting Code – Anchors – Backgrounds – Images – Hyperlinks – Lists – Tables – HTML Forms, Audio ,Video Tag.	
MODULE 2: CSS3	**4 Hrs**
CSS3: Levels of style sheets; Style specification formats; Selector forms; Property value forms; Font properties; List properties; Color; Alignment of text; Background images, Conflict Resolution, CSS Box Model .CSS3 features: Box Shadow, Opacity, Rounded corners, Attribute selector.	

MODULE 3 : JavaScript	6 Hrs
Overview of JavaScript; Object orientation and JavaScript; General syntactic, characteristics; Primitives, operations, and expressions; Screen output and keyboard input. Control statements; Arrays; Functions, Constructors; A brief introduction on pattern matching using regular expressions, DOM Events	
MODULE 4: Node JS	**6 Hrs**
Introduction to NodeJS, Set up Dev Environment, Node JS Modules, Node Package Manager, File System, Events, Database connectivity using Mongo DB.	
MODULE 5: Express.JS	**6 Hrs**
Introducing Express: Basics of Express, Express JS Middleware: Serving Static Pages ,Listing Directory Contents, Accepting JSON Requests and HTML Form Inputs, Handling Cookies.	

List of Laboratory/Practical Experiments activities to be conducted:

HTML5

1. Design a web page depicting: -
   - How markup works, including the working of various basic HTML elements andattributes..
   - The basic structure of an HTML document.
   - The usage of table tag to format a web page
   - Use and tags to provide a layout to the page instead of a table Layout.
   - The usage of lists to bring order to web pages
   - The usage of other various HTML tags like Image, anchor, links etc.
2. Design a web page and embed various multimedia features in the page.
3. Building of HTML Forms

CSS3:

4. Change the Look of a web page with a Style Sheet

JAVASCRIPT

5. Design of dynamic and Interactive web pages using Java script
   - Depicting the usage of declaring variables, running loops, if/then statements, and writing functions/Constructors using JavaScript
   - Depicting Event handling using Java script.
   - Depicting the Pattern matching using regular expressions.

NODE.JS

6. Demonstrate how to use Node.js http module to create a web server.
7. Create a Node.js file that that depicts the usage of various File System Modules

EXPRESS.JS

8. Create an app that starts a server using Express.js.
9. Demonstrate the usage of various Express JS Middleware.

TEXT BOOKS:

1. Robert W. Sebesta , "Programming the World Wide Web", 7th Edition, Pearson Education, 2008.
2. Basarat Ali Syed," Beginning Node.js ",Apress ,2014

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**21CS2305**					
TITLE OF THE COURSE	**COMPUTATIONAL THINKING WITH PYTHON**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	2	**-**	**2**	**-**	**26+26**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- To understand basic concepts of computational thinking.
- To introduce python programming for problem solving.
- To introduce different debugging and unit testing tools.
- To solve real world problems using python data structures.
- Learn to handle files and exception handling in python.
- To explore Python's object-oriented features.
- To build Web services and Networked programs in python.
- To train students to design an application as part of the course mini- project using computational thinking with python.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Understand basic concepts of computational thinking.	L2
CO2	Outline basic python programming for problem solving.	L2
CO3	Apply computational thinking to solve real world programs usingPython	L3
CO4	Build python programs using core data structures like list,dictionaries and tuples	L3
CO5	Implement object oriented concepts using python	L3
CO6	Design applications related to web services and networkProgramming.	L3

COURSE CONTENT:		
MODULE 1	13	**5Hrs**
INTRODUCTION TO COMPUTATIONAL THINKING AND PYTHON: Introduction to computational thinking: Stages of Computational thinking, Basics: Values,expressions and statements, Conditional execution,Functions, Iterations		
MODULE 2		**6Hrs**
PYTHON DATA STRUCTURES: Python Data Structures: Strings, Arrays, Lists, Tuples, Sets and Dictionaries		

MODULE 3	5Hrs
PYTHON OBJECTS: Classes and Objects: Creating classes, Using Objects, Accessing attributes, Classes as Types, Introduction to Multiple Instances, Inheritance.	
MODULE 4	**5Hrs**
EXCEPTION HANDLING: Try-Except, Exception syntax, examples, Types of exception with except, multiple exceptions with except, Try-Finally, Raise exceptions with arguments, Python built-in exceptions, User-defined exceptions, Assertions	
MODULE 5	**5Hrs**
PYTHON FILES & LIBRARIES Files: File types, modes, File functions, File attributes, File positions, Looping over file. Basics of NumPy and Pandas	

List of Laboratory/Practical Experiments activities to be conduct

1. Python program to evaluate Values, expressions, and statements, Conditional execution, and Functions Iterations
    a. prompt the user to enter an integer and reverse it. And print the sum of the reversed integer.
    b. Write a python program to find whether a number (num1) is a factor of 255.
    c. Write a python program to find whether a number (num1) is a factor of 255.
    d. Write a program to find the sum of the following series:
        i. 1 + 1/3 + 1/5 + 1/7 + ...up to 'N' terms.
        ii. 1 + x/1! + x3/2! + x5/3! + x7/4 + ... x2n-1/n!
2. Python program to evaluate Python Collections
    a. Write a Python Program to demonstrate the inbuilt functions of Strings, List, and sets.
    b. Write a Python program for counting a specific letter 'o' in a given string; the number of times vowel 'o' appears.
    c. Write a Python Program to find the frequency of each word in given strings/strings
    d. Store the following for 'n' countries, using a dictionary:
        i. Name of a country, country's capital, per capita income of the country.
        ii. Write a program to display details of the country with the highest and second lowest per capita income.
3. Write a python program to create two classes "Python" and "Java" having data members "Version" and "name" and a member function "display()". With the help of the object, print the appropriate messages.
4. Create a class "Employee" with init method to initialize data members: Name, Designation, Ph. No., and a member function display(). Create an instance for the class and display the details of the employee
5. Write an interactive calculator! User input is assumed to be a formula that consist of a number, an operator (at least + and -), and another number, separated by white space (e.g. 1 + 1). Split user input using str.split(), and check whether the resulting list is valid:
    a. If the input does not consist of 3 elements, raise a FormulaError, which is a custom Exception.

b. Try to convert the first and third input to a float (like so: float_value = float(str_value)). Catch any ValueError that occurs, and instead raise a FormulaError
c. If the second input is not '+' or '-', again raise a FormulaError
d. If the input is valid, perform the calculation and print out the result. The user is then prompted to provide new input, and so on, until the user enters quit.

6. Write a Python program to count the number of lines in a text file and read the file line by line and store it into a list as well as find the longest word in the file.
7. Write a Python program to create a list of student details: usn, name dob and email {using dictionary} and write a list to a file.
8. Generate one-hot encodings for an array in numpy.
9. Write a Pandas program to import excel data into a Pandas dataframe and find a list of employees where hire_date is between two specific month and year.

TEXT BOOKS:

1. "Python for Everybody-Exploring Data Using Python 3", Dr. Charles R. Severance,
2. "Introduction to Computing & Problem Solving with Python",Jeeva Jose,P.Sojan Lal, Khanna Book Publishing; First edition (2019).

REFERENCES:

1. "Computer Science Using Python: A Computational Problem- Solving Focus", CharlesDierbach, Introduction John Wiley, 2012.
2. "Introduction to Computation and Programming Using Python", John V Guttag,Prentice Hall of India, 2015.
3. "How to think like a Computer Scientist, Learning with Python", AllenDowney,JeffreyElkner and Chris Meyers, Green Tea Press, 2014.
4. "Learning to Program with Python", Richard L. Halterman, 2011.

SEMESTER	**III**					
YEAR	**III**					
COURSE CODE	**21CY2301**					
TITLE OF THE COURSE	**COMPUTER NETWORKS**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)			
#	Sem /Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- To introduce the fundamental aspects of various types of computer networks.
- To demonstrate the TCP/IP and OSI models with merits and demerits.
- To Understand the working principle of layering structure and basic network components
- To explore the features of each layer by various approach and methods

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Understand and explore the basics of Computer Networks and physical layer	L2
CO2	Understand about data link layer and its protocols	L2
CO3	Understand about routing mechanisms and different routingprotocols	L2
CO4	Identify the issues of Transport layer to analyse the congestioncontrol mechanism	L2
CO5	Explain principles of application layer protocols	L2

COURSE CONTENT	
MODULE 1: Overview of Networks	**9 Hrs**
Network Components- Network Physical Structure, Classification of networks (LAN-MAN- WAN), Protocols and Standards, Data representation and data flow, Layered Architecture – Comparison of the OSI and TCP/IP reference model. Physical Layer: Introduction to wired and wireless transmission media. Transmission mode (Serial/Parallel signals, Analog/Digital Signals and Periodic/Aperiodic Signals), Line coding Schemes.	
MODULE 2: Data Link Layer	9 **Hrs**
Data Link Layer – MAC (Media Access Control) and LLC (Logical Link Control) sublayer Functionalities– Design Issues: Framing – Flow control (Simplest protocol, Stop and wait,sliding win dow) – Error control (CRC, Hamming code) — Ethernet Basics-Multi Access Protocols: ALOHA, CSMA/CD, Connecting Devices: Hubs, Bridges, Switches, Routers, and Gateways	

MODULE 3: Network Layer	**8 Hrs**
Network Layer Design issues, Routing Protocol Basics, Routing Algorithm (Distance Vector Routing, Link State Routing and Hierarchical Routing). IP addressing, IP Packet format IPV4,IPV6 and IP Tunneling. Congestion control algorithms, QoS (Traffic Shaping, Packet Scheduling).	
MODULE 4: Transport Layer	7 **Hrs**
Transport Layer functions- Multiplexing and Demultiplexing. Introduction to TCP and UDP,The TCP Service Model, The TCP Segment Header, The TCP Connection Management, TCP Flow Control- Sliding Window, TCP Congestion Control, User Datagram Protocol	
MODULE 5: Application Layer	6 **Hrs**
Principles of Network Applications, WEB and HTTP, FTP, E-MAIL(SMTP, POP3), TELNET,DNS, SNMP	

TEXT BOOKS:

1. Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013.
2. Computer Networks - Andrew S Tanenbaum, 5th Edition, Pearson Education.

REFERENCES:

1. James F. Kurose, Keith W. Ross, “Computer Networking: A Top-Down Approach”, Seventh Edition, Pearson Education, 2017.
2. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers Inc., 2011.
3. William Stallings, “Data and Computer Communications”, Tenth Edition, Pearson Education, 2014.

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**21CS2307**					
TITLE OF THE COURSE	**DATA STRUCTURES LAB**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	**-**	**2**	**-**	**26**	**1**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	**	**	***

COURSE OBJECTIVES:

- To introduce C language concepts required for data structures
- To design data structure operations to solve problems
- To introduce applications of data structures
- To implement linear data structures – stack, queue, linked list
- To implement non-linear data structures – trees and graphs

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's TaxonomyLevel**
CO1	Design and develop the programs in C to understand thedifferent concepts of data structures.	L3
CO2	Implement stack & queue data structure and their applications, Analyse the output based on the given input data.	L3
CO3	Implement Conversions of Polish and reverse polish expressions and Record Experimental process and results	L4
CO4	Apply and implement concepts of dynamic memoryallocation	L3
CO5	Use the concepts of file structures and communicateresults effectively	L3

Sl. No.	**List of Laboratory/Practical Experiments activities to be conduct**
1.	Write a program to add, subtract, multiply and divide two integers using user defined function with return type.
2.	Write a program to find the sum of digits of the number and print the reverse of that number using Recursive Function.
3.	Write a program to add and multiply two matrices using pointers
4.	Design, Develop and Implement a menu driven Program in C for the Searching Techniques on arrays i.e, 1. Linear search 2. Binary search. If unsorted array is given as input, your program must perform sorting (bubble sort) to use it as input for binary search algorithm.
5.	Write a C program to convert infix expression to prefix expression.

6. 7. 8. 9.	Write a C program to convert infix expression to postfix expression. Write a C program to implement stack, queue and their variations using arrays. Write a C program to evaluate postfix expressions Write a C program to solve tower of hanoi using recursion
10.	Write a C program to implement stack, queue and their variations using linked lists.
11. 12.	Write a C program to implement Binary search tree insertion, deletion and traversal. Write a C program to implement Graph insertion, and traversal.
13.	Write a C program to implement File operations a. Open a file b. Write c. Read d. close d. close

Open-Ended Experiments

1. A man in an automobile search for another man who is located at some point of a certain road. He starts at a given point and knows in advance the probability that the second man is at any given point of the road. Since the man being sought mightbe in either direction from the starting point, the searcher will, in general, must turnaround many times before finding his target. How does he search to minimize the expected distance travelled? When can this minimum expectation be achieved?

2. The computing resources of a cloud are pooled and allocated according to customerdemand. This has led to increased use of energy on the part of the service providersdue to the need to maintain the computing infrastructure. What data structure will you use for allocating resources which addresses the issue of energy saving? Why?Design the solution.

3. Mini-Project on applying suitable data structure to a given real-world problem

TEXTBOOKS:

1. A M Tannenbaum, Y Langsam, M J Augentien "Data Structures using C", Pearson, 2013
2. R.L. Kruse, B.P. Leary, C.L. Tondo, "Data Structure and Program Design in C" PHI

REFERENCE BOOKS

1. Horowitz Anderson-Freed, and Sahni, "Fundamentals of Data structures in C", 2nd Edition, OrientLongman, 2008
2. Data Structures and Algorithm analysis in C by Mark Allen Weiss, Published by Addison Wesley (3rdIndian Reprint 2000).
3. D E Knuth, The Art of Computer Programming, Volume 1, Addison-Wesley Publishing, 2013

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**21CS2308**					
TITLE OF THE COURSE	**DIGITAL ELECTRONICS & LOGIC DESIGN LAB**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	**-**	**2**	**-**	**26**	**1**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	**	**	***

COURSE OBJECTIVES:

- To design digital circuit for given Boolean expressions using logic gates.
- To verify the design of arithmetic circuits using logic gates and ICs.
- To test different code-conversion circuits.
- Applications of Multiplexer and De-multiplexers for implementation of different logic circuits.
- To test comparator circuits.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Build a logic circuit using basic gates after simplifying thegiven Boolean expression using Karnaugh map method	L3
CO2	Design and implementation of comparators	L3
CO3	Build logic circuits and realize the given Boolean expressionusing Multiplexers.	L3
CO4	Design of Combinational circuits like Encoder and Decoderusing basic gates	L3
CO5	Design of Synchronous and Asynchronous Sequentialcircuits like registers and counters.	L3

List of Laboratory/Practical Experiments activities to be conducted

1. Study and verification of Basic gates with Truth Tables
2. Simplification of expressions using Karnaugh Maps and realizing circuitsusing Basic Gates
3. Realize binary to gray code converter and vice versa
4. Simplify the given expression using tabular method and to realize circuits using Multiplexers.
5. Design and implementation parallel adder and subtractor
6. Design and implementation of comparators
7. Design various combinational logic circuits like encoders, decoders
8. Design and implementation of shift register
9. Design and implementation synchronous counters
10. Design and implementation ring counter and Johnson counter
11. Study of 7490 BCD counter
12. Design and implementation of asynchronous counters

TEXT BOOKS:

1. M. Morris Mano and Michael D. Ciletti, "Digital Design", 6th Edition, Pearson Education, 2018
2. Donald.P. Leach, Albert Paul Malvino & Goutam Saha: Digital Principles and Applications, 8th Edition, Tata McGraw Hill, 2015

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**21CS2309**					
TITLE OF THE COURSE	**MANAGEMENT & ENTREPRENEURSHIP**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	2		**-**	**-**	**26**	**2**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- Identify and analyze the factors that contribute to the process of successfully launching an entrepreneurial venture and managing a new business.
- Learn the entrepreneurial process from idea generation to implementation.
- Acquaint with special problems of starting new ventures, finding products and services, which can support new enterprises, and raising capital.
- Discuss how to start own business and also to work in or with small business or are involved with entrepreneurship.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's TaxonomyLevel
CO1	Demonstrate knowledge of the key elements of the entrepreneurial Process	L2
CO2	Employ strategies to generate new ideas for startups	L2
CO3	Outline how to protect IP legally	L2
CO4	Examine different ways of generating funding	L2
CO5	Explain organizing managing people, finance and customers	L2

COURSE CONTENT:	
MODULE 1	**5Hrs**
OVERVIEW OF ENTREPRENEURSHIP: THE ENTREPRENEURIAL PERSPECTIVE: Nature and Development of Entrepreneurship. Defining Manager, Entrepreneur, Entrepreneurship and Entrepreneurship. Key Elements of Entrepreneurship. Personality Characteristics of Successful Entrepreneurs. Common Myths about Entrepreneurs. Ethics and Social Responsibility of Entrepreneurs. Types of Start-Up Firms. Process of New Venture Creation. Role of Entrepreneurship in Economic Development. Emerging Trends and Issues in entership22. **Case Study: Successful Entrepreneurs Narayana Murthy Infosys**	
MODULE 2	**6Hrs**
THE ENTREPRENEURIAL AND ENTREPRENEURIAL MIND: The Entrepreneurial Process: Identify and Evaluate the Opportunity, Develop a Business Plan, Determine the Resources Required, Manage the Enterprise. Managerial Versus Entrepreneurial Decision Making: Strategic Orientation, Commitment to Opportunity, Commitment of Resources, Control of Resources, Management Structure, Entrepreneurial Venturing inside a Corporation, Causes for Interest in	

Entrepreneurship, Climate for Entrepreneurship, Entrepreneurial Leadership Characteristics. **Case study: How to develop effective Business Plan**	
MODULE 3	**5Hrs**
CREATIVITY AND BUSINESS IDEA: Identify and Recognizing Opportunities: Observing Trends and Solving Problems. Creativity: Concept,Components and Types of Creativity, Stages of Creative Process. Sources of New Venture Ideas.Techniques for Generating Ideas. Stages of Analyzing and Selecting the Best Ideas. Protecting the Idea:Intellectual Property Rights and its Components. Linking Creativity, Innovation and Entrepreneurship. Case study: Application of Design Thinking in New business ideas generation in particular sector (Health care, Water Saving, Energy saving)	
MODULE 4	**5Hrs**
PREPARING THE PROPER ETHICAL AND LEGAL FOUNDATION: Initial Ethical and Legal Issues Facing a New Firm, Establishing a Strong Ethical Culture, Choosing an attorney (Lawyer), Drafting a founder's agreement, Avoiding legal disputes, Choosing a form of business organization, Obtaining business licenses and permits, Choosing a Form of Business Ownership (Sole, Proprietorship, Partnership, Corporation & Limited Liability Company) **Case study: Startup Law A to Z IP** https://techcrunch.com/2019/02/25/startup-law-a-to-z-intellectual-property/	
MODULE 5	**5Hrs**
MANAGING EARLY GROWTH AND CHALLENGES Recruiting and Selecting Key Employees. Lenders and Investors. Funding Requirements: Sources ofPersonal Financing. Venture Capital. Commercial Banks. Sources of Debt Financing. Key MarketingIssues for New Ventures. Why marketing is critical for Entrepreneurs. Entrepreneurs face uniqueMarketing Challenges. Guerrilla Marketing. Business Growth: Nature of Business Growth, Planning forGrowth, Reasons for Growth. Managing Growth: Knowing and Managing the Stages of Growth, Challenges of Growing a Firm. Strategies for Firms Growth: Internal and External Growth Strategies. Implications of Growth for the Firm and Entrepreneur. Entrepreneurial Skills and Strategies to OvercomePressures On: Financial Resources (Financial Control, Managing Inventory and Maintaining Good Records). Human Resources, Management of Employees, Time Management. **Case study: 9 ways to get startups funded** https://www.quicksprout.com/how-to-get-your-startup-funded/	

TEXT BOOKS:

1. Barringer, Ireland, "Entrepreneurship: Successfully Learning New Ventures", Pearson,Latest Edition.
2. Hisrich, Peters, Shepherd, "Entrepreneurship", Mc Graw Hill, Sixth Edition.

SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**21CS2401**					
TITLE OF THE COURSE	**PROBABILITY AND STATISTICS**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- Understand probability, random variable and random process concepts and their importance in Computer Engineering course.
- Calculate statistics related to Random variables and process such as mean, variance, etc.
- Evaluate standard distribution functions such as Poisson's, Normal distributions
- Apply functions of random variables such as characteristic function, moment generating function to calculate statistics.
- Understand probability, random variable and random process concepts and their importance in Computer Engineering course.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Compute and interpret descriptive statistics using numerical andgraphical techniques.	L4
CO2	Understand the basic concepts of random variables and find anappropriate distribution for analyzing data specific to an experiment.	L2
CO3	Extend the concepts to multiple random variables and apply themto analyze practical problems.	L2
CO4	Make appropriate decisions using statistical inference that is thecentral to experimental research.	L4

COURSE CONTENT:	
MODULE 1: INTRODUCTION TO PROBABILITY THEORY:	**6 Hrs**
Basic Notions of Probability, Axiomatic definition, properties, Conditional Probability and Independence – Baye's Theorem.	
MODULE 2: DISCRETE PROBABILITY DISTRIBUTIONS:	**7 Hrs**
Discrete random variables and its properties - Bernoulli trials – Binomial Distribution and its properties – Poisson Distribution and its properties.	
MODULE 3	**8 Hrs**
CONTINUOUS PROBABILITY DISTRIBUTIONS Continuous random variables and its properties – Exponential Distribution and its properties - Normal Distribution and its properties. **BIVARIATE DISTRIBUTIONS:** Bivariate random variables – Joint – Marginal - Conditional distribution**.**	

MODULE 4: RANDOM PROCESS AND QUEUING THEORY	9 Hrs
Classification – Stationary process – Markov process – Markov chain – Poisson process Auto correlation functions – Cross correlation functions – Properties – Power spectral density Queuing Models, Methods for generating random variables and Validation of random numbers	
MODULE 5: TESTING OF HYPOTHESIS	**9 Hrs**
Testing of hypothesis – Introduction-Types of errors, critical region, procedure of testing hypothesis- Large sample tests- Z test for Single Proportion - Difference of Proportion, mean and difference of mean - Small sample tests- Student's t-test.	

TEXT BOOKS:

1. A First Course in Probability, S. Ross, Pearson International Edition, 9th Edition.
2. Fundamentals of Mathematical Statistics, S. C. Gupta and V. K. Kapoor, Sultan Chand & Sons, 11thEdition.

REFERENCES:

1. K. S. Trivedi, Probability and Statistics with Reliability, Queuing, and L.Computer Science Applications, 2nd Ed., Wiley, 2001.
2. Robert V. Hogg, J.W. McKean, and Allen T. Craig: Introduction to Mathematical Statistics,Seventh Edition, Pearson Education, Asia.
3. Rohatgi, V K. and Saleh , A. K. Md. Ehsanes, "An Introduction to Probability and Statistics", (John Wiley and Sons) , (2nd edition) (2000)
4. Higher Engineering Mathematics by B S Grewal, 42 nd Edition, Khanna Publishers.
5. Probability and Statistics for engineers and scientists, R.,E.Walpole, R.H.Myers, S.L.Mayers andK.Ye, 9th Edition, Pearson Education (2012).
6. An Introduction to Probability Theory and its Applications, W. Feller , Vol. 1, 3rd Ed., Wiley, 1968

SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**21CS2402**					
TITLE OF THE COURSE	**DESIGN AND ANALYSIS OF ALGORITHMS**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)			
#	**Sem/Year**	**Course Code**	**Title of the Course**
*	**	**	***

COURSE OBJECTIVES:

- To introduce and implement various techniques for designing algorithms and advanced data structures
- To learn space and time complexity analysis of algorithms.
- To understand the Divide and conquer design strategy and the Greedy Technique
- To understand the concepts of Dynamic Programming Applications
- Synthesize efficient algorithms in common engineering design situations

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's TaxonomyLevel**
CO1	Outline the overview of Data structures and Algorithms	L1
CO2	Understand the different Algorithmic Design strategies	L2
CO3	Apply the Design principles and concepts to Algorithmic design	L3
CO4	Describe the DAA paradigms and when an Algorithmic Design situation calls for it.	L6
CO5	Analyse the efficiency of Algorithms using Time and Space complexity theory	L4
CO6	Implement an existing algorithm to improve the run time efficiency	L3

COURSE CONTENT:	
MODULE 1: INTRODUCTION	**6 Hrs**
The role of Algorithms in Computing, Running time analysis -- recall of asymptotic notation,big-oh, theta, big-omega, and introduce little-oh and little-omega. Worst case and average case complexity	
MODULE 2: DIVIDE AND CONQUER	**9 Hrs**
Recursive algorithms, Divide-and-Conquer recurrences, Methods for solving recurrences:substitution method, recursion tree method and the Master method. Examples-Binary search, Quick sort, Merge sort, Strassen's Matrix Multiplication. **GREEDY METHOD** Optimal substructure property- Minimum cost spanning tree, Knapsack problem, Single SourceShortest Path Algorithm. Fractional knapsack	
MODULE 3 : DYNAMIC PROGRAMMING	**9 Hrs**
Integral knapsack (contrasted with the fractional variant: 0/1 knapsack), longest increasing subsequence, All pair shortest path in graph, Matrix chain multiplication, Travelling salesman Problem	

MODULE 4: APPLICATION OF GRAPH TRAVERSAL TECHNIQUES	9 Hrs
Recall representation of graphs, BFS, DFS, connected components, Strongly-connected components of DAGs, Kosaraju's algorithm 1 and 2, Applications. Graph matching, String Matching: Boyer Moore algorithm.	
MODULE 5: REASONING ABOUT ALGORITHMS	**6 Hrs**
Complexity Analysis (Polynomial vs Non-Polynomial time complexity), P, NP-hard and NP-Completeness, Reductions.	

TEXT BOOK:

1. T. H. Cormen, Leiserson, Rivest and Stein, "Introduction of Computer algorithm," , 3rd Edition, The MIT Press, 2015

REFERENCES:

1. E. Horowitz, S. Sahni, and S. Rajsekaran, " Fundamentals of Computer Algorithms," Galgotia Publication, 2015.
2. Anany Levitin, ―Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2012
3. Sara Basse, A. V. Gelder, "Computer Algorithms : Introduction Design & Analysis", 3rd Edition, Addison Wesley.
4. J.E Hopcroft, J.D Ullman, "Design and analysis of Computer algorithms", PearsonEducation, 2009.
5. Steven S. Skiena, "The Algorithm Design Manual", Second Edition, Springer, 2008

SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**21CS2403**					
TITLE OF THE COURSE	**PRINCIPLES OF MICROPROCESSORS & COMPUTER ORGANIZATION**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	4	**-**	**-**	**-**	**52**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	*	**	***

COURSE OBJECTIVES:

- To introduce the architecture of 8086
- To understand the importance and function of each pin of 8086 Microprocessor
- To familiarize with the architecture of 8086 microprocessor and its operation
- To understand the various addressing modes required for assembly language
- Programming and to calculate the physical address.
- To learn the 8086 instruction set and write 8086 Assembly level programs
- To understand the importance of different peripheral devices and their interfacing to 8086
- Understand the concepts of Hardwired control and micro programmed control.
- To explain the current state of art in memory system design
- Discuss the concept of memory organization.
- Summarize the types of memory.
- Learn about various I/O devices and the I/O interface.
- Learn the different types of serial communication techniques.
- To understand DMA technique
- To provide the knowledge on Instruction Level Parallelism
- To understand the concepts of pipelining techniques.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Identify the basic building blocks of 8086 microprocessor and usethe addressing modes for executing programs efficiently	L2
CO2	Develop 8086 assembly language programs using modern assembler tools	L3
CO3	Discuss the computer arithmetic and design algorithms forvarious Arithmetic operations.	L2
CO4	Design data part and control part of a processor	L3
CO5	Analyze the performance of various classes of Memories	L4
CO6	Understand pipeline & parallel processing	L2

COURSE CONTENT:	
MODULE 1: Introduction to Microprocessor & its Architecture:	**8 Hrs**
Introduction-Evolution of Microprocessor, The Microprocessor-Based Personal Computer Systems, Internal Microprocessor Architecture, Real mode memory addressing, 8086 pin diagram, Internal Architecture of 8086, Registers, Addressing Modes-Immediate addressing, Register addressing, direct addressing, indirect addressing, relative addressing, Instruction formats	
MODULE 2: Programming 8086	**12 Hrs**
Assembler directives, Data Movement Instructions, String Data Transfers, Miscellaneous Data Transfer Instructions, Arithmetic and Logic Instructions, BCD and ASCII Arithmetic, Basic Logic Instructions, Shift and Rotate, String Comparisons. Program Control Instructions: The Jump Group,Assembly language programming with 8086, macros, procedures	
MODULE 3: Processor Organization:	**10 Hrs**
Basic organization of computers, Block level description of the functional units as related to the execution of a program; Fetch, decode and execute cycle. Execution cycle in terms machine instructions. Information representation, Floating point representation (IEEE754), computer arithmetic and their implementation; **Data Part Design:** Fixed-Point Arithmetic-Addition, Subtraction, Multiplication and Division, Arithmetic Logic Units control and data path, data path components, design of ALU and data-path, **Control Part Design:** Control unit design; Hardwired and Micro programmed Control unit. Discussions about RISC versus CISC architectures.	
MODULE 4: Memory Technology, Input/Output Organization:	**12 Hrs**
Memory hierarchy, static and dynamic memory, RAM and ROM chips, Memory address map, Auxiliary Memory, Associative Memory, Cache Memory and organization. Peripheral devices, Input-Output Interface; I/O Bus and Interface Modules, Isolated versus Memory-Mapped I/O, Modes of Transfer; Programmed I/O, Interrupt-initiated I/O, Direct memory access (DMA)	
MODULE 5: Pipelining	**10 Hrs**
Basic Concepts, Arithmetic Pipeline, Instruction Pipeline; Four-Segment Instruction Pipeline,Pipeline hazards and their resolution, **Parallel Processing;** Flynn's classification, Multicore architectures, Introduction to Graphics Processing Units, Example: NVIDIA GPU Architecture	

TEXT BOOK:

1. Barry B Brey: The Intel Microprocessors, 8th Edition, Pearson Education, 2009
2. Mano, Morris M. Computer system architecture. Dorling Kindesley Pearson, 2005.

REFERENCES:

1. Douglas V Hall, “MICROPROCESSORS AND INTERFACING, PROGRAMMING ANDHARDWARE” TMH, 2006.
2. Kenneth J. Ayala, “The 8086 Microprocessor: Programming & Interfacing The PC”,Delmar Publishers, 2007
3. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Danny Causey, The x86 PC Assembly LanguageDesign and Interfacing, 5th Edition, Pearson, 2013.
4. V. Carl Hamacher, Safwat G. Zaky and Zvonko G. Vranesic , Computer Organization ,McGraw-Hillseries 2002
5. Hayes, J.P , Computer Architecture and Organization, McGraw-Hill, 1998
6. David Patterson and John Hennessey, Computer Organization and Design, Elsevier. 2008
7. Comer, Douglas. Essentials of computer architecture. Chapman and Hall/CRC, 2017.
8. Hord, R. Michael. Parallel supercomputing in MIMD architectures. CRC press, 2018.
9. Tanenbaum, Andrew S. Structured computer organization. Pearson Education India, 2016.
10. William Stallings-Computer Organization and Architecture, Seventh Edition, Pearson Education

SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**21CS2404**					
TITLE OF THE COURSE	**FINITE AUTOMATA AND FORMAL LANGUAGES**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**2**	**-**	**39+26**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	*	**	***

COURSE OBJECTIVES:

- To learn general theory of automata, properties of regular sets and regular expressions.
- To understand basics of formal languages.
- To know push-down automata, context- free languages, Turing machines.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Understand the basic concepts of formal languages of finiteautomata techniques such as DFA, NFA and E-NFA	L2
CO2	Design Finite Automata for different Regular Expressions andLanguages Demonstrate the properties of regular grammar, regular language, regular expression & their relationship withfinite automata	L3
CO3	Construct context free grammar for various languages.Interpret and design different PDA for a given language	L3
CO4	Construct context free, regular, Chomsky normal formgrammars to design computer languages	L3
CO5	Design Turing machine to solve problems	L3

COURSE CONTENT:	
MODULE 1	**8Hrs**
Introduction to Finite Automata: Study and Central concepts of automata theory, An informalpicture of finite automata, deterministic and non-deterministic finite automata, applications offinite automata, finite automata with epsilon – transitions.	
MODULE 2	**8Hrs**
Regular expression and languages: Regular expressions, finite automata and regular expressions, algebraic laws of regular expressions. Properties of Regular Languages: closure properties of regular languages, Pumping Lemma, equivalence and minimization of automata.	

MODULE 3	9Hrs
Context – free Grammars and Languages: Context free grammars, Context-free languages,Parse trees, Ambiguity in grammars and languages, Pushdown Automata: Pushdown automation (PDA), the language of PDA, equivalence of PDA's and CFG's, Deterministic Pushdown Automata	
MODULE 4	**8Hrs**
Properties of Context – Free Languages: Normal forms of context free grammars, pumping lemma for context free languages, closure properties of context free languages. Applications of CFG - such as spec of programming languages, parsing techniques, and Yacc	
MODULE 5	**6Hrs**
Introduction to Turing Machine- The Turing machine, programming techniques for Turing machine, extensions to the basic Turing machine, Chomsky hierarchy	

List of Laboratory/Practical Experiments activities to be conducted
1. Design a Program for creating machine that accepts three consecutive one.
2. Design a Program for creating machine that accepts the string always ending with 101.
3. Design a Program for Mode 3 Machine
4. Design a program for accepting decimal number divisible by 2.
5. Design a program for creating a machine which accepts string having equal no. of 1's and 0's.
6. Design a program for creating a machine which count number of 1's and 0's in a given string.
7. Design a Program to find 2's complement of a given binary number.
8. Design a Program which will increment the given binary number by 1.
9. Design a Program to convert NDFA to DFA.
10. Design a Program to create PDA machine that accept the well-formed parenthesis.
11. Design a PDA to accept WCWR where w is any string and WR is reverse of that string and C is a Special symbol.
12. Design a Turing machine that's accepts the following language an b n c n where n>0.

TEXT BOOKS:

1. Daniel I. A. Cohen, Introduction to Computer Theory, 2nd Edition, Wiley India Student Edition, 2008.
2. J.E. Hopcroft , R. Motwani, and J. D. Ullman, Introduction to Automata Theory,Languages and Computation, 3rd Edn. Pearson Education , New Delhi 2008

REFERENCES:

1. K.L.P. Misra and N. Chandrashekaran. Theory of Computer Science- Automata,Languages and Computation, 3rd Edn. PHI, New Delhi, 2007

2. C. Martin - Introduction to Languages and the Theory of Computation 2ndEdn,TMH, New Delhi, 2000.

SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**21CS2405**					
TITLE OF THE COURSE	**SOFTWARE ENGINEERING AND PROJECT MANAGEMENT**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/ Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- This course is introduced to give the students necessary knowledge.
- Understanding and Design aspects in Software Engineering
- To understand the Software Project Planning and Evaluation techniques

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Understand software development life cycle models, process models, and various design engineering techniques	L2
CO2	Apply new software models, techniques and technologies tobring out innovative and novelistic solutions for the growth of the society in all aspects and evolving into theircontinuous professional development	L3
CO3	Analyze a problem, and identify and define the computingrequirements appropriate to its solution	L4
CO4	Apply a wide variety of testing techniques in an effectiveand efficient manner.	L3
CO5	Understand Project Management principles whiledeveloping software.	L2

COURSE CONTENT:	
MODULE 1	**8Hrs**
Introduction to Software Engineering: FAQs about software engineering, Professional and ethical responsibility. Socio-Technical systems: Emergent system properties, Organizations, people and computer systems; Legacy systems, the evolving role of software, Changing Nature of Software, Software myths. **A Generic view of process:** Software engineering- A layered technology, a process framework, The Capability Maturity Model Integration (CMMI), Process patterns, processassessment, personal and team process models. Software Cost Estimation: Productivity; Estimation techniques	

MODULE 2	8Hrs
Process models: A simple safety- critical system; System dependability; Availability and reliability, the waterfall model, Incremental process models, Evolutionary process models,The Unified process. Agile Development: Agile Tech, Extreme Programming, and other Agile Process Models: Scrum Methodology	
MODULE 3	**8Hrs**
Software Requirements: Functional and non-functional requirements, User requirements, System requirements, Interface specification, the software requirements document. Requirements engineering process: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management.	
MODULE 4	**8Hrs**
Testing Strategies: Verification and Validation: Planning; Software inspections; Automated static analysis; Verification and formal methods. A strategic approach to software testing, System testing, the art of Debugging; Component testing; Test case design; Test automation - Selenium, Test strategies for conventional software: Black-Box and White-Box testing, Validation tests, System testing.	
MODULE 5	**7Hrs**
Software Project Management Introduction to Software Project Management – all life cycle activities – Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.	

TEXT BOOKS:

1. Software Engineering, by Ian Sommerville Eighth edition, International Computer Science Series.
2. Software Engineering, A practitioner's Approach- Roger S. Pressman, 6th edition. McGraw Hill International Edition.

REFERENCES:

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – FifthEdition, Tata McGraw Hill, New Delhi, 2012.
2. SoftwareEngineering-K.K.Agarwal&YogeshSingh,NewAgeInternationalPublishers
3. Software Engineering, an Engineering approach-JamesF. Peters, Witold Percy, John Wiley.
4. Systems Analysis and Design –Shelly Cashman Rosenblatt, Thomson Publications.
5. Software Engineering principles and practice-Waman Jawadekar,The McGraw-HillCompanies

SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**21CY2401**					
TITLE OF THE COURSE	**CRYPTOGRAPHY AND NETWORK SECURITY**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
** *	***	** *	***

COURSE OBJECTIVES:

- Understand the need for, and the concepts of various cryptographic algorithms.
- Illustrate key management issues in security and their solutions.
- Familiarize with standard security Protocols.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Discuss cryptography and its need for various applications.	L2
CO2	Illustrate novel security solutions for various cyber security issues.	L2
CO3	Identify right protocols at different layers of security	L3
CO4	Utilize the technologies available for Web Services, WS- Security, SAML, Other Standards.	L3

COURSE CONTENT:	
MODULE 1	**08 Hrs**
INTRODUCTION- Cyber Attacks, Defense Strategies, and Techniques, Guiding Principles, Mathematical Background for Cryptography – Modulo Arithmetic's, The GCD, Useful Algebraic Structures, Basics of Cryptography – Preliminaries, Elementary Substitution Ciphers, Elementary Transport Ciphers, Other Cipher Properties, Secret key Cryptography – Product Ciphers, DES Construction	
MODULE 2	**08 Hrs**
RSA Operations, Performance, Applications, Practical Issues, Public Key Cryptography Standard (PKCS), Cryptographic Hash - Introduction, Properties, Construction, Applications and Performance, The Birthday Attack, Discrete Logarithm and its Applications - Introduction, Diffie-Hellman Key Exchange, Other Applications.	

MODULE 3	08 Hrs
Introduction, Digital Certificates, Public Key Infrastructure, Identity–based Encryption,Authentication–I - One way Authentication, Mutual Authentication, Dictionary Attacks, Authentication – II – Centralized Authentication, The Needham-Schroeder Protocol,Kerberos, Biometrics	
MODULE 4	**09 Hrs**
IPSec- Security at the Network Layer – Security at Different layers: Pros and Cons, IPSec inAction, Internet Key Exchange (IKE) Protocol, Security Policy and IPSEC, Virtual Private Networks, Security at the Transport Layer - Introduction, SSL Handshake Protocol, SSLRecord Layer Protocol, OpenSSL.	
MODULE 5	**09 Hrs**
IEEE 802.11 Wireless LAN Security - Background, Authentication, Confidentiality and Integrity, Viruses, Worms, and Other Malware, Firewalls – Basics, Practical Issues, Intrusion Prevention and Detection - Introduction, Prevention Versus Detection, Types of Instruction Detection Systems, DDoS Attacks Prevention/Detection, Web Service Security – Motivation,Technologies for Web Services, WS- Security, SAML, Other Standards.	

TEXT BOOK:

1. Cryptography, Network Security and Cyber Laws – Bernard Menezes, Cengage Learning, 2010 edition

REFERENCES:

1. William Stallings - Cryptography and Network Security 5th edition
2. Cryptography and Network Security: Atul Kahate, Mc Graw Hill Edition

SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**21CS2407**					
TITLE OF THE COURSE	**DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	-	2	-	26	1

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	****	****	****

COURSE OBJECTIVES:

- To learn mathematical background for analysis of algorithm
- To understand the concept of designing an algorithm.
- To analyze the algorithms using space and time complexity.
- To learn dynamic programming and greedy method.
- To acquire knowledge of various applied algorithms.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Design and develop the Algorithms to understand the differentconcepts.	L3
CO2	Apply the Design principles and concepts to Algorithmic design	L3
CO3	Describe the DAA paradigms and when an Algorithmic Designsituation calls for it.	L6
CO4	Analyse worst-case and best – case running times of algorithmsusing asymptotic analysis.	L4
CO5	Implement an existing algorithm to improve the run time efficiency	L3

List of Laboratory/Practical Experiments activities to be conducted:

1. Design a C program to solve the Tower of Hanoi. Compute the time complexity.
2. Apply divide and conquer method and Design a C program to search an element in a given array and Compute the time complexity. Binary search - recursive method
3. Apply Divide and Conquer method Design a C program to sort an array using Merge sort algorithm and compute its time complexity
4. Apply Divide and Conquer method Design a C program to sort an array using Quick sort algorithm and compute its time complexity.
5. Apply Greedy method and Design a C program to find the minimum cost spanningtree using Prim's and Kruskal's Algorithm and compute its complexity
6. Apply Dynamic Programming Technique and Design a C program to find the all pairsshortest path using Dijkstra's Algorithm and computes its complexity
7. Design a C program to find the optimal solution of 0-1 knapsack problem usingdynamic programming and Compute the time complexity
8. Design a C program to solve the Travelling Salesman Problem using dynamic programming and compute

its time complexity.

9. Design a C program to find the longest common subsequence using dynamic programming and compute its time complexity.
10. Mini project proposal should be submitted and Implementation should be done based on the problem stated in the proposal

TEXT BOOK:

1. Levitin A, "Introduction to the Design And Analysis of Algorithms", Pearson Education, 2008.
2. T. H. Cormen, Leiserson, Rivest and Stein, "Introduction of Computer algorithm," , 3rd Edition, The MIT Press, 2015

REFERENCES:

1. E. Horowitz, S. Sahni, and S. Rajsekaran, "Fundamentals of Computer Algorithms," Galgotia Publication, 2015.
2. Goodrich M.T., R Tomassia, "Algorithm Design foundations Analysis and Internet Examples", John Wiley and Sons, 2006.
3. Sara Basse, A. V. Gelder, "Computer Algorithms : Introduction Design & Analysis", 3rd Edition, Addison Wesley.

SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	21CY2402					
TITLE OF THECOURSE	**CRYPTOGRAPHY AND NETWORK SECURITY LAB**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	-	**2**	-	26	1

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

Course objectives: This course will enable students to

1. Exemplify Encryption and Decryption algorithm.
2. Illustrate security software's and Tools.
3. Demonstrate Virtual box, Root kits.

Course Outcomes:

1. Install necessary software and setup the environment to work with cryptography and network security.
2. Implement various Encryption and Decryption algorithm
3. Demonstrate the working of security tools and perform audits.

Lab Experiments:

PART A

1. Implement the encryption and decryption of 8-bit data using 'Simplified DES Algorithm'
2. Configure a mail agent to support Digital Certificates, send a mail and verify the correctness ofthis system using the configured parameters.
3. Implement the Euclid Algorithm to generate the GCD
4. Using Java Cryptography, encrypt the text "Hello world" using BlowFish. Create your own key using Java key tool
5. Implementation of Advanced Encryption Standard (AES)

PART B

1. Learn to install Wine/Virtual Box/ or any other equivalent s/w on the host OS
2. Perform an experiment to grab a banner with telnet and perform the task using Netcat
3. Perform an experiment how to use DumpSec.
4. Perform a wireless audit of an access point / router and decrypt WEP and WPA (software's netstumbler or airsniff).
5. Install IPCop on a Linux system and learn all the function available on the software. Install Rootkits and study variety of opt.

REFERENCES:

1. Build Your Own Security Lab: A field guide for network Testing, Michael Gregg, WileyIndia edition, ISBN: 9788126516919.

SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**21CY3501**					
TITLE OF THE COURSE	**DATABASE MANAGEMENT SYSTEM**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**0**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

This course will enable students to:

- To learn data models, conceptualize and depict a database system using ER diagram.
- To understand the internal storage structures in a physical DB design.
- To know the fundamental concepts of transaction processing techniques.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Summarize basic concepts of database management system design and build database blueprint using E-R model.	L2
CO2	Apply SQL queries for building structured databases.	L3
CO3	Make use of normalization techniques to design relational database management system.	L3
CO4	Examine transaction management, concurrency control and error recovery techniques in database management systems.	L4
CO5	Examine PLSQL and NoSQL queries for building structured and unstructured databases.	L4

COURSE CONTENT:	
MODULE 1	**8 Hrs**
Introduction: Purpose of Database System-–Views of data–data models, database management system, three-schema architecture of DBMS, components of DBMS. E/R Model - Conceptual data modeling - motivation, entities, entity types, attributes relationships, relationship types, E/R diagram notation, examples.	
MODULE 2	**8 Hrs**
Relational Model: Relational Data Model - Concept of relations, schema-instance distinction, keys, referential integrity and foreign keys, relational algebra operators, SQL -Introduction, data definition in SQL, table, key and foreign key definitions, update behaviors. Querying in SQL, notion of aggregation, aggregation functions group by and having clauses.	
MODULE 3	**8 Hrs**
Database Design: Dependencies and Normal forms, dependency theory– functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization, 4NF,	

and 5NF	
MODULE 4	**8 Hrs**
Transactions: Transaction processing and Error recovery - concepts of transaction processing, ACID properties, concurrency control, locking based protocols for CC, error recovery and logging, undo, redo, undo-redo logging and recovery methods.	
MODULE 5	**7 Hrs**
Embedded SQL: triggers, procedures and database connectivity. Introduction to NoSQL	

TEXT BOOKS:

1. Silberschatz, Henry F. Korth, and S. Sudharshan, "Database System Concepts", 5th Ed, Tata McGraw Hill, 2006.
2. J. Date, A. Kannan and S. Swamynathan, "An Introduction to Database Systems", 8th ed, Pearson Education, 2006.

REFERENCES:

1. Ramez Elmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", Fourth Edition, Pearson/Addision Wesley, 2007
2. Raghu Ramakrishnan, "Database Management Systems", Third Edition, McGraw Hill, 2003
3. S. K. Singh, "Database Systems Concepts, Design and Applications", First Edition, Pearson Education, 2006

SEMESTER	**III**					
YEAR	**V**					
COURSE CODE	**21CY3502**					
TITLE OF THE COURSE	**CYBER FORENSIC AND CYBER LAW**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- To introduce the fundamentals cyber forensics.
- To Learn forensic tools and techniques used for Forensic Investigations
- To Provide an overview of the legal issues arising from the use of information technology and the internet.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Summarize the cyber forensics tools and techniques to interpret cybercrimes.	L2
CO2	Build good cyber forensic report by utilizing evidence acquisition and data preparation methodologies.	L3
CO3	Inspect the network forensic tools and techniques like Wireshark, Network Miner, Xplico to detect and prevent intrusions.	L4
CO4	Survey the cloud forensic techniques associated with Google Drive, Dropbox and WhatsApp.	L4
CO5	Summarize different hardware specific tools and techniques like Slack Space, RAM Slack, Drive Slack, Swap File to investigate cybercrime.	L2

COURSE CONTENT	
MODULE 1	**8 Hrs**
INTRODUCTION TO CYBER FORENSICS: Introduction, Defining Cyber Forensics, Cyber Forensic Investigation Process, Forensic Protocol for Evidence Acquisition, Digital Forensics Standards and Guidelines, Digital Evidence, What Is a Cybercrime? Types of Cyber Crime, Challenges in Cyber Forensics, Skills Required to Become a Cyber Forensic Expert, Cyber Forensic Tools. (Text Book-3: Chapter 1)	
MODULE 2	**8 Hrs**
CYBER FORENSICS: INVESTIGATIVE SMART PRACTICES: The Forensic Process, Forensic Investigative Smart Practices, The Initial Contact, the Request, Evidence Handling, Acquisition of Evidence, Data Preparation. INVESTIGATION: INCIDENT CLOSURE - Forensic Investigative Smart Practices, Investigation (Continued), Communicate Findings, Characteristics of a Good Cyber Forensic Report, Report Contents, Retention and Curation of Evidence. (Text Book-1: Chapter 10 and Chapter 12).	

MODULE 3	**8 Hrs**
NETWORK FORENSICS: The OSI Model, Forensic Footprints, Seizure of Networking Devices, Network Forensic Artifacts, ICMP Attacks-Traceroute Attack, Inverse Mapping Attack, ICMP Smurf Attack, Drive-By Downloads, Network Forensic Analysis Tools-Wireshark, Case Study: Wireshark, Network Miner, Case Study: Network Miner, Xplico, Case Study: Xplico. (Text Book:2: Chapter 6)	
MODULE 4	**8 Hrs**
CLOUD FORENSICS: Cloud Computing Models Defining Cloud Forensics, Server-Side Forensics, Client-Side Forensics, Challenges in Cloud Forensics, Artifacts in Cloud Forensics, Use of Cloud Forensics, Forensics as a Service (FaaS) Case Study: Google Drive Investigation, Case Study: Dropbox Investigation, WhatsApp Forensics, Case Study: WhatsApp Database Extraction. (Text Book:2: Chapter 8)	
MODULE 5	**7 Hrs**
CYBER FORENSICS AND THE LAW: LEGAL CONSIDERATIONS – Introduction, Objectives, Cyber Forensics, Digital Information, Identification and Analysis, Digital Forensics Complexity Problem, Proliferation of Digital Evidence- Slack Space, RAM Slack, Drive Slack, Swap File. Chain of Custody, Discredit the Witness (aka Refute the Cyber Forensic Expert), Outline of an Investigation, Obtaining Proper Authorization, Who Are You Going to Call? Secure the Scene of the Alleged E-Crime, Seizing Evidence, Chain of Evidence, Chain-of-Evidence Model, seizing a Computer, Pros and Cons of Pulling the Plug. (Text Book-3: Chapter 11)	

TEXT BOOKS:

1. Albert J. Marcella Jr., Frederic Guillossou, "Cyber Forensics from Data to Digital Evidence" 2012 by John Wiley & Sons.
2. Niranjan Reddy, "Practical Cyber Forensics. An Incident-based Approach to Forensic Investigations", A press publications.
3. Albert J. Marcella, Jr., Doug Menendez, "Cyber Forensics A Field Manual for Collecting, Examining, and Preserving Evidence of Computer Crimes", Second Edition, Auerbach Publications.

REFERENCES:

1. R.K. Jain "Zero To Mastery In Information Security And Cyber Laws" , Vayu Education of India, First Edition: 2022.
2. Gerard Johansen "Digital Forensics and Incident Response-An intelligent way to respond to attacks" 7, Packt Publishing, 2017, ISBN 978-1-78728-868-3
3. Albert J. Marcella "Cyber Forensics Examining Emerging and Hybrid Technologies", CRC Press ,2022.
4. Cybersecurity: Managing Systems, Conducting Testing, and Investigating Intrusions, Thomas J. Mowbray, John Wiley & Sons, 2013.
5. Cyber Security Essentials James Graham, Ryan Olson, Rick Howard, CRC Press,

SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**21CY3503**					
TITLE OF THE COURSE	**OPERATING SYSTEMS**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**1**	**-**	**-**	**52**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- To understand the basic concepts and functions of operating systems.
- To understand Processes and Threads
- To analyze Scheduling algorithms.
- To understand the concept of Deadlocks.
- To analyze various Memory and Virtual memory management, File system and storage techniques.
- To discuss the goals and principles of protection in a modern computer system.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Summarize basic concepts of operating systems and identify its variants.	L2
CO2	Apply FIFO, SJF, SRT, Priority, Round Robin algorithms to solve process scheduling.	L3
CO3	Summarize process coordination and apply Banker's algorithm to prevent inter-process deadlock.	L2
CO4	Distinguish contiguous and virtual memory management.	L4
CO5	Apply the page replacement algorithms to detect page fault appear in virtual memory.	L3
CO6	Apply FCFS, SSTF, SCAN, C-SCAN, Look and C-Look algorithms to solve I/O scheduling.	L3

COURSE CONTENT:

MODULE 1: OS Overview and System Structure	**10Hrs**
Introduction to operating systems, System structures: What operating systems do?; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and Security; Distributed system; Computing environments. Operating System Services: User - Operating System interface; System calls; Types of system calls; System programs; Operating system design and implementation; Operating System structure; Virtual machines;	
MODULE 2: Process Management	**12Hrs**
Process Management: Process concept; Process scheduling; Operations on processes. Multi-threaded Programming: Overview; Multithreading models; Threading issues. Process Scheduling: Basic concepts;	

Scheduling Criteria; Scheduling Algorithms.	
MODULE 3: Process Coordination	**10Hrs**
Process Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization; Monitors. Deadlocks: Deadlocks; System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.	
MODULE 4: Memory Management	**10Hrs**
Memory Management Strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation. Virtual Memory Management: Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing.	
MODULE 5: File System and Secondary Storage Structure	**10Hrs**
File System, Implementation of File System: File system: File concept; Access methods; Directory structure; File system mounting; File sharing. Protection: Implementing File system: File system structure; File system implementation; Directory implementation; Allocation methods; Free space management. Mass storage structures; Disk structure; Disk attachment; Disk scheduling; Disk management; Swap space management. Protection and Security: Protection: Goals of protection, Principles of protection, System Security: The Security Problem, Program Threats, System and Network Threats.	

TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 8th edition, Wiley-India, 2010.

REFERENCES:

1. Operating Systems-Internals and Design Principles, William Stallings, 6th Edition, Pearson Education, 2009.
2. Operating Systems: A Modern Perspective, Gary J. Nutt, Addison-Wesley, 1997

SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**21CY3504**					
TITLE OF THE COURSE	**MACHINE LEARNING FOR CYBER SECURITY**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/ Projects Hours	Total Hours	Credits
	3	**-**	**2**	**-**	**52**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
1	IV	21CS2401	PROBABILITY AND STATISTICS

COURSE OBJECTIVES:

- Understand the basic concepts of machine learning and artificial intelligence.
- Implementation of machine learning algorithms in cyber security applications.
- Enable students to understand the need for AI in cyber security.
- To solve real world problems regarding anomaly detection techniques.

COURSE OUTCOMES:

CO No.	Outcomes	Blooms Taxonomy Level
CO1	Summarize the classical and statistical learning concepts to identify features for a given dataset.	L2
CO2	Make use of statistical and probability distributions functions to analyse comparing learning algorithms	L4
CO3	Experiment with supervised learning mechanisms for spam filtering and anomaly detection by considering email and log file datasets.	L3
CO4	Utilize unsupervised machine learning algorithms for network traffic analysis, intrusion detection and prevention by considering malware datasets.	L3
CO5	Measure different performance matrix like Confusion Matrix, Accuracy, Precision, F score, Cost function to analyse effectiveness of learning algorithms.	L5

COURSE CONTENT:	
MODULE 1: Introduction to Machine Learning	**8Hrs**
Overview of learning problems, Designing a Learning system. Types of learning: supervised, unsupervised and reinforcement learning. Perspective and Issues in Machine Learning. Settings of the learning problem: Classical paradigm of solving learning problems, The learning problems--classes and types of learning, fundamental of statistical learning and its framework. Introduction to feature representation and extraction. ***(Textbook 1: Chapter 1,13 and Textbook 2: Chapter 5 and Textbook 3: Chapter 1***)	
MODULE 2: Mathematics for Machine Learning	**4Hrs**
Introduction to Probability: joint probability, conditional probability, Bayes theorem, different distributions, univariate and multivariate Gaussian distribution, PDF, MLE, Motivation, estimating hypothesis accuracy, Basics of sampling theorem, General approach for deriving confidence intervals, Difference in error of two hypothesis, Comparing learning algorithms.	

(***Textbook 1: Chapter 5, Textbook 2: Chapter 2,3,4 and Textbook 3: Chapter 3***)	
MODULE 3: Supervised Learning	**14Hrs**
Introduction to Supervised Learning, Introduction to Perceptron model and its adaptive learning algorithms, Introduction to classification, Naive Bayes, regression, classification Binary and multi class Classification, Regression (methods of function estimation) --Linear regression and Non-linear regression, logistic regression Regularization, Introduction To Kernel Based Methods of machine learning: Nearest neighbourhood , kernel functions, maximal margin classifier and SVM Introduction to ensemble based learning methods-decision trees and random forest, introduction to ensemble machine learning algorithms, bagging and boosting. [Algorithms have to be explained with Cyber Security Case studies] ***(Textbook 1: Chapter 3, Textbook 3: Chapter 2,5***)	
MODULE 4: Unsupervised Learning	**9Hrs**
Introduction to Unsupervised Learning, Clustering (hard and soft clustering) Hierarchal clustering: K-means, Fuzzy C-Means (FCM) algorithm, Gaussian mixture models (GMM), Expectation Maximization algorithm, feature Engineering in Machine Learning, Dimensionality reduction, Linear Discriminant Analysis and Principal Component Analysis. (***Textbook 3: Chapter 3,5***)	
MODULE 5: Model Selection	**8Hrs**
Machine Learning model validation - Confusion Matrix, Accuracy, Precision, F score, Cost function, Machine Learning Optimization algorithms: Gradient descent, stochastic GD. Regularization: Normalization and Standardization overfitting, underfitting, optimal fit, bias, variance, cross-validation. (***Textbook 3: Chapter 7)***	

List of Laboratory/Practical Experiments activities to be conducted

1. Design and develop payment fraud detection model using logistic regression.
2. Develop a program for spam E-mail detection using Naïve Bayes algorithm.
3. Write a program for spam E-mail detection using Blacklist. Consider the required dataset.
4. Perform Anomaly detection using Elliptic Envelope Fitting for simple normally distributed datasets.
5. Know the difference between Complied Execution and Interpreted Execution with Malware Analysis

TEXT BOOKS;

1. Thomas M. Mitchell, Machine Learning, McGraw- Hill, Inc. New York.
2. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning." An MIT Press book in preparation. (2015).
3. Chio, Clarence_Freeman, David - Machine learning and security_ protecting systems with data and algorithms - O'Reilly Media (2018)

REFERENCE BOOKS:

1. Ethem Alpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning series), The MIT Press; second edition, 2009.

SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**21CY3508**					
TITLE OF THE COURSE	**OOPS WITH JAVA**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- This subject will help to improve the analytical skills of object-oriented Programming
- Overall development of problem solving and critical analysis
- Formal introduction to Java programming language

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Experiment with the execution of short programs/code fragments involving object-oriented programming.	L3
CO2	Make use of Inheritance, Polymorphism and Packages to construct modular, scalable and reusable object-oriented codes.	L3
CO3	Utilize try-catch, throw, throws, finally keywords to handle compile time and run time exceptions.	L3
CO4	Make use of Abstract Window Toolkit (AWT), Swing and Applet to develop Stand-alone and Web based Graphical User Interface.	L3, L6
CO5	Evaluate object-oriented program/code fragments using a modern IDE and associated tools.	L5
CO6	Summarize File and Multi-Threading concepts in OOPS.	L2

COURSE CONTENT:	
MODULE 1	**13Hrs**
Introduction to Java: Basics of Java programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, Math class, Arrays in java. Objects and Classes: Basics of objects and classes in java, Constructors, Finalizer, Visibility modifiers, Methods and objects, Inbuilt classes like String, Character, StringBuffer, File, this reference.	
MODULE 2	**6Hrs**
Inheritance and Polymorphism: Inheritance in java, Super and sub class, Overriding, Object class, Polymorphism, Dynamic binding, Generic	

programming, Casting objects, Instance of operator, Abstract class, Interface.	
MODULE 3	**4Hrs**
Packages and Exception Handling: Package in java, Exception handling with try-catch-finally block, throw and throws.	
MODULE 4	**9Hrs**
Event and GUI programming: Event handling in java, Event types, Mouse and key events, GUI Basics, Panels, Frames, Layout Managers: Flow Layout, Border Layout, Grid Layout, GUI components like Buttons, Check Boxes, Radio Buttons, Labels, Text Fields, Text Areas, Combo Boxes, Lists, Scroll Bars, Sliders, Windows, Menus, Dialog Box, Applet and its life cycle, Introduction to swing.	
MODULE 5	**7Hrs**
I/O programming: Text and Binary I/O, Binary I/O classes, Object I/O, Random Access Files. Multithreading in java: Thread life cycle and methods, Runnable interface, Thread synchronization, Collections in java, Introduction to JavaBeans and Network Programming.	

TEXT BOOKS:

1. The Complete Reference, Java 2 (Fourth Edition), Herbert Schild, TMH.

REFERENCES:

1. Murach's Beginning Java 2, Doug Lowe, Joel Murach and Andrea Steelman, SPD.
2. Core Java Volume-I Fundamentals, Eight Edition, Horstmann & Cornell, Pearson Education.
3. Java Programming, D. S. Malik, Cengage Learning.
4. Introduction to Java Programming (Comprehensive Version), Daniel Liang, Seventh Edition, Pearson.
5. Programming in Java, Sachin Malhotra & Saurabh Chaudhary, Oxford University Press.
6. Head First Java A Brain-Friendly Guide, Kathy Sierra, 3rd Edition,.

SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**21CY3509**					
TITLE OF THE COURSE	**DATA WARFARE**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- Introduce to the Unique and emerging policies, doctrine, strategy, and operational requirements of conducting cyber warfare at the nation-state level.
- Enable learners to appreciate unified battle-space perspective and enhances their ability to manage and develop operational systems and concepts in a manner that results in the integrated, controlled, and effective use of cyber assets in warfare.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Summarize the theory of data, information and knowledge as they pertain to information warfare.	L2
CO2	Identify the social, legal and ethical implications of information warfare.	L3
CO3	Inspect contemporary information warfare and Trusted recovery models.	L4
CO4	Experiment with Computer Break-Ins and Hacking-Accounts.	L3

COURSE CONTENT:	
MODULE 1	**9Hrs**
Concepts and Theories: Doctrines, Information warfare: definitions, models (The information environment, Definitions and models for information warfare), Information warfare or data warfare? (Defining data, Some theories about data, Visualization, Data warfare?)	
MODULE 2	**7Hrs**
Defensive Information Warfare: Introduction, Background and traditional system recovery, Trusted recovery models (Modelling Databases, Modelling IW Attack and Defense, Database Trusted Recovery Models)	
MODULE 3	**7Hrs**
Trusted Recovery by Syntactic approaches: The Repair Model, On-the-Fly Repair Based on In-Log Read Information, Extracting Read Information from Transaction Profiles, Trusted Recovery System Development.	
MODULE 4	**8Hrs**
Trusted Recovery by Rewriting Histories: The Model, Basic Algorithm to Rewrite a History, Saving Additional	

Good Transactions, Pruning Rewritten Histories, Relationships between Rewriting Algorithms, Implementing the Repair Model on Top of Sagas	
MODULE 5	**8Hrs**
Trusted Recovery in distributed systems: Introduction, The Damage Assessment and Repair Algorithm, Performance Issues, Discussion, Future Research.	

TEXT BOOKS:

1. Daniel Ventre, Information Warfare, Wiley - ISTE (2009) (ISBN 9781848210943).
2. Peng Liu, Sushil Jajodia, Trusted Recovery and Defensive Information Warfare, Springer Science + Business Media, LLC (ISBN 978-1-4419-4926-4 ISBN 978-1-4757-6880-0 (eBook)).

REFERENCES:

1. Information Warfare and Security, Dorothy E. Denning, Denning Edition 1, 1998 Addison Wesley.
2. Cyberwar and Information Warfare, edited by Daniel Ventre, Wiley – ISTE, 2011

SEMESTER	**III**					
YEAR	**V**					
COURSE CODE	**21CY3510**					
TITLE OF THE COURSE	**INTERNET OF THINGS**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- To learn the building blocks of the Internet of Things (IoT) and their characteristics.
- To introduce the students to the programming aspects of the Internet of Things with a view toward rapid prototyping of IoT applications.
- To learn communication protocol for IoT.
- To learn Reference architectures for different levels of IoT applications.
- To learn IoT data analytics and Tools for IoT.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Summarize the evolution of IoT and identify the difference with M2M technologies.	L3
CO2	Make use of the basic building blocks of IoT to design robust IoT-centric security and privacy preserving protocols.	L3
CO3	Apply communication technologies like Zigbee, 6LoWPAN, SOAP, REST to analyze data access methodologies in IoT.	L3
CO4	Design secure IoT applications and deploy the same on Raspberry Pi, Arduino Uno, ESP-32 board.	L6
CO5	Examine Cloud Computing infrastructure with IoT devices to access Big-Data Analytics.	L4

COURSE CONTENT:	
MODULE 1: INTRODUCTION TO IOT	**8Hrs**
Introduction: Concepts behind the Internet of Things, Definition, Characteristics of IoT, IoT Conceptual framework, Physical design of IoT, Logical design of IoT, Application of IoT, IoT and M2M, IoT System Management with NETCONF-YANG.	
MODULE 2: IOT ARCHITECTURE AND SECURITY	**8Hrs**
M2M high-level ETSI architecture, IETF architecture for IoT, IoT reference model, IoT 3 Tier, and 5 tier architecture IoT Security: IoT and cyber-physical systems, IoT security (vulnerabilities, attacks, and countermeasures), Security engineering for IoT development, IoT security lifecycle	

MODULE 3: IOT PROTOCOLS	**7Hrs**
IoT Access Technologies: Physical and MAC layers, Web Communication Protocols for connected devices, SOAP, REST, HTTP Restful, and Web Sockets. Internet Connectivity Principles: Internet Connectivity, Internet-based communication, Network Layer: IP versions, IP addressing in IoT, Zigbee,6LoWPAN, Routing over Low Power and Lossy Networks.	
MODULE 4: HARDWARE AND DEVELOPMENT TOOLS FOR IOT	**8Hrs**
Sensors, actuators, radio frequency identification (RFID) technology, wireless sensor networks, and participatory sensing technology. Embedded Platforms for IoT: Embedded computing basics, Overview of IoT supported Hardware platforms such as Arduino, Raspberry Pi, NodeMCU, Programming with Arduino IDE.	
MODULE 5: CASE STUDY AND REAL-WORLD APPLICATION	**8Hrs**
Case Studies: Smart Agriculture, IoMT, Smart Cities (Smart Parking, Smart Lighting, Smart Road, Health and Lifestyle), Data Analytics for IoT, Cloud Storage Models & Communication APIs, Cloud for IoT, Amazon Web Services for IoT.	

TEXT BOOKS:

1. Arshdeep Bahga and Vijay Madisetti, “Internet of Things - A Hands-On Approach”.
2. Rajkamal,” Internet of Things”, Tata McGraw Hill publication

REFERENCES:

1. Hakima Chaouchi “The Internet of Things: Connecting Objects”, Wiley publication.
2. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, by David Hanes, Gonzalo Salgueiro , Patrick Grossetete , Robert Barton, Jerome Henry by CISCO
3. Donald Norris “The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and Beagle Bone Black”, McGraw Hill publication

SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**21CY3511**					
TITLE OF THE COURSE	**MICROCONTROLLERS AND EMBEDDED SYSTEMS**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- Explain the architectural features and instructions of 32 bit microcontroller -ARM Cortex M3.
- Develop Programs using the various instructions of ARM Cortex M3 and C language for different applications.
- Identify and understand the unique characteristics and components of embedded systems
- Understand how can we interfacing different input and output devices/components to cortex M3 microcontroller
- Understanding of how Arduino Uno & Raspberry Pi work

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Summarize the architectural features and instructions of 32-bit ARM Cortex M3.	L2
CO2	Apply the knowledge of ARM Cortex M3 instruction sets and programming to design Microcontroller-based applications.	L3
CO3	Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.	L2
CO4	Develop an embedded application with Cortex M3 architecture	L3
CO5	Design embedded systems using Arduino board and RasberryPi	L3

COURSE CONTENT:	
MODULE 1 MODULE 1: ARM-32 bit Microcontroller	**8Hrs**
Microprocessors versus Microcontrollers, Different Microcontroller Architectures (CISC, RISC, ARISC), Microcontroller Types: PIC, AVR, ARM, Background of ARM and ARM Architecture: A Brief History, Architecture Versions, The Thumb-2 Technology and Instruction Set Architecture, Cortex-M3 Processor Applications, Overview of the Cortex- M3: What Is the ARM Cortex-M3 Processor, Architecture of ARM Cortex M3, Various Units in the architecture, General Purpose Registers, Special Registers, Exceptions and Interrupts	
MODULE 2: ARM Cortex M3 Instruction Sets and Programming:	**8Hrs**
Assembly basics, Instruction List, Instruction Descriptions: Moving Data, LDR and ADR Pseudo-Instructions, Processing Data, Call and Unconditional Branch, Decisions and Conditional Branches, Combined Compare	

and Conditional Branch, Conditional Execution Using IT Instructions, Instruction Barrier and Memory Barrier Instructions, MSR and MRS, More on the IF-THEN Instruction Block, SDIV and UDIV, REV, REVH, and REVSH, Reverse Bit, SXTB, SXTH, UXTB, and UXTH.	
MODULE 3: Cortex-M3 Programming	**8Hrs**
A Typical Development Flow, Using C, CMSIS: Background of CMSIS, Organization of CMSIS, Using CMSIS, Using Assembly: The Interface between Assembly and C, The First Step in Assembly Programming, Producing Outputs, The "Hello World" Example, Using Data Memory, Simple programming exercises	
MODULE 4: Embedded System Design Concepts	**8Hrs**
Introduction: Definition of Embedded System, Embedded Systems Vs General Computing Systems, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems, Core of the Embedded System: General Purpose and Domain Specific Processors, Embedded system architecture.	
MODULE 5: Embedded System Design using Raspberry Pi	**7Hrs**
Introduction to RaspberryPi, About the Raspberry Pi board and programming (on Linux) Hardware Layout, Operating systems on RaspberryPi, Configuring raspberry Pi, Programming raspberry Pi with Python libraries.	

TEXT BOOKS:

1. Joseph Yiu, "The Definitive Guide to the ARM Cortex-M3", 2nd Edition, Newnes, (Elsevier), 2010.
2. Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education Private Limited, 2nd Edition.

REFERENCES:

1. Muhammad Tahir, Kashif Javed, ARM Microprocessor Systems: Cortex-M Architecture, CRC Press 2017
2. Richard Blum, "Arduino Programming in 24 Hours", Sams Teach Yourself, Pearson Education, 2017.
3. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2016
4. Srinivasa K G, Internet of Things,CENGAGE Leaning India, 2017

SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**21CY3505**					
TITLE OF THE COURSE	**DATABASE MANAGEMENT SYSTEMS LAB**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	**-**	**2**	**-**	**30**	**1**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- Understand the fundamental concepts of database management. These concepts include aspects of database design, database languages, and database-system implementation.
- To provide a strong formal foundation in database concepts, recent technologies and best industry practices.
- To give systematic database design approaches covering conceptual design, logical design and an overview of physical design.
- To learn the SQL and NoSQL database system.
- To learn and understand various Database Architectures and its use for application development.
- To programme PL/SQL including stored procedures, stored functions, cursors and packages

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Make use of Oracle version 11i software to install and configure a relational database system in Windows OS.	L3
CO2	Design database-centric schema, entity, relation, and entity-relationship abstractions for a given problem-domain utilizing Oracle version 11i.	L5
CO3	Experiment with different varieties of Structure Query Languages (SQL) like Data Description Language (DDL), Data Manipulation Language (DML), Data Control Language (DCL), and Transaction Control Language (TCL) in Oracle version 11i.	L3
CO4	Examine SQL, Nested SQL, and sub-SQL queries to observe the behavior of the aggregate and built-in functions in DBMS.	L3
CO5	Make use of PL/SQL queries to design triggers, procedures, function and database cursor.	L3

List of Laboratory/Practical Experiments activities to be conducted
1. Design any database with at least 3 entities and relationships between them. Apply DCL and DDL commands. Draw suitable ER/EER diagram for the system.
2. Design and implement a database and apply at least 10 different DML queries for the following task. For a given input string display only those records which match the given pattern or a phrase in the search string. Make use of wild characters and LIKE operator for the same. Make use of Boolean and arithmetic operators wherever necessary.

3. Execute the aggregate functions like count, sum, avg etc. on the suitable database. Make use of built in functions according to the need of the database chosen. Retrieve the data from the database based on time and date functions like now (), date (), day (), time () etc. Use group by and having clauses.
4. Implement nested sub queries. Perform a test for set membership (in, not in), set comparison (<some, >=some, <all etc.) and set cardinality (unique, not unique).Retrieve the data from the database based on time and date functions like now (), date (), day (), time () etc., Use of group by and having clauses.
5. Write and execute suitable database triggers. Consider row level and statement level triggers.
6. Write and execute PL/SQL stored procedure and function to perform a suitable task on the database. Demonstrate its use.
7. Write a PL/SQL block to implement all types of cursor.
8. Execute DDL statements which demonstrate the use of views. Try to update the base table using its corresponding view. Also consider restrictions on updatable views and perform view creation from multiple tables.
9. Mini project.

TEXT BOOKS:

1. Ramon A. Mata-Toledo, Pauline Cushman, Database management systems, TMGH, ISBN: IS978-0-07-063456-5, 5th Edition.

REFERENCES:

1. Dr. P. S. Deshpande, SQL and PL/SQL for Oracle 10g Black Book, DreamTech.
2. Ivan Bayross, SQL, PL/SQL: The Programming Language of Oracle, BPB Publication.
3. Dalton Patrik, SQL Server – Black Book, DreamTech Press.

SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**21CY3506**					
TITLE OF THE COURSE	**OPERATING SYSTEMS LAB**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	**-**	**2**	**-**	**26**	**1**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- To learn creating process and Threads
- To implement various CPU Scheduling Algorithms
- To implement Process Creation and Inter Process Communication.
- To implement Deadlock Avoidance and Deadlock Detection Algorithms
- To implement Page Replacement Algorithms
- To implement File Organization and File Allocation Strategies

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Make use of system calls to create a new process, display PID, PPID and I/O operations on files.	L3
CO2	Develop C programs to implement FIFO, SJF, Priority, Round Robin algorithms to solve process scxxxheduling.	L3
CO3	Construct C programs for process synchronization using semaphores and deadlock detection and avoidance algorithm using Banker's algorithm.	L3
CO4	Make use of FIFO, LRU and LFU techniques to simulate page replacement strategies.	L3
CO5	Develop C program to implement Single level directory and Two-level directory file organization strategies and Sequential and Indexing file allocation strategies.	L3

List of Laboratory/Practical Experiments activities to be conducted		
Exp. No	Division of Experiments	List of Experiments
1	System Calls	Write a C program to create a new process that exec a new program using system calls fork(), execlp() & wait()
2		Write a C program to display PID and PPID using system calls getpid () & getppid ()
3		Write a C program using I/O system calls open(), read() & write() to copy contents of one file to another file
4	Process Management	Write a C program to implement multithreaded program using pthreads
5		Write C program to simulate the following CPU scheduling algorithms a) FCFS b) SJF c) Priority d) Round Robin

6	Process synchronization	Write a C program to simulate producer-consumer problem using semaphores
7	Deadlock	Write a C program to simulate Banker's algorithm for the purpose of deadlock avoidance.
8		Write a C program to simulate deadlock detection.
9	Memory Management	Write a C program to simulate paging technique of memory management
10		Write a C program to simulate page replacement algorithms a) FIFO b) LRU c) LFU
11	I/O System	Write a C program to simulate the following file organization techniques a) Single level directory b) Two level directory
12		Write a C program to simulate the following file allocation strategies. a) Sequential b) Indexed

TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 8th edition, Wiley-India, 2010

REFERENCES:

1. Operating Systems-Internals and Design Principles, William Stallings, 6th Edition, Pearson Education, 2009.
2. Operating Systems: A Modern Perspective, Gary J. Nutt, Addison-Wesley, 1997

SEMESTER	**VI**					
YEAR	**III**					
COURSE CODE	**21CY3601**					
TITLE OF THE COURSE	**ETHICAL HACKING**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**1**	**-**	**-**	**52**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- To understand and analyze Information security threats & countermeasures
- To perform security auditing & testing
- To understand issues relating to ethical hacking
- To study & employ network defense measures
- To understand penetration and security testing issues

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Outline the influence of security, penetration testing and vulnerability assessment on ethical hacking.	L2
CO2	Make use of port scanning tools like Nmap, OpenVAS and Nessus and ping sweeps such as Hping and Fping to identify open ports and ip addresses of an active host.	L3
CO3	Utilize brute force, key logger, sniffing and spoofing techniques to assess the computational security of a system.	L5
CO4	Summarize sql injection, cross-site scripting and session hijacking techniques to secure e-commerce-based web services.	L2
CO5	Perceive network packets of WLAN using modern tools like WLAN Scanners and WLAN Sniffers.	L5

COURSE CONTENT:

MODULE 1- ETHICAL HACKING OVERVIEW & PENETRATION TESTING	**10Hrs**
Understanding the importance of security, Concept of ethical hacking and essential Terminologies Threat, Attack, Vulnerabilities, Target of Evaluation, Exploit. Phases involved in hacking. Penetration Test – Vulnerability Assessments versus Penetration Test – Pre-Engagement – Rules of Engagement - Penetration Testing Methodologies – OSSTMM – NIST – OWASP – Categories of Penetration Test – Types of Penetration Tests – Vulnerability Assessment Summary -Reports.	
MODULE 2- FOOTPRINTING & PORT SCANNING	**9Hrs**
Foot printing - Introduction to foot printing, Understanding the information gathering methodology of the hackers, Tools used for the reconnaissance phase. Port Scanning - Introduction, using port scanning tools, ping sweeps, Scripting Enumeration-Introduction, Enumerating windows OS & Linux OS.	

MODULE 3- SYSTEM HACKING	10Hrs
Aspect of remote password guessing, Role of eavesdropping, Various methods of password cracking, Keystroke Loggers, Understanding Sniffers, Comprehending Active and Passive Sniffing, ARP Spoofing and Redirection, DNS and IP Sniffing, HTTPS Sniffing.	
MODULE 4- HACKING WEB SERVICES & SESSION HIJACKING	**12Hrs**
Web application vulnerabilities, application coding errors, SQL injection into Back-end Databases, cross-site scripting, cross-site request forging, authentication bypass, web services and related flaws, protective http headers Understanding Session Hijacking, Phases involved in Session Hijacking, Types of Session Hijacking, Session Hijacking Tools.	
MODULE 5- HACKING WIRELESS NETWORKS	**8Hrs**
Introduction to 802.11, Role of WEP, Cracking WEP Keys, Sniffing Traffic, Wireless DOS attacks, WLAN Scanners, WLAN Sniffers, Hacking Tools, Securing Wireless Networks.	

TEXT BOOKS:

1. Kimberly Graves, "Certified Ethical Hacker", Wiley India Pvt Ltd, 2010
2. Michael T. Simpson, "Hands-on Ethical Hacking & Network Defense", Course Technology, 2010

REFERENCES:

1. Rajat Khare, "Network Security and Ethical Hacking", Luniver Press, 2006
2. Ramachandran V, BackTrack 5 Wireless Penetration Testing Beginner’s Guide (3rd ed.). Packt Publishing, 2011
3. Thomas Mathew, "Ethical Hacking", OSB publishers, 2003

SEMESTER	**VI**					
YEAR	**III**					
COURSE CODE	**21CY3602**					
TITLE OF THE COURSE	**DIGITAL IMAGE PROCESSING**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	-	-	-

COURSE OBJECTIVES:

- To become familiar with digital image fundamentals.
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To become familiar with image compression and recognition methods.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Make use of the fundamentals of digital image processing to interpret the basic characteristics of two-dimensional images.	L3
CO2	Utilize digital signal processing techniques like transformation, restoration and enhancement to improvise the quality of an image.	L3
CO3	Make use of digital signal processing tools like conventional filters to construct fine-grained images.	L2
CO4	Examine segmentation algorithms to compute the edges and region of interest of a given images.	L3

COURSE CONTENT:	
MODULE 1	**08 Hrs**
Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.	
MODULE 2	**10 Hrs**
Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.	
MODULE 3	**08 Hrs**
Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering.	
MODULE 4	**07 Hrs**
Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region	

growing – Region splitting and merging.	
MODULE 5	**06 Hrs**
Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.	

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing', Pearson, Third Edition, 2010.
2. Anil K. Jain, 'Fundamentals of Digital Image Processing', Pearson, 2002.

REFERENCES

1. Kenneth R. Castleman, 'Digital Image Processing', Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 'Digital Image Processing using MATLAB', Pearson Education, Inc., 2011.

SEMESTER	**VI**					
YEAR	**III**					
COURSE CODE	**21CY3603**					
TITLE OF THE COURSE	**CLOUD APPLICATION DEVELOPMENT**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**2**	**-**	**52**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- To give insights into the Cloud computing Technology, Service Oriented Architecture (SOA) and Virtualization.
- To recognize the basic programming for building the Cloud Application and to be familiar with version control tool.
- To understand the design and development framework for Cloud Applications.
- To deploy the cloud infrastructure using different methods from the scratch.
- To apply and map theoretical knowledge to practical through case studies and tutorials.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Summarize the cloud architecture, cloud delivery and cloud deployment models including Virtualization Technology	L2
CO2	Design a cloud application and work with the version control tools.	L5
CO3	Select an appropriate cloud-oriented framework for the development of a specific cloud application.	L5
CO4	Implement cloud-based application by exploring modern tools like Microsoft Azure, Google Cloud Platform, and Amazon AWS.	L6
CO5	Examine cloud security risks in Amazon AWS cloud infrastructure.	L3

COURSE CONTENT:	
MODULE 1: Introduction	**8Hrs**
Introduction- Cloud Computing Architecture – The Cloud Reference Model – Cloud Characteristics –Cloud Deployment Models: Public, Private, Community, Hybrid Clouds- Cloud Delivery Models: IaaS, PaaS, SaaS Virtualization: Introduction, Characteristics of Virtualized Environments, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Paravirtualization, Full Virtualization	
MODULE 2: Understanding Cloud Programming	**8Hrs**
Introduction to Cloud development using HTML5-Tag and Structural elements, Input elements and Data Attributes, Management and support and scripting. CSS3-Styling HTML, JavaScript- Variables and control statement, functions and API's Client side Javascript	

MODULE 3: Design and Developing cloud Application	**9Hrs**
Building Native Cloud Application: REST APIs and JSON - Using RESTAPI's with WatsonAI Services. JSON Data types-Arrays, objects, Parse, Server and HTML Developing Cloud Applications with Node.js and React: Create server-side applications using Node.js and develop the front-end using React.	
MODULE 4: Deploying Cloud Applications and services	**7Hrs**
Cloud Application deployment models: Amazon Web Services- Compute Services, Storage Services, Communication Services, Google AppEngine- Architecture and Core Concepts, Application Life-Cycle, Cost Model, Observations. Microsoft Azure- Azure Core Concepts	
MODULE 5: Cloud Security	**7Hrs**
Introduction to Cloud Security: Security: The top concern for cloud users, Cloud security risks, Security as a service (SecaaS), Privacy and privacy impact assessment, Operating system security, Virtual machine security, Security of virtualization, Security risks posed by a management OS, Xoar: Breaking the monolithic design of the TCB, A trusted virtual machine monitor, Mobile devices and cloud security, AWS security	

List of Laboratory/Practical Experiments activities to be conducted

1. Install Oracle Virtual box and create two VMs on your laptop/Desktop.
2. Test ping command to test the communication between the guest OS and Host OS
3. Use gcc to compile c-programs. Split the programs to different modules and create an application using make command
4. Find a procedure to transfer the files from one virtual machine to another virtual machine.
5. Establish an AWS account. Use the AWS Management Console to launch an EC2 instance and connect to it.
6. Develop a Hello World application using Google App Engine in Eclipse.
7. Use version control systems command to clone, commit, push, fetch, pull, checkout, reset, and delete repositories
8. Develop a Windows Azure Hello World application.
9. Install Google App Engine. Create a hello world app and other simple web applications using python/java. Use GAE launcher to launch the web applications
10. Launch GUI applications inside Docker Container & access them from the Docker Host system.

TEXT BOOKS:

1. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi Mastering Cloud Computing McGraw Hill Education
2. Deitel, Deitel and Neito, "Internet and World Wide Web – How to program", Pearson Education Asia, 5th Edition, 2011.
3. Dan C. Marinescu - Cloud Computing_ Theory and Practice-Morgan Kaufmann (2022)

REFERENCES:

1. Tom Marrs, "JSON at Work - Practical Data Integration for the Web", O'REILLY, First edition, 2017
2. Guo Ning Liu, Qiang Guo Tong, Harm Sluiman, Alex Amies, "Developing and Hosting Applications on the Cloud", IBM Press (2012)
3. Dan Marinescu, "Cloud Computing: Theory and Practice", M K Publishers, 1st Edition, 2013
4. A.Srinivasan, J.Suresh, "Cloud Computing, A practical approach for learning and implementation", Pearson,2014

SEMESTER	**VI**					
YEAR	**III**					
COURSE CODE	**21CY3606**					
TITLE OF THE COURSE	**OPERATING SYSTEM SECURITY**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

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

- Outline the models of protection and techniques to enforce security in operating systems.
- Describe the impact of security features and access control mechanisms used in secure operating systems.
- Summarizes a variety of ways that commercial operating systems have been extended with security features by using case studies.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Identify and explain operating system security preliminaries.	L3
CO2	Survey the major and distinct approaches to build secure operating systems.	L4
CO3	Examine secure capability systems and virtual machine systems.	L4
CO4	Compare and contrast Separation and VAX VMM Security Kernel.	L2

COURSE CONTENT:	
MODULE 1	**9Hrs**
Operating System Resource Security and Protection: Access and Flow Control – Introduction, Preliminaries, The access Matrix Model, Implementation of Access Matrix, Safety in the Access Matrix Model, Advanced Models of Protection, Case Studies: The UNIX operating System, The Hydra Kernel, Amoeba, Andrew. Text Book 1: Ch.14.1 to Ch.14.7	
MODULE 2	**7Hrs**
Access Control Fundamentals: Secure Operating Systems, Security Goals, Trust Model, Threat Model, Protection System, Lampson's Access Matrix, Mandatory Protection Systems, Reference Monitor, Secure Operating System Definition, Assessment Criteria, Multics History, The Multics System, Multics Security, Multics Vulnerability Analysis. Text Book 2: Ch. 1.1 Ch 1.4, Ch. 2.1 to 2.4 and Ch.3.1 to 3.4	
MODULE 3	**7Hrs**
Security in Ordinary Operating Systems, Verifiable Security Goals, Security Kernels: System Histories, UNIX Security, Windows Security, Information Flow, Information Flow Secrecy Models, Information Flow Integrity Models, The Security Kernel, Secure communications processor, Gemini Secure operating system. Text Book 2: Ch. 4.1 to Ch. 4.3, Ch 5.1 to Ch 5.4 and Ch. 6.1 to Ch. 6.3	

MODULE 4	**9Hrs**
Securing Commercial Operating Systems, Case Studies: Retrofitting Security into a Commercial OS, History of Retrofitting Commercial OS's, Commercial Era, Microkernel Era, UNIX Era, Case Study1: Solaris Trusted Extensions, Case Study2: Building a Secure Operating System for Linux. Text Book 2: Ch. 7.1 to 7.5, Ch. 8.1 to 8.8 and Ch.9.1 to Ch. 9.3	
MODULE 5	**8Hrs**
Secure Capability & Virtual Machine Systems: Capability System Fundamentals, Capability Security, Challenges in Secure Capability Systems, Building Secure Capability Systems, Separation Kernels, VAX VMM Security Kernel, Security in Other Virtual Machine Systems. Text Book 2: Ch. 10.1 to Ch. 10.4 and Ch. 11.1 to 11.3	

TEXT BOOKS:

1. Mukesh Singhal and Niranjan Shivaratri, Advanced Concepts in Operating Systems, McGraw-Hill, 2011.
2. Trent Jaeger, Operating System Security, Morgan & Claypool Publishers, 2008.

REFERENCES:

1. Michael J. Palmer, "Guide To Operating Systems Security", 1st Edition, Cengage Learning, 2004.
2. Gerard Blokdyk, "Security-focused operating system: Master the Art of Design Patterns", CreateSpace Independent Publishing Platform, 2017.

SEMESTER	**VI**					
YEAR	**III**					
COURSE CODE	**21CY3607**					
TITLE OF THE COURSE	**PROACTIVE SECURITY TOOLS**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

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

- To understand the fundamentals of risk management
- To identify the threat assessment process and its input to risk assessment
- To learn the different vulnerability issues and its assessment for hazards, disaster, threats
- To understand various tools, types of risk assessment and processes of risk management

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Summarize the significance of risk, security and vulnerability assessment.	L2
CO2	Make use of threat assessment features to generate risk assessment parameters.	L3
CO3	Utilize COTS-based software to assess vulnerability issues like disasters, hazards and threats.	L3
CO4	Build policies using qualitative and quantitative risk assessment tools and techniques.	L3

COURSE CONTENT:	
MODULE 1	**7Hrs**
An Introduction to Risk Management: Introduction to the Theories of Risk Management; The Changing Environment; The Art of Managing Risks.	
MODULE 2	**7Hrs**
The Threat Assessment Process: Threat Assessment and its Input to Risk Assessment, Threat Assessment Method, Example Threat Assessment.	
MODULE 3	**9Hrs**
Vulnerability Issues: Operating System Vulnerabilities; Application Vulnerabilities; Public Domain or Commercial Off-the-Shelf Software; Connectivity and Dependence; Vulnerability assessment for natural disaster, technological hazards, and terrorist threats; implications for emergency response, vulnerability of critical infrastructures.	
MODULE 4	**8Hrs**
The Risk Process: What is Risk Assessment? Risk Analysis; Who is Responsible?	

MODULE 5	8Hrs
Tools and Types of Risk Assessment: Qualitative and Quantitative risk Assessment; Policies, Procedures, Plans, and Processes of Risk Management; Tools and Techniques; Integrated Risk Management; Future Directions: The Future of the Risk Management.	

TEXT BOOKS:

1. Malcolm Harkins, Managing Risk and Information Security, Apress, 2012.
2. Daniel Minoli, Information Technology Risk Management in Enterprise Environments, Wiley, 2009.

REFERENCES:

1. Andy Jones, Debi Ashenden ,Risk Management for Computer Security: Protecting Your Network & Information Assets, , 1st Edition, Butterworth-Heinemann, Elsevier, 2005.
2. Andreas Von Grebmer, Information and IT Risk Management in a Nutshell: A pragmatic approach to Information Security, 2008, Books On Demand Gmbh.

SEMESTER	**VI**					
YEAR	**III**					
COURSE CODE	**21CY3608**					
TITLE OF THE COURSE	**IOT AND BIG DATA SECURITY**					
SCHEME OF INSTRUCTION	**Lecture Hours**	**Tutorial Hours**	**Practical Hours**	**Seminar/Projects Hours**	**Total Hours**	**Credits**
	39	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	**Sem/Year**	**Course Code**	**Title of the Course**
***	-	-	Cloud Application Development, Python and Computer Networks.

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO 1	Apply the concept of conventional cryptographic protocols to solve security-related challenges in the domain of Big Data Networks, Wireless Sensor Networks, IoT, and Cyber-Physical Systems (CPSs).	**L3**
CO 2	Analyze and evaluate security protocols hosted in the IoT and Big Data platforms, and determine latency, energy efficiency, trust, reliability, and availability metrices for the same system.	**L4**
CO 3	Develop secure Big Data storing and processing platforms using Hadoop and Spark.	**L3**
CO 4	Design secure IoT applications and deploy the same on Raspberry Pi, Arduino Uno, ESP-32 board.	**L6**
CO 5	Create vender-specific secure IoT and Big Data storage systems through research-based internships, project-based activities, and life-long learning.	**L6**

COURSE CONTENT:	
MODULE 1 Fundamental of IoT and Big Data Security	**9 HRS**
Internet of Things, Big Data, IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies with Big Data: Development challenges, Security, Privacy, and Trust issues, Internet of Everything in Big Data, Security Requirements in IoT and Big Data Architecture and Applications.	
MODULE 2 Security Architecture of IoT and Big Data	**9 HRS**
Big Data Architecture, Big Data Eco System, Architecture Reference Model in IoT and Big Data, CISCO IoT Reference Model and architecture, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views of IoT, Security Architecture in the Internet of Things, Security Requirements in IoT, Blockchain.	
MODULE 3 IoT and M2M Security	**7 HRS**
Introduction, Definition of M2M, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An	

Architectural Overview, Building an architecture, Main design principles and needed capabilities, security and standards considerations in M2M.	
MODULE 4 Privacy, Security, and Trust in WSN and IoT	**10 HRS**
Security and privacy issues in WSN, Sensor deployment and node discovery, Big Data aggregation and dissemination, CIA: Confidentiality, Integrity, and Availability, Threats and attacks on IoT systems : unauthorized access, side-channel and covert channel attacks, device authentication and access control, accounting and auditing, digital signature algorithm, intrusion detection in IoT aggregation for the IoT in smart cities, Blockchain in IoT, security issues in Cloud assisted IoT, security protocols in IoT.	
MODULE 5 Secure IoT Application Programming	**8 HRS**
Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart and secure IoT applications design, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Home Management, Real-time monitoring and control of processes - Deploying smart machines, smart sensors, and smart controllers with proprietary communication and Internet technologies.	

TEXT BOOK:

1. "Internet of Things (A Hands-on-Approach)",Vijay Madisetti and Arshdeep Bahga, 1st Edition, VPT, 2014.
2. "Hadoop Security_ Protecting Your Big Data Platform", Ben Spivey, Joey Echeverria - O'Reilly Media, 2015,

REFERENCE BOOKS:

1. Handbook of Big Data and IoT Security,Ali Dehghantanha, Kim-Kwang Raymond Choo, Springer International Publishing 2019

SEMESTER	**VI**					
YEAR	**III**					
COURSE CODE	**21CY3609**					
TITLE OF THE COURSE	**DATA MINING AND ANALYSIS**					
SCHEME OF INSTRUCTION	**Lecture Hours**	**Tutorial Hours**	**Practical Hours**	**Seminar/Projects Hours**	**Total Hours**	**Credits**
	39	-	-	-	39	3

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	-	-	***

COURSE OBJECTIVES:

- To understand the basic concepts of Data Mining and Data-ware Housing
- To identify different Classification, clustering and association algorithms
- To learn the challenges and tasks of data mining process
- To understand various methods and techniques for implementing Data Ware-house

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO 1	Summarize data warehousing architectures and models like stars, snowflakes and fact constellations to measure data abstraction, complexity and computation.	**L2**
CO 2	Examine basic, intermediate and advanced data cube computation techniques to analysis the storage complexity.	**L2**
CO 3	Make use of FPGrowth algorithm to determine frequent item set.	**L3**
CO 4	Construct and examine classification and clustering strategies like Decision Tree, KNN, Rule based, Bayesian Classifiers, k- Means, DBSCAN, Density- Based, Graph-Based Clustering to detect hidden pattern inside datasets.	**L4**

COURSE CONTENT:	
MODULE 1	**9 HRS**
Data Warehousing & modelling: Basic Concepts, A multitier Architecture, Data warehouse models, Enterprise warehouse, Data mart and virtual warehouse, Extraction, Transformation and loading, Data Cube: A multidimensional data model, Stars, Snowflakes and Fact constellations: Schemas for multidimensional Data models, Dimensions: The role of concept Hierarchies, Measures: Their Categorization and computation, Typical OLAP Operations.	
MODULE 2	**8 HRS**
Data warehouse implementation& Data mining Efficient Data Cube computation: An overview, Indexing OLAP Data: Bitmap index and join index, Efficient processing of OLAP Queries, OLAP server Architecture ROLAP versus MOLAP Versus HOLAP.	

Introduction: What is data mining, Challenges, Data Mining Tasks, Data: Types of Data, Data Quality, Data Preprocessing, Measures of Similarity and Dissimilarity.	
MODULE 3	**8 HRS**
Association Analysis Association Analysis: Problem Definition, Frequent Item set Generation, Rule generation. Alternative Methods for Generating Frequent Item sets, FPGrowth Algorithm, Evaluation of Association Patterns.	
MODULE 4	**7 HRS**
Classification Decision Trees Induction, Method for Comparing Classifiers, Rule Based Classifiers, Nearest Neighbor Classifiers, Bayesian Classifiers.	
MODULE 5	**7 HRS**
Clustering Analysis Overview, K-Means, Agglomerative Hierarchical Clustering, DBSCAN, Cluster Evaluation, Density- Based Clustering, Graph-Based Clustering, Scalable Clustering Algorithms.	

TEXT BOOK:

1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Pearson, First impression,2014.
2. Jiawei Han, Micheline Kamber, Jian Pei: Data Mining -Concepts and Techniques, 3rd Edition, Morgan Kaufmann Publisher, 2012.

REFERENCE BOOKS:

1. Sam Anahory, Dennis Murray: Data Warehousing in the Real World, Pearson,Tenth Impression,2012.
2. Michael.J.Berry,Gordon.S.Linoff: Mastering Data Mining , Wiley Edition, second edtion,2012.

SEMESTER	**VI**					
YEAR	**III**					
COURSE CODE	**21CY3610**					
TITLE OF THE COURSE	**CYBER SECURITY PROGRAMS AND POLICIES**					
SCHEME OF INSTRUCTION	**Lecture Hours**	**Tutorial Hours**	**Practical Hours**	**Seminar/Projects Hours**	**Total Hours**	**Credits**
	39	-	-	-	39	3

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	-	-	***

COURSE OBJECTIVES:

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

- Know the importance of policies and governance in information security and cybersecurity.
- Maintaining confidentiality and integrity of information.
- Understand Asset Management and Data Loss Prevention and access controls
- Summarize Cybersecurity Framework Reference Tool.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO 1	Summarize cybersecurity policies, standards, hierarchy and format to protect IT assets.	**L2**
CO 2	Examine NIST's Cybersecurity Framework, risk assessment strategies to protect data privacy from both active and passive adversaries.	**L3**
CO 3	Choose robust employee learning, defense, access control models to assist asset management and loss prevention.	**L3**
CO 4	Make use of PCI-DSS HIPAA and GDPR standards to protect data breaches.	**L3**

COURSE CONTENT:	
MODULE 1	**8 HRS**
Cybersecurity Policy and Governance: Information Security vs. Cybersecurity Policies, Looking at Policy Through the Ages, Cybersecurity Policy, Assets, Cybersecurity Policy Life Cycle. Policy Organization, Format, and Styles: Policy Hierarchy, Writing Style and Technique, Policy Format.	
MODULE 2	**6 HRS**
Confidentiality, Integrity, and Availability, NIST's Cybersecurity Framework, Understanding Cybersecurity Policies, Cybersecurity Risk.	
MODULE 3	**10 HRS**
Asset Management and Data Loss Prevention: Information Assets and Systems, Information Classification, Labeling and Handling Standards, Information Systems Inventory, Understanding Data Loss Prevention	

Technologies, Employee life cycle, Employee learning during orientation, The Importance of Employee Agreements, The Importance of Security Education and Training, Understanding the secure Facility layered Defense Model, Protecting Equipment, Access Control Fundamentals, Infrastructure Access Controls, User Access Controls.	
MODULE 4	**7 HRS**
Incident Response, Investigation and Evidence Handling, Data Breach Notification Requirements.	
MODULE 5	**8 HRS**
Protecting Cardholder Data, PCI Compliance, Introduction to NIST Cybersecurity Framework Components, Framework Implementation Tiers, Improvement of Cybersecurity Program, NIST Cybersecurity Framework Reference Tool.	

TEXT BOOK:

1. Developing Cybersecurity Programs & Policies, OMAR SANTOS, Pearson Education.

REFERENCE BOOKS:

1. Cyber Law: The law of the Internet", Jonathan Rosenoer, Springer-Verlag, 1997.

SEMESTER	**VI**					
YEAR	**III**					
COURSE CODE	**21CY3604**					
TITLE OF THE COURSE	**ETHICAL HACKING LAB**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	**-**	**2**	**-**	**26**	**1**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- To cover the fundamentals and mathematical models in digital image and video processing
- To develop time and frequency domain techniques for image enhancement
- To expose the students to current technologies and issues in image and video processing.
- To develop image and video processing applications in practice.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Make use of reconnaissance tools like WHOIS, dig, nslookup, traceroute, ping, ifconfig, netstat to analyze computer network.	L3
CO2	Apply nmap to perform port scanning and visualize the OS fingerprinting.	L3
CO3	Utilize ARPWATCH tool to detect ARP spoofing and to perform ARP poisoning and make use of WireShark tool to analyze network packets.	L3
CO4	Inspect Cain and Abel tools for determine the Windows account and wireless network passwords using Dictionary attack.	L4
CO5	Experiment with DVWA, Tamper Data, Metaspoilt, Xampp applications to stimulate Cross Site Scripting attack, Session impersonation, exploiting, sql injection attack.	L3

List of Experiments:

1. Study the use of network reconnaissance tools like WHOIS, dig, nslookup, traceroute, ping, ifconfig, netstat to gather information about networks and domain registrars.
2. Download and install nmap. Use it with different options to scan open ports, perform OS fingerprinting, do a ping scan, tcp port scan and udp port scan.
3. Using Nmap scanner to perform port scanning of various forms like ACK, SYN, FIN, NULL, XMAS.
4. Detect ARP spoofing using open-source tool ARPWATCH.
5. Perform ARP Poisoning in Windows.
6. Use Cain and Abel for cracking Windows account password using Dictionary attack and to decode wireless network passwords.
7. Use WireShark sniffer to capture network traffic and analyze.
8. Simulate persistant Cross Site Scripting attack.
9. Session impersonation using Firefox and tamper data add-on.

10. Perform SQL injection attack.
11. Create a simple keylogger using python.
12. Using Metasploit to exploit to create exploit and add the exploit to the victim's PC.

REFERENCES:

1. Patrick Engebretson, The Basics of hacking and penetration testing, 8thedition, Wiley-India, 2010
2. Michael Gregg, Build Your Own Security Lab: A Field Guide for Network Testing, Wiley Publishing, Inc, 2008.

SEMESTER	**VI**					
YEAR	**III**					
COURSE CODE	**21CY3605**					
TITLE OF THE COURSE	**DIGITAL IMAGE PROCESSING LAB**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	**-**	**2**	**-**	**26**	**1**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- To understand image acquisition and storage using a open source software – SCILAB
- To study and analyze different image transforms on images
- To study, analyze and apply different techniques and algorithms for image enhancement
- To study, analyze and apply different techniques and algorithms for image restoration
- To study, analyze and apply different techniques and algorithms for image compression

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Construct program to read binary, gray scale, multi-spectral two-dimensional images and perform DFT, IDFT, DCT, IDCT, DWT and IDWT.	L3
CO2	Examine rotation, transformation, dimensionality reduction of a given gray-scale image	L4
CO3	Inspect image enhancement, smoothing, sharpening and noise reduction in spatial and frequency domain utilizing filters.	L4
CO4	Make use of Discrete Wavelet Transform to perform compress and decompress of a given gray-scale images.	L3

List of Experiments

The following programs can be developed in C or Java or Python programming languages or MATLAB tool:

1. Representation of a binary, gray scale, color and multi-spectral two-dimensional images.
2. Apply the Discrete Fourier Transform to a given gray scale image and perform inverse DFT.
3. Analyze the rotation, transformation, dimensionality reduction of a given gray scale image.
4. Find the Discrete Cosine Transforms of a given image. Compare Discrete Fourier Transform and Discrete Cosine Transforms.
5. Apply histogram equalization for enhancing the given images.
6. Perform image enhancement, smoothing and sharpening, in spatial domain using different spatial filters.
7. Perform image enhancement, smoothing and sharpening, in frequency domain using different filters.
8. Perform noise removal using different spatial filters and compare their performances.
9. For the given image perform edge detection using different operators and compare the results.
10. For a given gray-scale image, compress and decompress using wavelets.

REFERENCES:

1. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 'Digital Image Processing using MATLAB', Pearson Education, Inc., 2011.

SEMESTER	**VII**					
YEAR	**IV**					
COURSE CODE	**21CY4702**					
TITLE OF THE COURSE	**VULNERABILITY ANALYSIS AND PENETRATION TESTING**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- Understand the evolving tools, tactics and procedures used by cybercriminals to breach networks.
- Discuss implications of common vulnerabilities and recommend ways to rectify or mitigate.
- More complex vulnerabilities are sought which cannot be found by automated scanners and the effectiveness of the security measures taken at the technical, organizational and personnel level is checked.
- Understand the legal aspects, industry ethics and the approaches and methodologies used when performing a penetration test.
- Be able to use the appropriate penetration testing tools for a given scenario and understand their output.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Summarize the significance of risk, security and vulnerability assessment.	L2
CO2	Analyze penetration testing strategies for diagnosing security of web application using OWASP standards.	L4
CO3	Identify the types of vulnerability assessment policies to evaluate system security.	L5
CO4	Apply modern tools and techniques like Metasploit, RouterSploit, Backdoor, remote access to gather active and passive information of a system.	L3
CO5	Apply web application security concepts to design application portfolio for reducing risk and vulnerabilities.	L3

COURSE CONTENT:	
MODULE 1	**8Hrs**
Vulnerability Management Governance: Security basics, Identification, Authentication, Authorization, Auditing, Accounting, Non–repudiation, Vulnerability, Threats, Exposure, Risk, Safeguards, Attack vectors. Understanding the need for security assessments: Types of security tests: Security testing, Vulnerability assessment versus penetration testing, Security assessment, Security audit.	
MODULE 2	**7Hrs**
Penetration testing standards, Penetration testing lifecycle, industry standard, Open Web Application Security Project (OWASP) testing guide. Security Assessment Prerequisites: Target scoping and planning, Gathering requirements: checklist of test requirements, time frame and testing hours, Identifying stakeholders.	

MODULE 3	8Hrs
Types of vulnerability assessment: based on location, based on knowledge about environment/ infrastructure, Announced and Unannounced Automated Testing, Manual Testing Estimating the resources and deliverables, Preparing a test plan, Getting approval and signing NDAs, Confidentiality and Nondisclosure Agreements.	
MODULE 4	**9Hrs**
Information Gathering: Passive information gathering, Active information gathering. Enumeration: Enumeration Services. Gaining Network Access: Gaining remote access, Cracking passwords, Creating backdoors using Backdoor Factory, Exploiting remote services using Metasploit, Hacking embedded devices using RouterSploit, Social engineering using SET.	
MODULE 5	**7Hrs**
Assessing Web Application Security: Importance of web application security testing, Application profiling, Common web application security testing tools, Authentication, Authorization, Session management, Input validation, Security misconfiguration.	

TEXT BOOKS:

1. Sagar Rahalkar, Network Vulnerability Assessment, Packt Publishing Inc, 2018.

REFERENCES:

1. Abhishek Singh, Baibhav Singh and Hirosh Joseph, Vulnerability Analysis and Defense for the Internet, Springer Publishing Inc, 2008.
2. Wil Allsopp, Unauthorized Access: Physical Penetration Testing For IT Security, Wiley Publishing Inc, 2009.
3. Kimberly Graves, Vulnerability Analysis and Defense for the Internet, Wiley Publishing Inc.; 2007.
4. Shakeel Ali and Tedi Heriyanto, Backtrack -4: Assuring security by penetration testing", PACKT Publishing; 2011

SEMESTER	**VII**					
YEAR	**IV**					
COURSE CODE	**21CY4703**					
TITLE OF THE COURSE	**QUANTUM CRYPTOGRAPHY AND COMMUNICATION**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**42**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- To apply techniques of linear algebra to quantum mechanics
- To analyze basic quantum circuits
- To explore the techniques of quantum communication
- To study the protocols of quantum cryptograph

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Examine the tools and techniques of linear algebra to the quantum mechanics problems	L4
CO2	Design and analyze basic quantum circuits and quantum computing algorithms	L5
CO3	Develop the quantum communication tools using quantum gates	L6
CO4	Design quantum cryptography protocol using quantum mechanics	L6

COURSE CONTENT:

MODULE 1: LINEAR ALGEBRA REVIEW	**9 Hrs**
Bases and Linear Independence, Linear Operators and Matrices, Inner Products Eigen Vectors and Eigen Values, Adjoints and Hermitian Operators, Tensor Products, Operator Functions, Commutator and Anti-Commutator	
MODULE 2: QUANTUM MECHANICS	**8 Hrs**
State Space, Evolution, Measurement, Distinguishing Quantum States, Projective Measurements and POVMs	
MODULE 3: QUANTUM GATES AND ALGORITHMS	**7 Hrs**
Universal set of gates, quantum circuits, Solovay-Kitaev theorem, Deutsch-Jozsa algorithm, Shor's factoring, Grover Algorithm and HHL Algorithm	
MODULE 4: QUANTUM COMMUNICATION	**9 Hrs**
Overview of Quantum Operations, Quantum Noise, Distance Between Quantum States, Accessible Information, Data Compression, Classical Information Over Quantum Channels, Quantum Information Over Quantum Channels, Entanglement as a Physical Resource	

MODULE 5 : QUANTUM CRYPTOGRAPHY	9 Hrs
Private Key Cryptography, Privacy Amplification, Quantum Key Distribution, Privacy and Coherent Information, Security of Quantum Key Distribution	

TEXT BOOKS:

1. Nielsen, M. A., & Chuang, I. (2002). Quantum computation and quantum information.

REFENCE BOOKS:

1. Phillip Kaye, Raymond Laflamme et. al., An introduction to Quantum Computing, Oxford University press, 2007.
2. Chris Bernhardt, Quantum Computing for Everyone, The MIT Press, Cambridge, 2020

SEMESTER	**VII**					
YEAR	**IV**					
COURSE CODE	**21CY4704**					
TITLE OF THE COURSE	**WIRELESS NETWORK SECURITY**					
SCHEME OF INSTRUCTION	**Lecture Hours**	**Tutorial Hours**	**Practical Hours**	**Seminar/Projects Hours**	**Total Hours**	**Credits**
	3	-	-	-	39	3

COURSE OBJECTIVES:

1. Understanding the fundamentals and architecture of wireless sensor networks, enabling students to evaluate and comprehend their structure and components.
2. Explore different security architectures and protocols used in wireless networks.
3. Students will be able analyze the OSI model, evaluate wireless LAN security protocols, apply cryptographic techniques, and assess security considerations in wireless networks.
4. Gaining knowledge of identity-based cryptography and countermeasures against attacks, identifying and mitigating wireless threats,
5. Studying hacking techniques, familiarizing with wireless security tools, and developing skills in creating effective wireless security policies.

CO No.	Outcomes	Bloom's Taxonomy Level
CO 1	Summarize the WSN applications, history, architecture, routing challenges, and security countermeasures.	L2
CO 2	Compare different wireless security architectures and assess their strengths and weaknesses.	L2
CO 3	Interpret the OSI model, wireless LAN security protocols, cryptography, and security considerations.	L2
CO 4	Analyze symmetric, asymmetric key systems, PKI, and identity-based cryptography.	L3
CO 5	Utilize scanning, sniffing, denial-of-service, and access point attacking tools to identify wireless threats, employ hacking techniques, and develop a comprehensive wireless security policy.	L3

COURSE CONTENT:	
MODULE 1	**8 HRS**
Introduction To Wireless Sensor Networks: Introduction-WSN Applications, History of WSN, WSN Architecture, Architecture of Sensor Nodes, The Protocol Stack in WSN; MANET Versus WSN, Challenges in WSN, The Routing Problem in WSN, Broadcasting and Multicasting. **Security in Wireless Sensor Networks:** Introduction, Attacks on WSN, Countermeasures to Attacks in WSN.	
MODULE 2	**8 HRS**

Wireless Security Architectures: Static WEP Wireless Architecture, VPN, Wireless VPN Architecture Overview, Wireless VPN Architecture Overview, VPN Policy Aspect, Wireless Gateway Systems ,802.1x, Comparing Wireless Security Architectures. **Introduction to Wireless Security Protocols and Cryptography:** Removing the FUD, OSI Model, Wireless Local Area Network (LAN) Security Protocols, Cryptography, Secure Sockets Layer/Transport Layer Security (SSL/TLS), Man-in-the-Middle (MITM) of SSL/TLS and SSH, Security Considerations for Wireless Security-wireless device security issues.	
MODULE 3	**8 HRS**
Identity-Based Cryptography: Introduction-Symmetric Key Cryptographic Systems, Asymmetric Key Cryptographic Systems, Public Key Infrastructure- Single-Certificate Authority Model, A Hierarchy of Certificate Authorities, Pros and Cons of PKI, Identity-Based Cryptography-Computational Problems, Identity-Based Encryption Schemes, Hierarchical Identity-Based Encryption Scheme , Identity-Based Authentication Schemes , Key Distribution in IBC, Key Escrow Problem, Threshold Signature Scheme	
MODULE 4	**8 HRS**
Wireless Threats: The Uncontrolled Terrain, Eavesdropping, Communications Jamming, Injection and Modification of Data, Rogue Client, Attacker Equipment, Covert Wireless Channels, Roaming Issues, Cryptographic Threats. **Breaking Wireless Security:** The Hacking Process, Wireless Network Compromising Technique, Access Point Compromising Techniques	
MODULE 5	**7 HRS**
Wireless Tools: Scanning Tools., Sniffing Tools, Hybrid Tools, Denial-of-Service Tools, Denial-of-Service Tools, Access Point Attacking Tools, Other Wireless Security Tools. **Wireless Security Policy**: Policy Overview, The Policy-Writing Process, Risk Assessment, Impact Analysis, Wireless Security Policy Areas.	

TEXT BOOK:

1. Harsh Kupwade Patil Stephen A. Szygenda, "Security for Wireless Sensor Networks using Identity-Based Cryptography", CRC Press, Taylor & Francis Group-2013
2. Merritt Maxim and David Pollino, "Wireless Security", McGraw-Hill publication,2002
3. Aaron E. Earle, "Wireless Security Handbook", Published in 2006 by Auerbach Publications Taylor & Francis Group

REFERENCE BOOKS:

1. "MOBILE AND WIRELESS NETWORKS SECURITY", Maryline Laurent-Maknavicius, Hakima Chaouchi, France Proceedings of the MWNS 2008 Workshop Singapore 9 April 2008.
2. "Wireless Network Security", by YANG XIAO, XUEMIN SHEN, and DING-ZHU DU, Spinger Series, 2007, ISBN-10 0-387-28040-5.

SEMESTER	**VII**					
YEAR	**IV**					
COURSE CODE	21CY4705					
TITLE OF THE COURSE	**DATA PRIVACY**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**38**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	-	-	-

COURSE OBJECTIVES:

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

- Learn about keeping data private with classical cryptography, modern cryptography, Steganography.
- Understand different types of Ciphers.
- Use various algorithms of public key cryptography.
- Identify the methods for data hiding in different types of images and videos.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Examine Monoalphabetic and Polyalphabetic Substitution Ciphers to discover plaintext.	L4
CO2	Make use of public cryptography to hide data in text, image, audio and video signal.	L2
CO3	Summarize LSB Encoded, BPCS, Spread Spectrum Steganography to hide private data inside text, image, audio and video signal.	L2
CO4	Apply digital signal processing tools and techniques to construct digital watermark.	L3

COURSE CONTENT:	
MODULE 1	**08 Hrs**
Monoalphabetic Substitution Ciphers: Letter Distributions, Breaking a Monoalphabetic Cipher, The Pigpen Cipher, Polybius's Monoalphabetic Cipher, Extended Monoalphabetic Ciphers, The Playfair Cipher, Homophonic Substitution Ciphers. Polyalphabetic Substitution Ciphers: Self-Reciprocal Ciphers, The Porta Polyalphabetic Cipher, The Beaufort Cipher, The Trithemius Cipher, The Vigenere Cipher, Breaking the Vigenere Cipher, Long Keys, A Variation on Vigenere, The Gronsfeld Cipher, Generating Permutations, The Eyraud Cipher, The Hill Cipher, The Jefferson Multiplex Cipher, Strip Ciphers, Polyphonic Ciphers and Ambiguity, Polybius's Polyalphabetic Cipher.	
MODULE 2	**08 Hrs**
Public-Key Cryptography: - Diffie-HeIlman-Merkle Keys, Public-Key Cryptography, Rabin Public-Key Method, El Gamal Public-Key Method, Pretty Good Privacy, Sharing Secrets: Threshold Schemes, The Four	

Components, Authentication, Elliptic Curve Cryptography. Data Hiding in Text: Basic Features, Applications of Data Hiding, Watermarking, Intuitive Methods, Simple Digital Methods, Data Hiding in Text, Innocuous Text, Mimic Functions	
MODULE 3	**08 Hrs**
Data Hiding in Images: LSB Encoding, BPCS Steganography, Lossless Data Hiding, Spread Spectrum	
MODULE 4	**09 Hrs**
Data Hiding in Images with Watermarking: Watermarking, Detecting Malicious Tampering Wavelet Methods, Kundur-Hatzinakos Watermarking: Kundur-Hatzinakos Watermarking: II Data Hiding in Binary Images, The Zhao-Koch Method, The Wu-Lee Method, The CPT Method, The TP Method, Data Hiding in Fax Images	
MODULE 5	**09 Hrs**
Data Hiding: [Other Methods] Protecting Music Scores, Data Hiding in MPEG-2 Video, Digital Audio, The Human Auditory System, Audio Watermarking in the Time Domain, Echo Hiding, The Steganographic File System, Ultimate Steganography, Public-Key Steganography, Current Software	

TEXT BOOK:

1. Data Privacy and Security, David Salomon, 2003 Springer-Verlag New York, Inc.

REFERENCES:

1. William Stallings - Cryptography and Network Security 5th edition
2. Cryptography and Network Security : Atul Kahate, Mc Graw Hill Edition

SEMESTER	**VII**					
YEAR	**IV**					
COURSE CODE	21CY4706					
TITLE OF THE COURSE	**EMBEDDED SYSTEM SECURITY**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**38**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	-	-	C Programming for Problem Solving, Embedded Systems and Proactive Security tools.

COURSE OBJECTIVES:

a. Understand the technological uplifts with biometrics compared to traditional securing mechanisms and standards applied to security
b. To understand the concepts of different types of biometrics and to enable design of biometric system and its privacy risks
c. To familiarize with biometric interface and biometric applications

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Understand the concept of secure embedded (hardware-software integrated device) system design to mitigate side-channel and covert channel attacks in the domain of IoT and cyber-physical systems.	L2
CO2	Determine security, energy efficiency, risk, reliability, availability, and sustainability metrices for a given embedded system.	L5
CO3	Develop secure firmware and trusted embedded devices or electronic gadgets using Raspberry Pi, Python, and Embedded C programming language.	L3
CO4	Design secure IoT applications and deploy the same on various embedded platforms to analyze the attack surface.	L6
CO5	Create vender-specific secure embedded systems through research-based internships, project-based activities, and life-long learning.	L6

COURSE CONTENT:	
MODULE 1 Introduction to Embedded System Security	**10 Hrs**
Fundamentals of embedded systems and their security challenges, Overview of different security threats and attack vectors in embedded systems, Side channel and Covert channel Attacks, Security engineering principles and secure development methodologies, Secure coding practices and vulnerability mitigation techniques in embedded systems.	
MODULE 2 Secure Boot and Firmware Integrity	**08 Hrs**
Importance of secure boot and firmware integrity in embedded systems, Boot loader design and implementation for secure boot process, Trusted Platform Module (TPM), Hardware-based secure boot solutions, Secure	

firmware update mechanisms and over-the-air (OTA) updates.	
MODULE 3 Embedded System Authentication and Authorization	**08 Hrs**
Authentication and Access control protocols for embedded systems, Public Key infrastructure (PKI) and Digital Certificates in embedded systems, Role-based access control (RBAC) and Privilege Escalation Prevention Techniques (PEPTs), Secure Communication Protocols (SCPs) and Secure Data Transfer (SDT) in embedded systems	
MODULE 4 Embedded System Security Testing and Evaluation	**10 Hrs**
Security Testing in Embedded Systems, Threat Modeling and Risk Assessment, Vulnerability Assessment and Penetration Testing, Secure Code Review and Static Analysis, Security Evaluation and Compliance, Incident Response and Handling, Security testing using Python with Raspberry Pi and Embedded C Programming.	
MODULE 5 Embedded System Security Case Studies and Emerging Trends	**03 Hrs**
Embedded System Security Case Studies, Case Studies in Vulnerabilities and Exploits, Case Studies in Secure Design and Implementation, Emerging Trends in Embedded System Security, Future Directions and Industry Perspectives.	

TEXT BOOK:

1. ``Embedded Systems Security: Practical Methods for Safe and Secure Software and Systems Development" by David Kleidermacher and Mike Kleidermacher, 2012.
2. ``Practical Embedded Security Building Secure Resource-Constrained Systems" by Timothy Stapko, Elsevier, 2008..

REFERENCES:

1. "Machine Learning for Embedded System Security-Springer" by Basel Halak, Springer, 2022.
2. "Hardware Security: A Hands-on Learning Approach" by Mark Tehraipoor and Swarup Bhunia, Morgan Kaufmann Publisher, 2019.

SEMESTER	**VII**					
YEAR	**IV**					
COURSE CODE	21CY4707					
TITLE OF THE COURSE	**PATTERN RECOGNITION**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**38**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	-	-	Digital Image Processing

COURSE OBJECTIVES:

- To understand the fundamentals of parameter estimation techniques
- To learn the basics of classification and clustering methods
- To understand various learning algorithms and risk minimization factors.
- To identify the different kernel methods useful in classification

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Interpret parameter estimation strategies like MLE, MAP, MMIE to analyze the basic characteristics of data.	L2
CO2	Summarize classification methodologies like PDM, Regression, Least squares, Discriminant analysis method to categorize hidden data pattern.	L2
CO3	Make use of unsupervised learning algorithms to identify the incomplete data present in the pattern.	L3
CO4	Construct and formulate kernel methods like SVM and clustering strategies like Rough k- Means, Fuzzy k-Means, k-Harmonic Means algorithms for pattern classification.	L3

COURSE CONTENT:

MODULE 1	**8 Hrs**

Parameter Estimation
Maximum Likelihood Estimation, Maximum A-Posteriori (MAP) Estimation, Maximum Entropy Estimation, Minimum Relative Entropy Estimation, Maximum Mutual Information Estimation (MMIE); Model Selection, Akaike Information Criterion (AIC)Bayesian Information Criterion (BIC)

MODULE 2	**09 Hrs**

Classification
Linear Models for Classification, Discriminant Functions, Two classes, Multiple classes, Least squares for classification, Fisher's linear discriminant, Relation to least squares, Fisher's discriminant for multiple classes, The perceptron algorithm; Probabilistic Generative Models, Continuous inputs, Maximum likelihood solution, Discrete features, Exponential family; Probabilistic Discriminative Models, Fixed basis functions, Logistic regression, Iterative reweighted least squares, Multiclass logistic regression, Probit regression, Canonical link functions.

MODULE 3	07 Hrs
Learning Learning Algorithms, Risk Minimization, Empirical Risk Minimization, Capacity and Bounds on Risk, Structural Risk Minimization; Decision and Regression Trees, Vector Quantization (VQ)	
MODULE 4	**07 Hrs**
Clustering Basic Clustering Techniques, Standard k-Means (Lloyd) Algorithm, Generalized Clustering, Over-partitioning, Merging, Modifications to the k-Means Algorithm, k-Means Wrappers, Rough k- Means, Fuzzy k-Means, k-Harmonic Means Algorithm, Hybrid Clustering Algorithms; Estimation using Incomplete Data, Expectation Maximization (EM); Semi-Supervised Learning.	
MODULE 5	**08 Hrs**
Kernel Methods and Support Vector Machines The Two-Class Problem, Dual Representation, Soft Margin Classification; Origins of Kernel methods, Kernel Mapping, The Kernel Trick; Constructing Kernels Formulation and Computation; Radial Basis Function Networks; Positive Semi-Definite Kernels, Linear Kernel, Polynomial Kernel, Gaussian Radial Basis Function (GRBF) Kernel, Cosine Kernel, Fisher Kernel, GLDS Kernel, GMM-UBM Mean Interval (GUMI) Kernel.	

TEXT BOOK:

1. HomayoonBeigi, Fundamentals of Speaker Recognition, Springer,2011
2. K.P. Soman, R.Loganathan, V.Ajay, Machine Learning with SVM and other Kernel methods, PHI Learning Private Limited,2009

REFERENCES:

1. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer,2006
2. Tom Mitchell,Machine Learning, McGraw Hill, 1997.
3. Petra Perner. Machine Learning and Data Mining in Pattern Recognition, Springer Science & Business Media, 2009.

SEMESTER	**VIII**					
YEAR	**IV**					
COURSE CODE	**21CY4803**					
TITLE OF THE COURSE	**RISK MANAGEMENT**					
SCHEME OF INSTRUCTION	**Lecture Hours**	**Tutorial Hours**	**Practical Hours**	**Seminar/Projects Hours**	**Total Hours**	**Credits**
	39	-	-	-	39	3

COURSE OBJECTIVES:

1. Understand the fundamental concepts and history of information security and its importance in various organizations.
2. Develop the knowledge and skills necessary to perform common system administration tasks and implement hardware and software controls to maintain information security.
3. Identify and characterize assets, analyze threats and vulnerabilities, and implement encryption controls and identity and access management to ensure data protection.
4. Develop the ability to handle and analyze security incidents, conduct risk assessments, and implement risk management frameworks.
5. Understand the importance of policies, standards, and guidelines in information security and develop the ability to write policies that comply with the required guidelines.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO 1	Identify the importance of information security in the domain of data storage and processing.	L3
CO 2	Apply basic security model for identification and characterization of IT assets.	L3
CO 3	Identify and Analyze threats and vulnerabilities to measure robust encryption controls and identity and access management strategies.	L4
CO 4	Make use of access control, firewalls, and intrusion detection and prevention strategies to inspect security incidents.	L4
CO 5	Interpret risk assessment and management standards, guidelines, policies to develop a new security model.	L6

COURSE CONTENT:	
MODULE 1	**8 HRS**
Introduction - Overview, professional utility of information security knowledge, History, Definition of Information Security **System Administration (part 1) -** Overview, what is System administration? System administration and information security, Common administration tasks, System administration utilities. **System Administration (part 2) –** Operating system structure, command line interface, files and directories-moving around file system - *pwd, cd,* file management-viewing of files, searching of files, Access control and user management-Access control lists, File Ownerships-editing files, Account Management.	
MODULE 2	**7 HRS**

The Basic Information Security Model – Overview, introduction, Components of Basic Information Security Model, Common Vulnerabilities and threats, Case Study- ILOVEYOU Virus. **Asset Identification and Characterization** – Overview, Asset overview, determining assets that are important to organization, Asset Types, Asset Characterization, IT Asset Lifecycle and asset identification, System profiling, Asset Ownership and operational responsibilities	
MODULE 3	**8 HRS**
Threats and Vulnerabilities - Overview, Introduction, Threat Models, threat Agents, Threat Actions, Vulnerabilities. **Encryption controls** – Encryption Basics, Encryption types, Encryption types details, Encryption in use. **Identity and Access Management** - identity Management, Access management, Authentication, Single-Sign-on, federation.	
MODULE 4	**9 HRS**
Hardware and Software Controls - Password Management, Access Control, Firewalls, Intrusion detection/Prevention system, patch management for operating system and applications, End-point Protection. **Incident Handling and Analysis**- Introduction, Incidents overview, Incident handling, The disaster, Log analysis, Event criticality, General log configuration and Maintenance, Live incident responses, Timelines, other forensic topics.	
MODULE 5	**9 HRS**
IT Risk Analysis and Risk Management - Introduction, Risk Management as a component of organizational management, Risk Management framework, The NIST 800-39 framework, Risk Assessment, Other Risk Management Frameworks, IT general controls for Sarbanes-Oxley Compliance, Compliance VS. Risk Management, Selling Security. **Policies, Standards and Guidelines** – Guiding Principles, writing a policy, impact assessment and vetting, policy review, compliance, key policy issues.	

TEXT BOOK:

1. Manish Agarwal, Alex Campoe and Eric Pierce – "Information Security and IT Risk Management", Wiley Publications, ISBN: 978-1-118-80313-4.

REFERENCE BOOKS:

1. D.P. Sharma, E-retailing Principles and Practice, Himalaya Publications.

SEMESTER	**VIII**					
YEAR	**IV**					
COURSE CODE	**21CY4804**					
TITLE OF THE COURSE	**MOBILITY SECURITY**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)			
#	**Sem/Year**	**Course Code**	**Title of the Course**
*	**	***	***

COURSE OBJECTIVE:

- To provide a detailed, in-depth, state-of-the-art description of vehicle connectivity and cybersecurity with respect to developments, technologies, inventions, and services

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Summarize the need of Cyber Security in Automotive industry.	L2
CO2	Categorize security threats for security-critical vehicular applications and In Vehicular Network (IVN).	L4
CO3	Identify the causes of the threats by analyzing threat incentives, attackers, and threat models.	L3
CO4	Evaluate security risk and vulnerabilities in the domain of Vehicular Ad-hoc Network (VANET) and Internet of Vehicle (IoV).	L5

COURSE CONTENT:	
MODULE 1: Introduction to Automotive Cybersecurity	**10 Hrs**
Overview, Introduction, Security and Its Impact, Cyber Security in Automotive Technology, The Rising Threat, Vehicular Ransomware Attack, Vehicle Ransomware Attack Scheme, Overview, History of Intelligent and Autonomous Vehicle, Classification of Autonomous Vehicle Based on Driving Levels, State of the Art of Intelligent and Autonomous Vehicle, Battle for Adoption, Market Demand of AutomotiveCyber Security, Cyber Security in Intelligent and Autonomous Vehicles	
MODULE 2: In-Vehicle Communication and Cyber Security	**8 Hrs**
Overview, In-Vehicle System, In-Vehicle Communication, In-Vehicle Network Architecture and Topology, Functional Safety and Cyber security, In-Vehicle Cyber security Issues and Challenges, Cyber Security in In-Vehicle Network (IVN)	
MODULE 3: AUTOSAR Embedded Security in Vehicles	**7 Hrs**
Overview, Introduction, Threat Models for the Automotive Domain, Applying the Adapted Threat Models tothe Automotive Domain, Results	
MODULE 4: Inter-Vehicle Communication and Cyber Security	**7 Hrs**
Overview, Connected Vehicles, State-of-the-Art Technologies in VANET, Role of Edge Computing and SDN in V2X, Connected Vehicle Cyber Security, Trust Management in V2X Communication,Homomorphic	

Encryption in VANET, Blockchain in V2X Communication, Safety Standards for IAV	
MODULE 5: Internet of Vehicles, Vehicular Social Networks, and Cyber security.	**7 Hrs**
Overview, Internet of Vehicles, Machine Learning in Vehicular Networks, Vehicular Social Network.	

TEXT BOOK:

1. Shiho Kim, Rakesh Shrestha - Automotive Cyber Security_ Introduction, Challenges, and Standardization-Springer Singapore_Springer (2020)

REFERENCES:

1. Marko Wolf (auth.) - Security Engineering for Vehicular IT Systems_ Improving the Trustworthiness and Dependability of Automotive IT Applications- Vieweg, Teubner Verlag (2009)

SEMESTER	**VIII**					
YEAR	**IV**					
COURSE CODE	**21CY4805**					
TITLE OF THE COURSE	**BIOMETRIC SECURITY**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**38**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	-	-	-

COURSE OBJECTIVES:

- Understand the technological uplifts with biometrics compared to traditional securing mechanisms and standards applied to security
- To understand the concepts of different types of biometrics and to enable design of biometric system and its privacy risks
- To familiarize with biometric interface and biometric applications

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Make use of biometric fundamental and standards to assess privacy risk.	L3
CO2	Examine finger print, palm print, facial, ear, iris, retina, DNA, Hand vascular geometry, ECG for identifying user.	L4
CO3	Utilize behavioral biometric for human gesture identification.	L3
CO4	Inspect hardware and software based biometric scanner.	L4

COURSE CONTENT:	
MODULE 1	**08 Hrs**
Biometric Fundamentals and Standards: Biometrics versus traditional techniques, Characteristics, Key biometric processes: Verification -Identification -Biometric matching, Performance measures in biometric systems, Assessing the privacy risks of biometrics - Designing privacy sympathetic biometric systems, Different biometric standards, Application properties.	
MODULE 2	**08 Hrs**
Physiological Biometrics: Facial scan, Ear scan, Retina scan, Iris scan, Finger scan, Automated fingerprint identification system, Palm print, Hand vascular geometry analysis, DNA, Cognitive Biometrics -ECG.	
MODULE 3	**08 Hrs**
Behavioral Biometrics: Signature scan, Keystroke scan, Voice scan, Gait recognition, Gesture recognition, Video face, Mapping the body technology.	
MODULE 4	**07 Hrs**
User interfaces: Biometric interfaces: Human machine interface -BHMI structure, Human side interface: Iris image interface -Hand geometry and fingerprint sensor, Machine side interface: Parallel port -Serial port -Network topologies, Case study: Palm Scanner interface.	

MODULE 5	07 Hrs
Biometric applications: Categorizing biometric applications, Application areas: Criminal and citizen identification –Surveillance -PC/network access -E-commerce and retail/ATM, Costs to deploy, Issues in deployment, Biometrics in medicine, cancellable biometrics.	

TEXT BOOK:

1. Anil K Jain, Patrick Flynn and Arun A Ross, Handbook of Biometrics, Springer, US; 2010
2. John R Vacca, Biometric Technologies and Verification Systems, Elsevier, USA; 2009

REFERENCES:

1. Samir Nanavati, Michael Thieme and Raj Nanavati, Biometrics –Identity Verification in a Networked World, John Wiley and Sons; 2003
2. Paul Reid, Biometrics for Network Security, Pearson Education; 2004
3. ReidM. Bolle et al, Guide to Biometrics, Springer, USA; 2004
4. David D Zhang, Automated Biometrics: Technologies and Systems, Kluwer Academic Publishers; 2000.