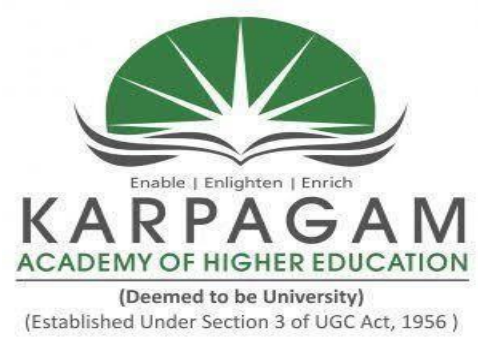
B.E. COMPUTER SCIENCE AND ENGINEERING

SYLLABI 2024-2025

(CHOICE BASED CREDIT SYSTEM)

Department of Computer Science and Engineering

FACULTY OF ENGINEERING



KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)

(Established Under Section 3 of UGC Act 1956)

(Accredited with A+ Grade by NAAC in the Second Cycle)

Pollachi Main Road, Eachanari Post

Coimbatore-641 021

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University Established under Section 3 of UGC Act 1956)

Eachanari, Coimbatore-641 021. INDIA

FACULTY OF ENGINEERING

DEGREE OF BACHELOR OF ENGINEERING / TECHNOLOGY

REGULAR PROGRAMME

REGULATIONS 2024

CHOICE BASED CREDIT SYSTEM

These regulations are effective from the academic year 2024 – 2025 and applicable to the candidates admitted to B. E. / B. Tech programmes. during 2024 - 2025 and onwards.

1. ADMISSION

1.1 Candidates seeking admission to the first semester of the eight semesters B. E./B.Tech Degree Programme:

Should have passed the Higher Secondary Examination (10+2) prescribed by the State Government / Central Government with Mathematics/ Physics/ Chemistry/ Computer Science/ Electronics/ Information Technology/ Biology/ Informatics Practices/ Biotechnology/ Technical Vocational subject/ Agriculture/ Engineering Graphics/ Business Studies/ Entrepreneurship. (Any of the above three subjects) or any similar Examination of any other institution/ University or authority accepted by the Karpagam Academy of Higher Education as equivalent thereto).

Should have obtained at least 45% marks (40% marks in case of candidates belonging to reserved category) in the above subjects taken together. **(OR)**

Passed min. 3 years Diploma examination with at least 45% marks (40% marks in case of candidates belonging to reserved category) subject to vacancies in the First Year, in case the vacancies at lateral entry are exhausted. (The University will offer suitable bridge courses such as Mathematics, Physics, Engineering drawing, etc., for the students coming from diverse backgrounds to achieve desired learning outcomes of the programme)

1.2 Lateral Entry Admission

Candidates who possess Diploma in Engineering / Technology (10+3 or 10+2+2) awarded by the Directorate of Technical Education with passed minimum THREE years / TWO years (Lateral Entry) Diploma examination with at least 45% marks (40% marks in case of candidates belonging to reserved category) in ANY branch of Engineering and Technology are eligible to apply for admission to the third semester of B. E./B. Tech.

OR

Passed B.Sc. Degree from a recognized University as defined by UGC, with at least 45% marks (40% marks in case of candidates belonging to reserved category) and passed 10+2 examination with Mathematics as a subject.

OR

Passed D.Voc. Stream in the same or allied sector.
(The University will offer suitable bridge courses such as Mathematics, Physics, Engineering

drawing, etc., for the students coming from diverse backgrounds to achieve desired learning outcomes of the programme)

Eligibility criteria for admission in the third semester is given in the table below.

S. No.	Programme	Eligibility criteria
1.	B.E Bio Medical Engineering	Passed Minimum THREE years / TWO years (Lateral Entry) Diploma examination with at least 45% marks (40% marks in case of candidates belonging to reserved category) in ANY branch of Engineering and Technology. **OR** Passed B.Sc. Degree from a recognized University as defined by UGC, with at least 45% marks (40% marks in case of candidates belonging to reserved category) and passed 10+2 examination with Mathematics as a subject. **OR** Passed D.Voc. Stream in the same or allied sector. (The Universities will offer suitable bridge courses such as Mathematics, Physics, Engineering drawing, etc., for the students coming from diverse backgrounds to achieve desired learning outcomes of the programme)
2	B. E. Civil Engineering	
3.	B. E. Computer Science and Engineering	
4.	B. E. Computer Science and Engineering (Cyber security)	
5.	B. E. Electrical and Electronics Engineering	
6.	B. E. Electronics and Communications Engineering	
7.	B. E. Mechanical Engineering	
8.	B. Tech. Artificial Intelligence and Data Science	
9.	B. Tech Bio - Technology	
10.	B. Tech Food Technology	

1.3 Migration from other University

Candidates who are willing to migrate to Karpagam Academy of Higher Education for admission to their next semester of B. E./B. Tech programme may get admitted from 2nd semester onwards upto 7th semester. The student will be exempted from appearing for Examination of the equivalent courses passed in the earlier programme and will have to appear for courses which he/she has not done during the period of his/her earlier programme. Along with the request letter and mark sheets, he/she has to submit a copy of syllabus of the programme duly attested by the Competent authority, he/she has undergone. Equivalence Certificate shall be provided by the respective Head of the Department of Karpagam Academy of Higher Education.

2 . PROGRAMMES OFFERED

A candidate may undergo a programme in any one of the branches of study approved by the University as given below.

List of B. E. and B. Tech. Degree Programmes

1. B.E Bio Medical Engineering
2. B. E. Civil Engineering
3. B. E. Computer Science and Engineering
4. B. E. Computer Science and Engineering (Cyber Security)
5. B. E. Electrical and Electronics Engineering
6. B. E. Electronics and Communications Engineering
7. B. E. Mechanical Engineering
8. B.Tech. Artificial Intelligence and Data Science
9. B. Tech. Bio-Technology
10. B. Tech Food Technology

3. MODE OF STUDY

3.1 Full-Time:

In this mode of study, the candidates are required to attend classes regularly on the specified working days of the University.

3.2 Change from one programme to another is not permitted.

4. STRUCTURE OF PROGRAMMES

4.1 Every programme will have a curriculum with syllabus consisting of theory and practical courses such as:

(i) General core courses comprising Mathematics, Basic Sciences, Engineering Sciences and Humanities.

(ii) Core courses of Engineering/Technology.

(iii) Elective courses for specialization in related fields.

(iv) Workshop practice, computer practice, engineering graphics, laboratory work, internship, seminar presentation, project work, industrial visits, camps, etc.

Every student is encouraged to participate in at least any one of the following programmes

- NSS / Sports/Physical exercise/NCC/YRC.
- Other Co-Curricular and Extra Curricular activities

(V) **Choice Based Credit System**

CBCS is introduced for students admitted in the academic year 2017-18. As per AICTE guidelines, CBCS is an approach in which students opt for courses of their choice. CBCS provides greater flexibility with multiple courses and enable students to undergo additional courses. CBCS is applicable to Full Time Undergraduate & Post Graduate Programmes of study. It provides a choice for students to select from the prescribed courses (Professional core, Professional Electives, Open Electives, Value added courses, Humanity Sciences, Basic sciences & Engineering sciences). A course designated as hard core for a particular programme of study must invariably be completed by the student to receive the degree in the programme. The Hardcore courses cannot be substituted by another courses. Students can exercise their choice among a set of soft-core courses from the list of Soft core courses specified for each Programme of study. The student should meet the criteria for prerequisites to become eligible to register for that course. The student should request for the course for every semester within the first week of semester. Maximum no of students to be registered in each course shall depend on availability of physical facilities, classroom availability and lab capacity. Registration of already requested courses by students in previous semester is not allowed.

4.2 Each course is normally assigned certain number of credits.

No. of credits per lecture period per week	1
No. of credits per tutorial period per week	1
No. of credits for 3 periods of laboratory course per week	2
No. of credits for 3 periods of project work per week	2
No. of credits for 2 weeks of field project/internship training during semester vacations	1

4.3 In every semester, the curriculum shall normally have a blend of theory courses not exceeding 6 and practical courses not exceeding 4.

4.4 The prescribed credits required for the award of the degree shall be within the limits specified below.

PROGRAMME	PRESCRIBED CREDIT RANGE
B. E./B. Tech.	160– 165

4.5 The medium of instruction for all Courses, Examinations, Seminar presentations and Project/Thesis reports is English except Tamil/French.

4.6 Value Added Course

Besides core courses and elective courses, value added course is introduced. The blend of different courses is so designed that the interested students would be trained, for the holistic development to enhance employment opportunity.

4.7 Evaluation of the courses comprises of two parts, one is the Continuous Internal Assessment (CIA) and the other one is the End Semester Examination (ESE). Evaluation in a mandatory course may be by Internal Assessment only.

5. DURATION OF THE PROGRAMME

5.1 The prescribed duration of the programme shall be

Programme	Min. No. of semesters	Max. No. of semesters
B. E./B. Tech. (HSC Candidates)	8	14
B. E./B. Tech. (Lateral Entry Candidates)	6	12

5.2 Each semester shall normally consist of 90 working days or 540 hours.

5.3 Additional classes for improvement, conduct of model test, etc., over and above the specified periods shall be arranged, if required. But for the purpose of calculation of attendance requirement for eligibility to appear for the end semester Examinations (as per Clause 11) by the students, 540 hours conducted within the specified academic schedule alone shall be taken into account and the overall percentage of attendance shall be calculated accordingly.

6. REQUIREMENTS FOR COMPLETION OF THE SEMESTER

6.1 Ideally every student is expected to attend all classes and secure 100% attendance. However, in order to allow for certain unavoidable circumstances, the student is expected to attend at least 75% of the classes and the conduct of the candidate has been satisfactory during the course.

6.2 A candidate who has secured attendance between 65% and 74% (both included), due to medical reasons (Hospitalization / Accident / Specific Illness) shall be given exemption from prescribed minimum attendance requirements and shall be permitted to appear for the Examination on the recommendation of the Head of the Department concerned and Dean to condone the lack of attendance. The Head of the Department has to verify and certify the genuineness of the case before recommending to the Dean concerned. However, the candidate has to execute a one-time bond (Stamp paper) with an undertaking from the parent and the student that this situation never arises in the future.

6.3 Candidates who are not recommended for condonation and those who have less than 65% attendance will not be permitted to proceed to the next semester and have to redo the course. However, they are permitted to write the arrear Examinations, if any.

7. CLASS ADVISOR

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a teacher of the Department who shall function as Class Advisor for those students throughout their period of study. Such Class Advisors shall advise the students and monitor the courses undergone by the students, check the attendance and progress of the students and counsel them periodically. If necessary, the Class Advisor may display the cumulative attendance particulars in the Department notice board and also discuss with or inform the Parents/Guardian about the progress of the students. Each student shall be provided with course plan for each course at the beginning of each semester.

8. CLASS COMMITTEE

8.1. Every class shall have a class committee consisting of teachers of the class concerned, Maximum of six student representatives [boys and girls] and the concerned Head of the Department. It is like the 'Quality Circle' with the overall goal of improving the teaching-learning process. The functions of the class committee include

- Clarifying the regulations of the degree programme and the details of rules therein particularly Clause 4 and 5 which should be displayed on Department Notice-Board.
- Informing the student representatives, the details of Regulations regarding weightage used for each assessment. In the case of practical courses (laboratory / drawing / project work / seminar, etc.) the breakup of marks for each experiment / exercise /module of work, should be clearly discussed in the class committee meeting and informed to the students.
- Solving problems experienced by students in the class room and in the laboratories.
- Informing the student representatives, the academic schedule, including the dates of assessments and the syllabus coverage for each assessment.
- Analyzing the performance of the students of the class after each test and finding the ways and means of solving problems, if any.
- Identifying the weak students, if any and requesting the teachers concerned to provide some additional academic support.

8.2 The class committee for a class under a particular branch is normally constituted by the Head of the Department. However, if the students of different branches are mixed in a class (like the first semester which is generally common to all branches), the class committee is to be constituted by the Dean.

8.3 The class committee shall be constituted within the first week of each semester.

8.4 The Chairperson of the Class Committee may convene the meeting of the class committee.

8.5 The Dean may participate in any Class Committee of the Faculty.

8.6 The Chairperson is required to prepare the minutes of every meeting, submit the same to Dean through the HOD within two days of the meeting and arrange to circulate it among the students and teachers concerned. If there are some points in the minutes requiring action by the

Management, the same shall be brought to the notice of the Registrar by the HOD through Dean.

8.7 The first meeting of the Class Committee shall be held within one week from the date of commencement of the semester, in order to inform the students about the nature and weightage of assessments within the framework of the regulations. Two subsequent meetings may be held in a semester at suitable intervals. During these meetings the student members representing the entire class, shall meaningfully interact and express their opinions and suggestions of the other students of the class in order to improve the effectiveness of the teaching-learning process.

9. COURSE COMMITTEE FOR COMMON COURSES

Each common theory course offered to more than one discipline or group, shall have a "Course Committee" comprising all the teachers handling the common course with one of the nominated as Course Coordinator. The nomination of the Course Coordinator shall be made by the Dean depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The 'Course Committee' shall meet to arrive at a common scheme of evaluation for the test and shall ensure a uniform evaluation of the tests. Where ever feasible, the Course Committee may also prepare a common question paper for the Internal Assessment test(s).

10. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

10.1 Every teacher is required to maintain an 'ATTENDANCE AND ASSESSMENT RECORD'(Log book) which consists of attendance marked in each theory or practical or project work class, the test marks and the record of class work (topic covered), separately for each course.

10.2 Continuous Internal Assessment (CIA): The performance of students in each course will be continuously assessed by the respective teachers as per the guidelines given below:

a. **THEORY COURSES**

S. No.	CATEGORY	MAXIMUM MARKS
1.	Assignment	5
2.	Seminar *	5
3.	Attendance	5
4.	Test – I	12.5
5.	Test – II	12.5
Continuous Internal Assessment: TOTAL		40

*Evaluation shall be made by a committee.

PATTERN OF TEST QUESTION PAPER (Test I & II)

INSTRUCTION	REMARKS
Maximum Marks	100
Duration	3 Hours
Part – A	Question no. 1 to 10 Two Mark Questions, covering 2.5 units of the syllabus. **(10 x 2= 20 Marks)**
Part- B	Question 11 to 15 will be of either-or type, covering 2.5 units of the syllabus. Each Question may have subdivision. **(5 x 16=80 Marks).**

b. PRACTICAL COURSES:

S. No	CATEGORY	MAXIMUM MARKS
1.	Attendance	5
2.	Observation work	5
3.	Record work	5
4.	Internal Practical Assessment	15
5.	Viva – Voce [Comprehensive]	10
Continuous Internal Assessment: TOTAL		40

Every practical exercise / experiment shall be evaluated based on the conduct of exercise/ experiment and records maintained.

c. **INTEGRATED THEORY AND PRACTICAL COURSES**:

The Continuous Internal Assessment for Integrated Theory and Practical Course is awarded for 40 Marks with mark split up similar to regular theory course. But Assignment and Seminar components are replaced by Observation and Record marks.

S.No.	CATEGORY	MAXIMUM MARKS
1.	Observation	5
2.	Record	5
3.	Attendance	5
4.	Test –I	12.5
5.	Test –II	12.5
Continuous Internal Assessment: TOTAL		40

The external evaluation of integrated practical component from End semester Examination is conducted for 50 Marks and later scaled down to 15 Marks and similarly the external evaluation for integrated theory from End semester Examination is awarded for 100 Marks and later scaled down to 45 Marks. Hence the external assessment for integrated theory and practical components contribute to 60 Marks.

10.3 ATTENDANCE

Attendance carries a maximum of 5 marks and the distribution is as under:

S. No.	Attendance %	Marks
1	91 and above	5.0
2	81-90	4.0
3	76-80	3.0

10.4 PROJECT WORK/ INTERNSHIPS:

Final year project work will be normally in-house. However, as a special case, if a student is able toget a project from a government organization or private or public sector company, the student may be permitted to do his/her project work in that institution/research organization/industry.

11. REQUIREMENTS FOR APPEARING FOR END SEMESTER EXAMINATION (ESE)

A candidate shall normally be permitted to appear for the ESE of any semester commencing from I semester if he/she has satisfied the semester completion requirements (Subject to Clause 5) and has registered for Examination in all courses of the semester. Registration is mandatory for Semester Examinations as well as arrear Examinations failing which the candidate will not be permitted to attend the next semester. A candidate already appeared for a course in a semester and passed the Examination is not entitled to reappear in the same course of the semester for improvement of grade.

12. END SEMESTER EXAMINATION

ESE will be held at the end of each semester for each course, for 100 marks, later scaled down to 60 marks.

PATTERN OF ESE QUESTION PAPER:

INSTRUCTION	REMARKS
Maximum Marks	100
Duration	3 Hours
Part – A	Question no. 1 to 10 Two Mark Questions, covering all the 5 units. **(10 x 2= 20 Marks)**
Part- B	Question 11 to 15 will be of either or type, covering Five units of the syllabus. Each Question may have subdivision. **(5 x 16=80 Marks).**

13. PASSING REQUIREMENTS

13.1 Minimum marks to pass: The minimum marks to pass for CIA is 20 (i.e. out of 40 marks). The minimum marks to pass for ESE is 30 (i.e. out of 60 marks). The overall minimum marks to pass for theory/laboratory course is 50 (Sum of his/her score in CIA and ESE) out of 100 marks.

13.1.1 The minimum marks to pass for Value Added Course /Skill Development is 50 marks out of 100marks. There will be two tests, the first covering 50% of syllabus for 50 marks and the other for 50 marks.

13.2 If the candidate fails to secure a pass in ESE of a particular course, it is mandatory that candidate shall register and reappear for the Examination in that course during the subsequent semester when Examination is conducted in that course. Further the candidate should continue to register and reappear for the Examination till a pass is secured in such supplementary Examination within the stipulated maximum duration of the programme (Clause 5.1).

The CIA marks obtained by the candidate in his/her first or subsequent appearance were nhe/she secures a pass shall be retained by the office of the Controller of Examinations and considered valid for all remaining attempts till the candidate secures a pass in his/her ESE.

13.3 If the candidate fails to secure a pass in CIA of a particular course, it is mandatory that candidate shall register and reappear for the CIA in that course during the subsequent semester when CIA is conducted in that course by the faculty member assigned for that particular course during that semester by the concerned HOD. Further, the candidate should continue to register and reappear for the CIA till a pass is secured in such subsequent Examination within the stipulated maximum duration of the programme (Clause 5.1).

13.3.1 If a candidate fails to secure a pass in Value Added Course /Skill Development course, he/she has to appear for the tests when course is conducted subsequently.

13.4 CREDIT TRANSFER THROUGH MOOC

The MOOC coordinator shall assist the students for the online courses offered by the SWAYAM platform periodically and also monitor their course.

Open Elective Courses shall be considered for the credit transfer. Only courses available in SWAYAM platform (which are totally beyond the scope of the programme under consideration) shall

be considered as open elective courses and get completed at any time within the duration of the Programme before the last semester. This is a mandatory requirement for completion of the programme. At least 2 Open Electives (3 credits each) to be completed for the credit transfer.

14. AWARD OF LETTER GRADES

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

Letter grade	Marks Range	Grade Point	Description
O	91 - 100	10	OUTSTANDING
A+	81- 90	9	EXCELLENT
A	71-80	8	VERY GOOD
B+	66- 70	7	GOOD
B	61 – 65	6	ABOVE AVERAGE
C	55 - 60	5	AVERAGE
D	50 - 54	4	PASS
RA	<50	-	REAPPEARANCE
AAA		0	ABSENT

14.2 GRADE SHEET

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

i. The list of courses enrolled during the semester and the grade scored,

ii. The Grade Point Average (**GPA**) for the semester and

iii. The Cumulative Grade Point Average (**CGPA**) of all courses enrolled from first semester onwards.

GPA is the ratio of the sum of the products of the number of Credits (**C**) of courses enrolled and the Grade Points (**GP**) corresponding to the grades scored in those courses, taken for all the courses to the sum of the number of credits of all the courses in the semester.

$$GPA = \frac{\text{Sum of } [C * GP]}{sum\ of\ c}$$

CGPA will be calculated in a similar manner, considering all the courses enrolled from First semester. **RA** grade and value added course will be excluded for calculating **GPA** and **CGPA**.

14.3 REVALUATION

Revaluation and Re-totaling are allowed on representation. A candidate can apply for revaluation of his/her semester Examination answer paper in a theory course, within 2 weeks from

the declaration of results, on payment of a prescribed fee through proper application to the Controller of Examinations through the Head of the Department and Dean. A candidate can apply for revaluation of answer scripts for not exceeding 5 subjects at a time. The Controller of Examinations will arrange for the revaluation and the results will be intimated to the candidate through the Head of the Department and Dean. Revaluation is not permitted for Supplementary Examinations, Practical Examinations, Technical Seminars, In-plant Training and Project Work.

14.4 TRANSPARENCY AND GRIEVANCE COMMITTEE

A student may get the Photostat copy of the answer script on payment of prescribed fee, if he/she wishes. The students can represent the grievance, if any, to the Grievance Committee, which consists of Dean of the Faculty, (if Dean is HoD, the Dean of another Faculty nominated by the University), HoD of the Department concerned, the faculty of the course and Dean from other discipline nominated by the University and the CoE. If the Committee feels that the grievance is genuine, the script may be sent for external valuation; the marks awarded by the External Examiner will be final. The student has to pay prescribed fee for the same.

15. ELIGIBILITY FOR AWARD OF DEGREE

A student shall be declared to be eligible for award of Degree if he/she has

- Successfully gained the required number of total credits as specified in the curriculum corresponding to his/her programme within the stipulated time.

The award of the degree must be approved by the Board of Management of Karpagam Academy of Higher Education.

16. CLASSIFICATION OF THE DEGREE AWARDED

16.1 A candidate who qualifies for the award of the Degree (vide Clause 15) having passed the Examination in all the courses in his/her first appearance within the specified minimum number of semesters (vide Clause 5.1) securing a CGPA of not less than **7.5** shall be declared to have passed the Examination in First Class with Distinction.

16.2 A regular candidate or a lateral entrant is eligible to register for B. E (Honors), B.Tech.(Honors). If, he / she has passed all the courses in the first appearance and holds / maintains a CGPA of 7.5 up to VIII Semester, he / she has to take an additional 20 credits by studying online courses through Swayam/NPTEL. Such a candidate is eligible for the award of B.E (Honors), B.Tech.(Honors). However, if he / she fails in securing 20 additional credits but maintains CGPA of 8 and above is not eligible for Honors degree but eligible for First class with Distinction.

16.3 A candidate who qualifies for the award of the Degree (vide Clause 15) having passed the Examination in all the courses within the specified minimum number of semesters (vide Clause 5.1) plus one year (two semesters), securing CGPA of not less than **6.5** shall be declared to have passed the Examination in First Class.

16.3 All other candidates (not covered in Clauses 17.1 and 17.2) who qualify for the award of the degree (vide Clause 15) shall be declared to have passed the Examination in Second Class.

17. SUPPLEMENTARY ESE: After the publication of VIII semester results, if a student has **ONE** arrear in any theory course of the entire programme, he/she will be permitted to apply within 15 days of the publication of results, and appear for supplementary Examination.

18. DISCIPLINE

Every student is required to observe discipline and decorous behavior both inside and outside the University and not to indulge in any activity which will tend to bring down the prestige of the University. The erring student will be referred to the Disciplinary Committee constituted by the University, to enquire in to acts of indiscipline and recommend to the University about the disciplinary action to be taken.

If a student indulges in malpractice in any of the ESE/CIA he/she shall be liable for punitiveaction as prescribed by the University from time to time.

19. ADVANCED LEARNERS, ON-DEMAND EXAMINATION

Students
1. Who secure 7.5 CGPA and maintain an attendance of 75% in every semester
2. Clear all the courses in their first appearance itself are referred to as advanced learners. When a student fails to maintain any of the above conditions at any given time, he cannot be an advanced learner further.

When a student fails to maintain any of the above conditions at any given time, he cannot be an advanced learner further. These students can request for an on-demand examination for the courses in their forthcoming semester(s). These students on prior permission can appear for such examinations well in advance and complete the entire courses well before the prescribed period of study and can progress for a full time Research Project/Internship/Minor Project during the remaining prescribed period of study. The Internal and External examinations will be conducted for these courses as like the other courses. One or more faculty mentors will be allocated based on the number of students/courses enrolled for the on-demand examination.

Also, these advanced learners can also register for online courses from NPTEL/SWAYAM/SWAYAM Plus portals on prior and proper approval from the department. The credits earned from those courses will be transferred to the mark statement of the students.

20. REVISION OF REGULATION AND CURRICULUM

The University may from time-to-time revise, amend or change the Regulations, Scheme of Examinations and syllabi, if found necessary on the recommendations of Board of Studies, Academic Council and Board of Management of Karpagam Academy of Higher Education.

21. CREDIT TRANSFER THROUGH ONLINE / INTERNATIONAL STUDIES

Students are encouraged to enroll in courses offered by MOOC platforms and international institutions of higher learning, either virtually or in person. The equivalent credits for these courses will be determined by a committee named Subject Equivalency Committee comprising the Dean, Head of Department (HoD), and one faculty member nominated by the Vice Chancellor. The committee's decision will be submitted for ratification/approval by the Board of Studies (BoS) and the Academic Council. Additionally, the equivalent grade points for marks/grades/grade points awarded by various

MOOC platforms and international institutions of higher learning will be determined by a committee named Grade Equivalency Committee duly constituted by the Vice-Chancellor. The decisions of this committee will also be submitted for ratification/approval by the Academic Council. This shall be approved to be implemented from the even semester of the academic year 2024-25.

22.KARPAGAM INNOVATION AND INCUBATION COUNCIL (KIIC)
(A Section 8 Company)

Based on the 2019 National Innovation and Startup Policy and the 2019–2023 Tamil Nadu Startup Policy, KIIC has recommended to the KAHE students who are affiliated with the KIIC that it be incorporated in the university Program Regulations 2023-24 and implement from this academic year.

21.1 Norms to Student Start-Ups

a) Any (UG/PG /(Ph.D.) Research scholars, student, right from the first year of their programme is allowed to set a startup (or) work part time/ full time in a startup or work as intern in a startup

b) Any (UG/PG / (Ph.D.) Research scholars) student right from the first year of their programme is allowed to earn credit for working on Innovative prototypes/business Models/ Pre incubation (case to case basis). Start Up activities will be evaluated based on the guidelines being given by the expert committee of the KIIC

c) Student Entrepreneurs may use the address of incubation center (KIIC) to register their venture while studying in KAHE.

d) Students engaged in startups affiliated with the KIIC or those who work for them may be exempted from KAHE's attendance requirements for academic courses under current regulations, up to a maximum of 30% attendance per semester, including claims for ODs and medical emergencies Potential Students who have been incubated at KIIC may be permitted to take their University semester exams even if their attendance is below the minimum acceptable percentage, with the proper authorization from the head of the institution.

(On case-to-case basis depends upon the applicability strength, societal benefits and quality of the Innovation and Subsequent engagement of the students with the/ her business)

e) Any Students Innovators/entrepreneurs are allowed to opt their startup in place mini project/major project, /seminar and summer training etc. (In plant training, Internship, value added Course.). The area in which the student wishes to launch a Startup may be interdisciplinary or multidisciplinary.

f) Student’s startups are to be evaluated by Expert committee, formed by KIIC and KAHE.

21.2 Guide lines to award Credits/ Marks to a Student startup

Student's startup stages are divided into five phases and these startup phases can be considered equally in place of the course title as mentioned below with the same credits allotted to the course title in a university curriculum.

Sl. No.	Description/Startup phases	In place of the Subject / Course title	Grades/Credits /Marks
1	Idea stage/Problem Identification	Seminar	Same Marks/Credits can be awarded that are listed in the course title's curriculum for the respective startup phases.
2	Proof of Concept (POC) /Solution development	In-plant training /Internship	
3	Product Development (Lab scale) /Prototype Model/ Company Registered	Mini Project/ Value added Course	
4	Validation/Testing	Main Project phase I	
5	Business Model/Ready for Commercialization/Implementation	Main Project phase II	

List of PEOs, POs and PSOs

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I. To equip well in their professional career by acquiring enough knowledge in the field of Computer Science and Engineering.

II. To establish themselves as an entrepreneur, employable in industries/public sector/research organizations and pursue higher education.

III. To exhibit communication skills, follow professional ethics and collaborate effectively on teams within global, environmental, societal context.

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis**: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/ Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct Investigations of Complex Problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long Learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECFIC OUTCOMES (PSOs):

1. Develop and analyze algorithms in the computational thrust areas to deliver effective solutions for the challenges of society and industry.
2. Deploy computing tools and immersive technology in the field of computer vision, cloud computing, Internet of Things, gaming and animation for successful career, research, entrepreneurship and higher studies.

MAPPING:

PEO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
PEO I	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓
PEO II	✓	✓	✓	✓	✓			✓	✓	✓			✓	✓
PEO III	✓	✓	✓		✓	✓	✓	✓		✓	✓		✓	✓

Credit Distribution:

S. No.	Course Category	Credit Distribution	Percentage
1	Basic Science (BS)	24	14.8
2	Engineering Science (ES)	19	11.7
3	Humanities and Science (HS)	14	8.5
4	Professional Core (PC)	59	36.2
5	Professional Elective (PE)	18	11.0
6	Open Elective (OE)	6	3.7
7	Mandatory Course (MC)	3	1.9
8	Project Work (PW)	18	11.0
9	Skill Development (SD)	2	1.2
	Total	163	100

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
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Course Code	Name of the course	Category	Outcomes		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
SEMESTER I												
24BECC101	Technical English I	HS	5,8,9,10,12	1	3	0	0	3	40	60	100	1
24BECC102	Matrices and Calculus	BS	1,2,3,12	1	3	1	0	4	40	60	100	4
24BECC141	Environmental Chemistry	BS	1,2,3,4,6,7,8,9,12	1	3	0	2	4	40	60	100	6
24BECS142	Digital Logic and Circuits	ES	1,2,3,8,9,10,11,12	1	3	0	2	4	40	60	100	9
24BECC143	Programming in C	ES	1,2,3,9,10,12	1	3	0	2	4	40	60	100	11
24BECC111	Communication Skills Laboratory	HS	5,8,9,10,12	-	0	0	2	1	40	60	100	14
24BEMC151	Women Safety and Security*	MC		-	1	0	0	0	100	-	100	210
24BEMC152	தமிழர் மரபும் பண்பாடும் *	MC		-	1	0	0	0	100	-	100	212
SEMESTER TOTAL					**17**	**1**	**8**	**20**	**440**	**360**	**800**	

Course Code	Name of the course	Category	Outcomes		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
SEMESTER II												
24BECC201	Technical English II	HS	5,8,9,10,12	1	3	0	0	3	40	60	100	16
24BECC202A/ 24BECC202B/ 24BECC202C	Graph Theory / Computational Methods for Engineers/ Transforms and its Applications	BS	1,2,3,12	2/1/1	3	1	0	4	40	60	100	18/ 20/ 22
24BECS241	Physics for Computing Engineers	BS	1,2,3,6,9,10,12	2	3	0	2	4	40	60	100	24
24BECS242	Web Technology	ES	1,2,3,5,9,10,12	2	3	0	2	4	40	60	100	27
24BECS243A/ 24BECS243B	Data Structures and Algorithms / Python Programming	PC	1,2,3,9,10,12	1/2	3	0	2	4	40	60	100	30/ 32
24BEMC251	Yoga*	MC		-	0	0	4	2	100	-	100	214
24BECS291	Application Development I*	PW	1,2,3,4,5,6,7,8,9, 10,11,12	1,2	0	0	2	1	100	-	100	224
SEMESTER TOTAL					**15**	**1**	**12**	**22**	**400**	**300**	**700**	

Course Code	Name of the course	Category	Outcomes		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
SEMESTER III												
24BECC301A/ 24BECC301B	Discrete Mathematics and Stochastic Process / Numerical Methods	BS	1,2,12 / 1,2,3,12	1,2	3	1	0	4	40	60	100	35/ 38
24BECS302	Computer Architecture	ES	1,2,3,9,10,12	1	3	0	0	3	40	60	100	40
24BECS341	Database Management Systems	PC	1,2,3,9,10,11,12	2	3	0	2	4	40	60	100	42
24BECS342	Java Programming	ES	1,2,3,9,10,12	2	3	0	2	4	40	60	100	45
24BECS343A/ 24BECS343B	Data Structures and Algorithms / Design and Analysis of Algorithms	PC	1,2,3,4,9,10,12	1	3	0	2	4	40	60	100	48/ 51
24BECS344	Operating Systems	PC	1,2,3,4,9,10,12	2	3	0	2	4	40	60	100	54
24BECS311	Skill Development I*	SD	1,2,3,4,5,6,7,8,9, 10,11,12	1,2	0	0	2	1	100	-	100	233
24BEMC351	Aptitude and Reasoning*	MC	8,9,10,12	-	1	0	0	0	100	-	100	216
24BECS391	Application Development II *	PW	1,2,3,4,5,6,7,8,9, 10,11,12	1,2	0	0	2	1	100	-	100	225
24BECS392	Internship I*	PW	1,2,3,4,5,6,7,8,9, 10,11,12	1,2	0	0	2	1	100	-	100	226
SEMESTER TOTAL					**19**	**1**	**14**	**26**	**640**	**360**	**1000**	

Course Code	Name of the course	Category	Outcomes		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
SEMESTER IV												
24BECC401A/ 24BECC401B	Probability and Statistics / Statistics and Optimization Techniques	BS	1,2,3,12	1,2	3	1	0	4	40	60	100	57/ 59
24BECS441	Computer Networks	PC	1,2,3,9,10,12	2	3	0	2	4	40	60	100	61
24BECS442	Artificial Intelligence	PC	1,2,3,4,9,10,12	1	3	0	2	4	40	60	100	64
24BECS443A/ 24BECS443B	Advanced Algorithms / Design and Analysis of Algorithms	PC	1,2,3,4,9,10,12	1	3	0	2	4	40	60	100	67/ 70
24BECS444A/ 24BECS444B	Web Application Development / Low Code Application Development	PC	1,2,3,5,9,10,11, 12	2	3	0	2	4	40	60	100	73/ 76
24BECS4E4X	Professional Elective I	PE			2	0	2	3	40	60	100	108-123
24BECS411	Skill Development II*	SD	1,2,3,4,5,6,7,8,9, 10,11,12	1,2	0	0	2	1	100	-	100	234
24BEMC451	Foundation of Entrepreneurship *	MC			1	0	0	0	100	-	100	218

24BEMC452	Essence of Traditional Indian Knowledge and Heritage *	MC			1	0	0	0	100	-	100	220
24BECS491	Application Development III *	PW	1,2,3,4,5,6,7,8,9, 10,11,12	1,2	0	0	2	1	100	-	100	227
SEMESTER TOTAL					**19**	**1**	**14**	**25**	**640**	**360**	**1000**	

Course Code	**Name of the course**	**Category**	**Outcomes**		**Instruction hours/week**			**Credits**	**Maximum Marks**			**Page No**
			PO	**PSO**	**L**	**T**	**P**		**CIA**	**ESE**	**Total**	
									40	**60**	**100**	
SEMESTER V												
24BECS501	Theory of Computation	PC	1,2,3,4,9,10,12	1	3	0	0	3	40	60	100	79
24BECS502	Cloud Computing	PC	1,2,3,9,10,12	2	3	0	2	4	40	60	100	81
24BECS541	Machine Learning	PC	1,2,3,4,5,9,10,12	2	3	0	2	4	40	60	100	84
24BECS5E4X	Professional Elective II	PE			2	0	2	3	40	60	100	126-140
24BECS5E4X	Professional Elective III	PE			2	0	2	3	40	60	100	143-157
24BECS5E4X	Professional Elective IV	PE			2	0	2	3	40	60	100	160-173
24BECS511	Open Source Software Laboratory	PC	1,2,3,4,9,10,12	2	0	0	4	2	40	60	100	87
24BECS512	Community Engagement and Social Responsibility *	HS	6,8,12	-	0	0	4	2	100	-	100	90
24BEMC551	Design Thinking *	MC	1,2,3,4,6,7,8,9,10 ,12	2	1	0	0	1	100	-	100	221
24BECS591	Internship II *	PW	1,2,3,4,5,6,7,8,9, 10,11,12	1,2	0	0	2	1	100	-	100	228
SEMESTER TOTAL					**16**	**0**	**20**	**26**	**580**	**420**	**1000**	

Course Code	**Name of the course**	**Category**	**Outcomes**		**Instruction hours/week**			**Credits**	**Maximum Marks**			**Page No**
			PO	**PSO**	**L**	**T**	**P**		**CIA**	**ESE**	**Total**	
									40	**60**	**100**	
SEMESTER VI												
24BECC601	Universal Human Values	HS	6,8,9,12	2	2	0	0	2	40	60	100	92
24BECS602	Cryptography and Network Security	PC	1,2,3,4,9,10,12	1	3	1	0	4	40	60	100	95
24BECS603	Agile Software Development	PC	1,2,3,9,10,11,12	1	3	0	0	3	40	60	100	97
24BECS641	Compiler Design	PC	1,2,3,9,10,12	2	3	0	2	4	40	60	100	100
24BECS6E4X	Professional Elective V	PE			2	0	2	3	40	60	100	175-189
24BECS6E4X	Professional Elective VI	PE			2	0	2	3	40	60	100	191-206
24BECS691	Mini Project *	PW	1,2,3,4,5,6,7,8,9, 10,11,12	1,2	0	0	2	1	100	0	100	229
SEMESTER TOTAL					**15**	**1**	**8**	**20**	**340**	**360**	**700**	

Course Code	Name of the course	Category	Outcomes		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
SEMESTER VII												
24BECS701	Principles of Management and Engineering Ethics	HS	1,2,3,4,10,12	1,2	3	0	0	3	40	60	100	103
24BECS702	Multicore Architecture and Programming	PC	1,2,3,4,8,9,12	1	3	0	0	3	40	60	100	105
24BECS791	Project Work Phase I/ Field Project	PW	1,2,3,4,5,6,7,8,9, 10,11,12	1,2	0	0	8	4	40	60	100	230
SEMESTER TOTAL					**6**	**0**	**8**	**10**	**120**	**180**	**300**	

Course Code	Name of the course	Category	Outcomes		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
SEMESTER VIII												
24BECS891	Project Work and Viva Voce Phase II	PW	1,2,3,4,5,6,7,8,9, 10,11,12	1,2	0	0	16	8	80	120	200	231
24BEXXOEXX	Open Elective I	OE			3	0	0	3	40	60	100	-
24BEXXOEXX	Open Elective II	OE			3	0	0	3	40	60	100	-
SEMESTER TOTAL					**6**	**0**	**16**	**14**	**160**	**240**	**400**	
PROGRAM TOTAL					**113**	**5**	**100**	**163**	**3320**	**2580**	**5900**	

* 100% Internal exam only

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FACULTY OF ENGINEERING
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Course Code	Name of the course	Category	Outcomes		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
PROFESSIONAL ELECTIVE I												
24BECS4E41	Deep Learning	PE	1,2,3,9,10,12	2	2	0	2	3	40	60	100	108
24BECS4E42	Parallel and Distributed Computing	PE	1,2,3,9,10, 12	1	2	0	2	3	40	60	100	111
24BECS4E43	Ethical Hacking	PE	1,2,3,8,9,10,12	1	2	0	2	3	40	60	100	114
24BECS4E44	Devops	PE	1,2,3,5,9,10,11,12	2	2	0	2	3	40	60	100	117
24BECS4E45	Mern Stack Development	PE	1,2,3,9,10,11,12	2	2	0	2	3	40	60	100	120
24BECS4E46	Cryptocurrency and Blockchain Technologies	PE	1,2,3,4,9,10,12	1	2	0	2	3	40	60	100	123
PROFESSIONAL ELECTIVE II												
24BECS5E41	Cognitive Science	PE	1,2,3,4,9,10, 12	1	2	0	2	3	40	60	100	126
24BECS5E42	Internet of Things	PE	1,2,3,9,10, 12	2	2	0	2	3	40	60	100	129
24BECS5E43	Digital and Mobile Forensics	PE	1,2,3,4,9,10	2	2	0	2	3	40	60	100	132
24BECS5E44	Virtualization	PE	1,2,3,9,10,12	2	2	0	2	3	40	60	100	134
24BECS5E45	Mobile Application Development	PE	1,2,3,4,5,9,10	1	2	0	2	3	40	60	100	137
24BECS5E46	Digital Marketing	PE	1,2,3,9,10,12	2	2	0	2	3	40	60	100	140
PROFESSIONAL ELECTIVE III												
24BECS5E47	Big Data Analytics	PE	1,2,3,4,9,10	1	2	0	2	3	40	60	100	143
24BECS5E48	Edge Computing	PE	1,2,3,9,10, 12	1	2	0	2	3	40	60	100	146
24BECS5E49	Malware Analysis	PE	1,2,3,9,10,12	2	2	0	2	3	40	60	100	149
24BECS5E410	Cloud Services Management	PE	1,2,3,4,9,10,12	2	2	0	2	3	40	60	100	151
24BECS5E411	UI/UX Design	PE	1,2,3,5,9,10,12	2	2	0	2	3	40	60	100	154
24BECS5E412	Game Theory	PE	1,2,3,4,9,10,12	2	2	0	2	3	40	60	100	157

Course Code	Name of the course	Category	Outcomes		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
PROFESSIONAL ELECTIVE IV												
24BECS5E413	Business Analytics	PE	1,2,3,9,10, 12	1	2	0	2	3	40	60	100	160
24BECS5E414	Quantum Computing	PE	1,2,3,9,10, 12	2	2	0	2	3	40	60	100	163
24BECS5E415	Modern Cryptography	PE	1,2,3,4,9,10,12	2	2	0	2	3	40	60	100	166
24BECS5E416	Storage Technologies	PE	1,2,3,4,9,10,12	1	2	0	2	3	40	60	100	168
24BECS5E417	C# and .Net Programming	PE	1,2,3,9,10,12	2	2	0	2	3	40	60	100	171
24BECS5E418	3D Printing and Design	PE	1,2,3,4,9,10,12	2	2	0	2	3	40	60	100	173
PROFESSIONAL ELECTIVE V												
24BECS6E41	Natural Language Processing	PE	1,2,3,9,10,12	1	2	0	2	3	40	60	100	175
24BECS6E42	Human Computer Interaction	PE	1,2,3,9,10, 12	2	2	0	2	3	40	60	100	178
24BECS6E43	Social Network Security	PE	1,2,3,4,9,10,12	2	2	0	2	3	40	60	100	181
24BECS6E44	Software Defined Networks	PE	1,2,3,4,9,10,12	1	2	0	2	3	40	60	100	183
24BECS6E45	Software Testing And Automation	PE	1,2,3,9,10,12	2	2	0	2	3	40	60	100	186
24BECS6E46	Robotic Process Automation	PE	1,2,3,4,5,9,10	1	2	0	2	3	40	60	100	189
PROFESSIONAL ELECTIVE VI												
24BECS6E47	Computer Vision	PE	1,2,3,9,10,12	2	2	0	2	3	40	60	100	191
24BECS6E48	Augmented Reality and Virtual Reality	PE	1,2,3,9,10, 12	2	2	0	2	3	40	60	100	194
24BECS6E49	Engineering Secure Software Systems	PE	1,2,3,9,10,12	1	2	0	2	3	40	60	100	197
24BECS6E410	Security and Privacy in Cloud	PE	1,2,3,9,10,12	2	2	0	2	3	40	60	100	200
24BECS6E411	Web Application Security	PE	1,2,3,9,10,12	2	2	0	2	3	40	60	100	203
24BECS6E412	Generative AI	PE	1,2,3,4,5,9,10	1	2	0	2	3	40	60	100	206

SEMESTER-I

24BECC101 TECHNICAL ENGLISH I 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PRE-REQUISITES: English at 10+2 or equivalent level

COURSE OBJECTIVES

The goal of this course is for students to:

- Acquire the fundamental reading and writing skills, proper grammar usage, listening, and speaking
- Understand and improve skills in listening and speaking, in expressing oneself formally in writing, and in deducing meaning from what one reads
- Apply one's receptive (reading and listening) and productive (writing and speaking) language skills

COURSE OUTCOMES:

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

• Replicate grammar usage in reading, speaking, and writing skills.	P2
• Describe precise transitions while reading, writing, and speaking to enhance communication coherence and clarity.	A2
• Report the interpretation of linguistic parameters in day-to-day reading, listening, and speaking interactions.	A2
• Point out errors to restructure paragraphs, compose, compile, and synthesize documents for presentations.	P2
• Demonstrate proficiency in reading, writing, and critical listening and the ability to interpret and articulate complex ideas persuasively in written and oral forms.	A3

UNIT I **9**

Grammar **:** Parts of Speech – Gerunds and infinitives – Sentence Pattern

Reading **:** Reading comprehension: (vocabulary, referents, and inferences/conclusions)

Writing **:** Business letter – e-mail Writing

Listening **:** Listening to different short recordings – Listen to a longer recording

Speaking **:** Introduction to Phonetics, Diphthongs

UNIT II **9**

Grammar **:** Tenses: Simple Tenses – Concord – Types of Sentences

Reading **:** Identifying main and secondary information

Writing **:** Check lists – Building Itineraries

Listening **:** Listening Comprehension – Job Description

Speaking **:** Pronunciation – Describing people, places, jobs and things – Asking and answering questions

UNIT III **9**

Grammar **:** Tenses: Progressive Tenses – Direct and Indirect speech – Concord
Reading **:** Identifying, organizing, comparing and interpreting information
Writing **:** Writing Articles – Paragraph Writing
Listening **:** Telephonic conversation
Speaking **:** Stress, Intonation – Self Introduction

UNIT IV **9**

Grammar **:** Tenses: Perfect Tenses – Active and Passive voice
Reading **:** Reading Comprehension (Reconstruction, Rewording)
Writing **:** Memo – Notice – Agenda
Listening **:** Critical Listening
Speaking **:** Oral presentation

UNIT V **9**

Grammar **:** Tenses: Perfect Continuous Tenses – Reported Speech
Reading **:** Reading Comprehension (Cause and Effect identification)
Writing **:** Creative writing – Copy Writing
Listening **:** Listening and Interpretation of ideas
Speaking **:** Group Discussion

TOTAL: 45 Hours

TEXT BOOKS:

1. Richards J C, Hull J, et al., "Interchange 2 Student's Book", 5th Edition, Cambridge University Press, 2022.
2. Kumar Sanjay and Pushp Latha, "English Language and Communication Skills for Engineers", 1st Edition, Oxford University Press, 2018.

REFERENCE BOOKS:

1. Swan Michael and Walter Catherine, "Oxford English Grammar Course", 1st Edition, Oxford University Press, 2019.
2. Sudharshana N P and Savitha C, "English for Engineers", 1st Edition, Cambridge University Press, 2018.
3. Brook-Hart G, "Business Benchmark: Upper intermediate: Business Vantage: Student's Book", 2nd Edition, Cambridge University Press, 2021.

WEB SITES:

1. www.onestopenglish.com
2. www.britishcouncil.org
3. www.cambridgeenglish.org/learning-english/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	2	-	-	2	2	3	-	2	1	-
CO2	-	-	-	-	2	-	-	2	2	3	-	2	1	-
CO3	-	-	-	-	2	-	-	2	2	3	-	2	1	-
CO4	-	-	-	-	2	-	-	2	2	3	-	2	1	-
CO5	-	-	-	-	2	-	-	2	2	2	-	2	1	-
Average	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**2**	**2**	**2.8**	**-**	**2**	**1**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-I

24BECC102 MATRICES AND CALCULUS 4H-4C

Instruction Hours/week: L: 3 T: 1 P: 0 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PRE-REQUISITES: Nil

COURSE OBJECTIVES

The goal of this course is for students to:

- Provide sufficient knowledge in calculus and matrix algebra in the respective fields
- Find an extremum value for a function of several variables subject to a given constraint.
- Provide knowledge in evaluating double and triple integrals
- Apply mathematical tools to solve second and higher order ODE and PDE with constant coefficients.

COURSE OUTCOMES:

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

• Make use of orthogonal transformation to reduce the quadratic form to canonical form	K3
• Utilize differential calculus of multivariable to optimization problems.	K3
• Apply multiple integrals for finding area and volume.	K3
• Solve the n^{th} order Ordinary Differential Equations (ODE) and Homogeneous equation of Eulers type	K3
• Solve the n^{th} order Partial Differential Equations.	K3

UNIT – I MATRICES 12

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

UNIT – II DIFFERENTIAL CALCULUS OF MULTIVARIABLE FUNCTIONS 12

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

UNIT – III MULTIPLE INTEGRALS 12

Definite and Indefinite Integrals – Double integrals – Change of order of integration – Double integrals in polar coordinates – Area using double integrals – Evaluation of Triple Integrals- Volume of Solids.

UNIT – IV ORDINARY DIFFERENTIAL EQUATIONS **12**

Linear differential equation of second and higher order with constant coefficients – Cauchy- Euler linear differential equation – Method of Variation of parameters.

UNIT – V PARTIAL DIFFERENTIAL EQUATIONS **12**

Homogeneous linear partial differential equations of second and higher order with constant coefficients – Classification of partial differential equations.

TOTAL: 45 + 15 Hours

TEXT BOOKS:

1. Hass, Heil and Weir, “Thomas Calculus”, 14 th Edition, Pearson Education, 2018.
2. Dennis G. Zill, “Advanced Engineering Mathematics”, 7 th Edition, Jones & Bartlett Learning, 2022.

REFERENCE BOOKS:

1. Rogawski, Adams and Franzosa, “Calculus”, 4 th Edition, W. H. Freeman, 2019.
2. Boyce, DiPrima and Meade, “Elementary Differential Equations and Boundary Value Problems”, 12 th Edition, John Wiley & Sons, 2021.
3. Alexander Graham, “Matrix Theory and Applications for Scientists and Engineers”, 1st Edition, Dover Publications Inc.,2018.
4. Grewal, B. S.,Higher engineering mathematics. 2018, Khanna Publishers, New Delhi.

WEBSITES:

1. www.classcentral.com/course/matrix-methods-13644
2. www.classcentral.com/course/brilliant-calculus-ii-59290
3. www.classcentral.com/course/differential-equations-engineers-13258

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO2	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO4	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO5	3	2	1	-	-	-	-	-	-	-	-	1	1	-
Average	3	2	1	-	-	-	-	-	-	-	-	1	1	-

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

24BECC141 ENVIRONMENTAL CHEMISTRY (THEORY & LABORATORY) 5H-4C

Instruction Hours/week: L:3 T:0 P:2 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

PRE-REQUISITES: Nil

i) THEORY

COURSE OBJECTIVES

The goal of this course is for students to:

- Summarize the importance of water and its treatment processes.
- Create a basic understanding of energy resources, storage devices and pollution eradication.
- Clarify the concepts of corrosion and analytical techniques.

COURSE OUTCOMES:

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

• Identify the problems associated with water and appropriate technologies	K3
• Infer the alternate energy sources and storage devices.	K2
• Summarize the problems of environmental pollution and its control measures.	K2
• Illustrate the types of corrosion and its prevention methods.	K2
• Demonstrate the principle and working of analytical techniques.	K2

UNIT I – WATER AND ITS TREATMENT 9

Sources -surface and ground water – problems of over-exploitation - Surface water treatment -Water quality parameters -Alkalinity- Types of alkalinities and determination - Hardness - Types and estimation by EDTA method - Boiler feed water - Requirements - Disadvantages of using hard water in boilers - Internal conditioning (Phosphate, Calgon and Carbonate conditioning methods) - External conditioning - Demineralization process- Desalination - Reverse osmosis.

UNIT II- ENERGY SOURCES AND STORAGE DEVICES 9

Renewable and Non-Renewable resources - Nuclear energy (Fission and fusion)- light water nuclear power plant- Wind energy - Hydroelectric power-Geothermal energy- solar energy conversion - solar cells-Batteries, Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H2-O2 fuel cell

UNIT III-ENVIRONMENTAL POLLUTION 9

Definition, causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution. Nuclear hazards and human health risks. Solid waste

management and control measures of urban, industrial and e-wastes. Role of an individual in prevention of pollution. Case studies

UNIT IV -CORROSION AND ITS CONTROL 9

Chemical corrosion and Electrochemical corrosion - Galvanic corrosion - Differential aeration corrosion- Factors influencing the rate of corrosion -Corrosion control - Sacrificial anode and Impressed current cathodic methods - Corrosion inhibitors - Protective coatings - Organic coatings(Paints - Constituents and functions) - Metallic coatings (Inorganic coatings) - Electroplating (Au) and Electro less plating (Ni).

UNIT V – ANALYTICAL TECHNIQUES AND APPLICATIONS 9

Introduction-Instrumentation and applications of Colorimetry, Flame Photometry, Potentiometry, Conductometry (Strong acid with strong base, Mixture of acids with strong base, precipitation titrations)-Electronic spectroscopy- Vibrational spectroscopy-Atomic Absorption spectroscopy.

TOTAL: 45 Hours

ii) LABORATORY

LIST OF EXPERIMENTS

1. Determination of Sodium Carbonate and Sodium Hydrogen Carbonate in a mixture using volumetric titration
2. Determination of Ca / Mg using complexometric titration
3. Determination of chloride content of water
4. Determination of the rate of corrosion by weight loss method
5. Conductometry - Determination of conductance of solutions (strong acid Vs strong base)
6. pH Metry - Determination of Acid/Base
7. Potentiometry - Estimation of iron content in a water sample.

TOTAL: 30 Hours

TEXT BOOKS:

1. Anubha Kaushik., and Kaushik, C.P. 7Th Edition, 2021. Perspectives in Environmental Studies. New Age International Pvt. Ltd. Publications, New Delhi.
2. Erach Bharucha, “A Textbook of Environmental Studies for UG Courses” 3rd Edition, University Press India ltd, 2021.
3. P C Jain & Monica Jain, (2022). Engineering Chemistry, 18th edition, Dhanpat Rai Publishing Company
4. Prabhakar S Mithra, “Methodologies for environmental studies”, 1st Edition, Academic Apirations, 2021.
5. B. H. Mahan, (2010). University chemistry, Pearson Education.

REFERENCE BOOKS:

1. C. N. Banwell, (2001) Fundamentals of Molecular Spectroscopy, McGraw-Hill.
2. Tyler Miller and Scott Spoolman, “Living in the Environment”, 20th Edition, Cengage Learning, 2021.

3. M.J. Sienko and R.A. Plane,(1976) Chemistry: Principles and Applications. 5th edition, McGraw-Hill Higher Education.
4. Sing, J.S., Sing. S.P. and Gupta, S.R. 2022. Ecology, Environmental Science and Conservation. S. Chand & Publishing Company, New Delhi.
5. Linda D Williams, "Environmental Science" 1st Edition, Tata McGraw Hill, 2017.

WEBSITES:

1. https://www.insightsonindia.com/2013/09/06/environment-biodiversity
2. https://www.nptelvideos.in/2012/11/energy-resources-and-technology.html
3. https://www.bspublications.net/downloads/0523ff2e4a5331_chemistry_ch_01_JNTUK.pdf

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	1	1	1	1	-	-	1	1	-
CO2	2	2	1	1	-	1	1	1	1	-	-	1	1	-
CO3	2	1	-	-	-	2	2	2	1	-	-	1	1	-
CO4	2	1	-	-	-	1	1	1	1	-	-	1	1	-
CO5	2	1	-	-	-	1	1	1	1	-	-	1	1	-
Average	**2.2**	**1.4**	**1**	**1**		**1.2**	**1.2**	**1.2**	**1**	**-**	**-**	**1**	**1**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24BECS142 DIGITAL LOGIC AND CIRCUITS (THEORY & LABORATORY) 5H-4C

Instruction Hours/week: L: 3 T: 0 P:2 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

PRE-REQUISITES: Nil

i) THEORY

COURSE OBJECTIVES

The goal of this course is for students to:

- Understand the digital fundamentals and minimization of logic.
- Be familiar with different Combinational and Sequential logic circuits.
- Be exposed to memory and programmable logic.

COURSE OUTCOMES:

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

- Explain the fundamental concepts of various number systems. K2
- Make use of the postulates of Boolean algebra for optimization and Implementation of digital circuits. K3
- Build different combinational digital circuits using logic gates. K3
- Build different synchronous circuits using flip-flops. K3
- Construct digital circuits using semiconductor memories and related technology. K3

UNIT – I DIGITAL FUNDAMENTALS 9

Number Systems – Decimal, Binary, Octal, Hexadecimal, number base conversions, 1‘s and 2‘s complements, Arithmetic Operations, Binary codes–Binary, BCD, Excess 3, Gray, Alphanumeric codes. Boolean Algebra: Basic definitions, basic theorems and properties of Boolean algebra, Boolean functions, Sum of products and product of sums, Min terms and Max terms, Canonical form, Conversion between canonical forms, Digital logic gates, Universal gates.

UNIT – II GATE LEVEL MINIMIZATION 9

The K-map method- two-variable map, three-variable map and four-variable map, Sum of products and product of sums, simplification, don’t-care conditions, determination and selection of Prime Implicants, Essential and Non-essential prime Implicants, Implementation of logic functions using gates, Multilevel gate implementation, NAND and NOR implementation.

UNIT – III COMBINATIONAL LOGIC CIRCUITS 9

Design procedure, Design of Half and Full Adders, Half and Full Subtractors, 4-bit Binary Parallel Adder, 4-bit Binary Parallel Adder/subtractor, 2 bit Magnitude Comparator, 3-to-8- line Decoders, 8-to-3-line conventional Encoders, 4-to-2-line

Priority Encoder,8x1 Multiplexer, and 1x8 De-multiplexers.

UNIT – IV SYNCHRONOUS LOGICCIRCUITS **9**

Sequential circuits, latches, Flip flops – SR, JK, T, D, Flip Flop conversions, analysis of clocked sequential circuits- Moore/Mealy models, state minimization, state assignment, state diagram. Registers, shift registers, Universal Shift Register, ripple counters, synchronous counters - Modulo counters.

UNIT – V MEMORY AND PROGRAMMABLE LOGIC **9**

Classification of memories- Random access memory – Static and dynamic RAM, memory decoding, Read only memory- PROM - EPROM – EEPROM, programmable logic array, programmable array logic, Field Programmable Gate Arrays, Implementation of combinational logic circuits using PLA, PAL.

TOTAL: 45 Hours

ii) LABORATORY

LIST OF EXPERIMENTS

1. Verification of Boolean theorems using logic gates.
2. Realization of Universal gates.
3. Implementation of full adder and full subtractor.
4. Implementation of encoder and decoder circuits.
5. Implementation of Synchronous Decade counter using T flip-flops.
6. Implementation of a Shift left register and shift right register.

TOTAL: 30 Hours

TEXT BOOK:

1. M. Morris Mano, Michael D. Ciletti (2008), Digital Design, 4th edition, Pearson Education Inc, India.

REFERENCE BOOKS:

1. Zvi. Kohavi (2004), Switching and Finite Automata Theory, Tata McGraw Hill, India.
2. C. V. S. Rao (2009), Switching and Logic Design, 3rd Edition, Pearson Education, India.
3. Donald D. Givone (2002), Digital Principles and Design, Tata McGraw Hill, India.
4. Roth (2004), Fundamentals of Logic Design, 5th Edition, Thomson, India.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	1	1	-	1	1	-
CO2	3	2	1	-	-	-	-	1	1	1	1	1	1	-
CO3	3	2	1	-	-	-	-	1	1	1	1	1	1	-
CO4	3	2	1	-	-	-	-	1	1	1	1	1	1	-
CO5	3	2	1	-	-	-	-	1	1	1	1	1	1	-
Average	**2.8**	**1.8**	**1**	-	-	-	-	**1**	**1**	**1**	**1**	**1**	**1**	-

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-I

24BECC143 PROGRAMMING IN C 5H-4C

(THEORY & LABORATORY)

Instruction Hours/week: L:3 T:0 P:2 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PRE-REQUISITES: Nil

i) THEORY

COURSE OBJECTIVES

The goal of this course is for students to:

- Understand problem solving using C
- Learn the arrays, strings and functions of C Language
- Develop C Programs using structures, unions and file handling

COURSE OUTCOMES:

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

• Interpret problem solving aspect using C programming.	K2
• Utilize C constructs for finding solutions for computational problems	K3
• Develop applications in C using functions and file handling	K3
• Make use of pointers, structures, unions and arrays in C	K3
• Solve the real-world problems using programming logics in C	K3

UNIT I INTRODUCTION 9

Overview of computers and programming – Understanding computer systems – Programming logic– Steps in program development – Algorithm – Using pseudocode and flowchart – Types of programming languages – Compiler – Interpreter – Linker – Introduction to C – Structure of C program – Identifiers and Keywords – Data types – Constants and variables – Type conversion – Operators – Expressions. Formatted and Unformatted Input/output functions – Control structures.

UNIT II ARRAYS AND STRINGS 9

Arrays in C – Declaring and initializing arrays in C – Defining and processing 1D and 2D arrays – Inserting and deleting elements of an array – Strings – Defining and initializing strings – Processing of string – Character arithmetic – String manipulation functions and library functions of string.

UNIT III FUNCTIONS 9

Functions – Types of Functions – Function prototypes – Function definition – Function call including passing arguments by value and passing arguments by reference – Passing arrays to functions – Math library functions – Recursive functions – Scope rules (local and global scope) –Storage classes in C.

UNIT IV POINTERS **9**

Pointers – Pointer declaration and initialization – Types of pointers – Pointer expressions and arithmetic – Operations on pointers – Passing pointer to a function – Pointer and one-dimensional array – Pointers and strings – Command line arguments – Dynamic memory management functions.

UNIT V USER DEFINED TYPES AND FILE HANDLING **9**

User defined types – Enumerator – Typedef - Structures – Declaration of a structure – Accessing structures – Array of Structures – Structures and pointers – Nested structures – Bit fields – Unions – Declaration of a union – Accessing unions – Union vs Structure – files and Binary files – File handling – Text File Input/output – Preprocessor directives.

TOTAL: 45 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Create a program using operators and expressions in C.
2. Implement programs using arrays in C.
3. Develop programs to perform sort operations in C.
4. Write programs using functions and storage classes in C.
5. Create programs using pointers and function pointers in C.
6. Develop programs using structures and unions in C.
7. Construct programs using file handling and preprocessor directives in C.

TOTAL: 30 Hours

TEXT BOOKS:

1. Brian Kernighan and Dennis Ritchie, "The C Programming Language", 2nd Edition, Pearson, 2017.

2. Behrouz A. Forouzan, Richard F.Gilberg, "Computer Science: A Structured Programming Approach Using C", 3rd Edition, CENGAGE, 2022.

REFERENCE BOOKS:

1. Reema Thareja, "Programming in C", AICTE Edition, Oxford University Press, 2019.

2. Balagurusamy, "Programming in ANSI C", 8th Edition, Mc Graw Hill Education, 2019.

3. Yashwant Kanetkar, "Let Us C", 17th Edition, BPB Publications, 2020.

4. Herbert Schildt, "C: The Complete Reference", 4th Edition, Mc Graw Hill Education, 2019.

WEBSITES:

1. https://www.programiz.com/c-programming
2. https://www.geeksforgeeks.org/c-programming-language/
3. https://onlinecourses.nptel.ac.in/noc24_cs02/preview

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	3	-
CO2	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO3	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO4	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO5	3	2	1	-	-	-	-	-	2	2	-	2	3	-
Average	**2.8**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**3**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-I

24BECC111 COMMUNICATION SKILLS LABORATORY 2H-1C

Instruction Hours/week: L:0 T:0 P:2 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PRE-REQUISITES: Nil

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Acquire different listening techniques for understanding different kinds of audio content, including lectures, conversations, videos, etc. and to effectively communicate their ideas using a variety of media
- Understand the "English language skills" by engaging them in listening and reading activities that are relevant to authentic contexts and to help learners use language effectively in academic /work contexts
- Apply the communicative competence of learners in listening, speaking, reading and writing

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

• Organize the context, topic, and pieces of specific information of English through all four skills.	P1
• Identify the purpose and clarity of facts and reflect their thoughts, opinions, and knowledge through all the language skills.	A1
• Put together skimming, scanning, and listening techniques effectively to acquire the gist from the context.	P2
• Demonstrate in communication more effectively with their peers, instructors, and colleagues.	A2
• Master public speaking techniques, business writing, and listening with professional speaking techniques.	P3

LIST OF EXPERIMENTS:

S.No.	SKILLS	TOPICS
1	Listening	Dialogues from TV/radio/Ted talk/Podcast
2	Listening	Listening for gist
3	Reading	Reading for detail, global understanding
4	Speaking	Presentations and interactive communication – Pair presentations
5	Listening	Listen and respond appropriately
6	Reading	Reading different genres
7	Writing	Documentary and Movie review
8	Writing	Informational or Analytical Reports
9	Speaking	Mock Interview
10	Speaking	Group Discussion

TOTAL: 30 Hours

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	2	-	-	2	3	3	-	2	-	-
CO2	-	-	-	-	2	-	-	2	3	3	-	2	-	-
CO3	-	-	-	-	1	-	-	2	3	3	-	2	-	-
CO4	-	-	-	-	1	-	-	1	2	3	-	2	-	-
CO5	-	-	-	-	1	-	-	1	2	3	-	2	-	-
Average	**-**	**-**	**-**	**-**	**1.4**	**-**	**-**	**1.6**	**2.6**	**3**	**-**	**2**	**-**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24BECC201 **TECHNICAL ENGLISH II** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

PRE-REQUISITES: Technical English I

COURSE OBJECTIVES:

The goal of this course is for the students to:

- To acquire the context of grammar and the importance of Listening, Speaking, Reading and Writing
- To understand and develop critical Listening, Speaking, Reading, and Writing skills
- To apply students' capability to listen vigilantly, read proficiently, innovative writing, and speak fluently

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Demonstrate the aspects of writing, speaking, reading, and listening with grammar. P2
- Refine speaking, listening, reading, and writing skills in the social milieu. P3
- Justify the text critically in reading, writing, speaking, and listening. A3
- Differentiate grammatical structures in reading and listening and apply the structure in speaking and writing. A3
- Adapt writing, reading, listening, and speaking rules in formal and informal situations. P3

UNIT I **9**

Grammar : Prepositions – Adjectives – Adverbs
Reading : Reading comprehension: Skimming and Scanning
Writing : Letter writing (Formal and Informal) – Letter to Editor
Listening : Listening to Business talks – TED Talks

UNIT II **9**

Grammar : Use of sequence words – Modal Verbs
Reading : Mind Mapping (Structured thinking and related ideas)
Writing : Interpreting visual materials – Note Making – Recommendations
Listening : Listening to specific tasks – Focused Listening – Note Taking.
Speaking : Making presentations on given topics – Speaking in formal Situations

UNIT III **9**

Grammar : Contextual usage of Tenses – Connectives
Reading : Cohesion and Coherence in Reading
Writing : Paragraph writing: Compare and Contrast – Cause and Effect – Jumbled Sentences
Listening : Listening and responding to video lectures
Speaking :Role-play – Group Interaction

UNIT IV **9**

Grammar : WH Questions – Identifying Common Errors
Reading : Critical Reading Shifting facts from opinions
Writing : Resume writing with cover letter – Free writing
Listening : Watching videos or documentaries and answering
Speaking : Responding to questions – Mock Interviews

UNIT V **9**

Grammar : Use of Imperatives – Confusing words in English
Reading : Reading and making inference
Writing : Essay writing – Report – Proposals
Listening : Listening to different accents – Listening to Speeches
Speaking : Impromptu Speeches – Describing a process

TOTAL: 45 Hours

TEXT BOOKS:

1. Richards J C, Hull J, et al. "Interchange 3 Student's Book", 5th Edition, Cambridge University Press, 2022.
2. Harding, Keith, and Appleby, Rachel, "International Express: Pre-Intermediate: Student's Book", 3rd Edition, Oxford University Press, 2019.

REFERENCE BOOKS:

1. Swan, Michael and Walter Catherine, "Oxford English Grammar Course", 1st Edition, Oxford University Press, 2019.
2. Sudharshana N P and Savitha C, "English for Engineers", 1st Edition, Cambridge University Press, 2018.
3. Brook-Hart G, "Business benchmark: Upper intermediate: Business vantage: Student's book", 2nd Edition, Cambridge University Press, 2021.

WEBSITES:

1. www.myenglishpages.com
2. www.cambridgeenglish.org/learning-english/
3. www.eslvideo.com/index.php

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	2	-	-	2	2	2	-	2	1	-
CO2	-	-	-	-	2	-	-	2	2	2	-	2	1	-
CO3	-	-	-	-	2	-	-	2	2	2	-	2	1	-
CO4	-	-	-	-	2	-	-	2	2	2	-	2	1	-
CO5	-	-	-	-	2	-	-	2	2	2	-	2	1	-
Average	-	-	-	-	**2**	-	-	**2**	**2**	**2**	-	**2**	**1**	-

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-II

24BECC202A GRAPH THEORY 4H-4C

Instruction Hours/week: L:3 T:1 P:0 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PRE-REQUISITES: Matrices and Calculus

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Provide the basic concepts of graphs
- Impart the knowledge of trees and its properties.
- Afford the adequate knowledge on matrix representation of graphs, coloring and dominating sets.
- To understand the concepts and significance of lattices

COURSE OUTCOMES:

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

- Infer the basic terminologies of directed and undirected graphs. K2
- Illustrate the properties of trees, connectivity, fundamentals of circuits, cutset through algorithms. K2
- Apply matrix representation of graphs to explore spectra and energy of graphs. K3
- Interpret the coloring and domination of a given graph. K2
- Explain Lattice theory and its operations on discrete structural areas of computing. K2

UNIT I GRAPHS 12

Graphs: Directed and undirected graphs – Konigsberg bridge problem – Handshaking Theorem– Walk, Trail, Path, Circuit, Cycle, sub graphs, induced and spanning sub graphs, connected graphs, complement of a graph – Euler, Hamiltonian graphs - Isomorphism of graphs.

UNIT II TREES 12

Properties of trees – Distance and centers in tree – Rooted and binary tree Spanning trees –Connectivity and separability – Fundamental Circuits and Cut sets – Algorithm on spanning trees: Kruskal's and Prim's Algorithm – Dijkstra's shortest path algorithm.

UNIT III MATRIX REPRESENTATION OF GRAPHS 12

Matrix Representation of Graphs: Adjacency matrix, Incidence matrix, Circuit matrix, Fundamental circuit matrix, Laplacian matrix, rank of these matrices and its properties – Spectra and Energy of Graphs.

UNIT IV COLORING, COVERING AND PARTITIONING **12**

Coloring, Covering and Partitioning: Chromatic number – Chromatic Partitioning: Dominating set – Minimal Dominating set – Domination number- Chromatic Polynomial– Matching – Four color theorem (Statement only).

UNIT V LATTICE THEORY **12**

Partial ordering – Posets – Lattices as Partial Ordering-Posets – Properties of lattices – Lattices as algebraic systems – Sub lattices – Direct product and homomorphism – Some special lattices.

Total Hours: 45+15

TEXT BOOKS:

1. Narsingh Deo., "Graph Theory with applications to Engineering and Computer Science", 1st Edition, Prentice Hall Series, 2021.
2. Karin R Saoub., "Graph Theory – An Introduction to Proofs, Algorithms and Applications", 1st Edition, CRC Press, 2021.
3. Kenneth H. Rosen., "Discrete Mathematics and Applications", 7thEdition, Tata McGraw Hill, 2012.

REFERENCE BOOKS:

1. Allan Bickle, "Fundamentals of Graph Theory", American Mathematical Society,2020.
2. LonathanI, Gross, Jay Yellen and Mark Anderson, "Graph Theory and Its Applications", 3rd Edition, CRC press, 2019.
3. Madhumangal Pal, SovanSamanta and Anita Pal, "Advanced Applications of Graph Theory in Modern Society", IGI Global, 2021.
4. J. P. Tremblay, R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, India, 1st Edition,1997

WEBSITES:

1. www.classcentral.com/subject/graph-theory
2. www.nitttrc.edu.in/nptel/courses/video/106106183/lec292.pdf
3. www.digimat.in/nptel/courses/video/106108054/L17.html

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	1	-	1
CO2	2	1	-	-	-	-	-	-	-	-	-	1	-	1
CO3	3	2	1	-	-	-	-	-	-	-	-	1	-	1
CO4	2	1	-	-	-	-	-	-	-	-	-	1	-	1
CO5	2	1	-	-	-	-	-	-	-	-	-	1	-	1
Average	**2.2**	**1.2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-II

24BECC202B COMPUTATIONAL METHODS FOR ENGINEERS 4H-4C

Instruction Hours/week: L:3 T:1 P:0 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PRE-REQUISITES: Matrices and Calculus

COURSE OBJECTIVES:

The goal of this course is for students to:

- Provide the knowledge of Vector differentiation and Integration.
- Inculcate the concepts of Number Theory.
- Introduce the concepts of graphs and algorithm on spanning trees.
- Afford adequate knowledge of Linear Programming Problems.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Make use of vector calculus for finding area and volume. K3
- Interpret the concepts of divisibility, prime number, congruence and number theorems. K2
- Explain the terminology of basic graphs and its matrix representation. K2
- Illustrate the properties of trees, connectivity, fundamentals of circuits, cut set through algorithms. K2
- Solve linear programming models by Graphical method, Simplex method and Dual simplex method. K3

UNIT I VECTOR CALCULUS 12

Vector differential operator – Gradient, divergence and curl – Identities (Statement only) – Directional derivatives – Irrotational and solenoidal vector fields – Conservative vector fields – Vector integration Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proofs) – Simple applications involving square, rectangle, cubes and rectangular parallelopipeds.

UNIT II NUMBER THEORY 12

Divisibility – Fundamental Properties – Euclidean algorithm – Euclid's lemma – Fundamental theorem of arithmetic – Congruence – Fermat's Little theorem – The Fermat-Euler theorem.

UNIT III GRAPH THEORY 12

Incidence and degree – Finite and Infinite graphs – Sub graphs – Isomorphism of graphs – Walks, Paths and Circuits – Eulerian and Hamiltonian graphs – Planar graph – Matrix representation of graphs – Incidence and Adjacency matrices

UNIT IV TREES 12

Properties of trees – Distance and centers in tree – Rooted and binary tree – Spanning trees– Properties of trees –Algorithm on spanning trees – Kruskal's algorithm.

UNIT V LINEAR PROGRAMMING PROBLEM **12**

Formulation of Linear Programming Problem– Advantages and disadvantages of LPP – Algebraic solution of a LPP - Graphical method - The Simplex method - Principle of duality - Dual and primal problems - Dual Simplex method.

TOTAL HOURS: 45+15

TEXT BOOKS:

1. Jonathan L. Gross, Jay Yellen, Mark Anderson, "Graph Theory and Its Applications", 3rd Edition, Chapman and Hall, 2023.
2. Satyabrota Kundu, Supriyo Mazumder, "Number Theory and Its Applications", 1st Edition, CRC Press, London, 2022.

REFERENCE BOOKS:

1. Colley, Susan Jane, "Vector Calculus", 4th Edition, Pearson Education, 2019.
2. Pio J Arias, "Elementary Number Theory", 1st Edition, Toronto Academic Press, 2024.
3. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall Series, 2021.
4. Hamdy A. Taha, "Operations Research: An Introduction", 10th Edition, Pearson Education, 2019.

WEBSITES:

1.www.khanacademy.org/computing/computer-science/cryptography/random-algorithms-probability/fermat-s-little-theorem-visualization

2. www.udemy.com/course/linear-programming-basics/

3. www.udemy.com/course/graph-theory

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	1	2	-
CO3	2	1	-	-	-	-	-	-	-	-	-	1	2	-
CO4	2	1	-	-	-	-	-	-	-	-	-	1	2	-
CO5	3	2	1	-	-	-	-	-	-	-	-	1	2	-
Average	**2.4**	**1.4**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-II

24BECC202C TRANSFORMS AND ITS APPLICATIONS 4H-4C

Instruction Hours/week: L:3 T:1 P:0 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

Pre-Requisites: Matrices and Calculus

COURSE OBJECTIVES:

The goal of this course is for students to:

- Understand the concept of periodic functions and represent it as Fourier series.
- Provide knowledge of Fourier series techniques in solving heat flow problems and wave equations.
- Acquaint Fourier transforms techniques used in various applications.
- Impart the knowledge of Laplace Transforms and Inverse Laplace Transforms techniques and its applications.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Illustrate Fourier series representation of periodic functions K2
- Apply Fourier series in one dimensional heat flow and wave equation K3
- Make use of Fourier transform for converting elementary functions into frequency domain K3
- Utilize Laplace Transform to convert time-domain systems into frequency-domain systems K3
- Apply Inverse Laplace Transform in linear differential equations K3

UNIT I FOURIER SERIES 12

Dirichlet's conditions – General Fourier series in the interval (0,2l) & (-l,l) – Half range sine series –Half range cosine series –Parseval's Identity – Harmonic analysis.

UNIT II APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Fourier series solution for one dimensional wave equation – Fourier series solution for one dimensional heat equation with zero end conditions.

UNIT III FOURIER TRANSFORMS 12

Fourier Integral Theorem – Fourier transform pair –Fourier sine and cosine transforms – Properties – Convolution theorem – Parseval's identity of Fourier transform.

UNIT IV LAPLACE TRANSFORM 12

Transforms of standard functions – Properties of Laplace transform – Transforms of derivatives and integrals –Initial and final value theorem – Transforms of periodic functions.

UNIT V INVERSE LAPLACE TRANSFORM **12**

Inverse Laplace transforms of standard functions – Inverse Laplace transform using second shifting theorem – Method of partial fractions– Convolution– Solution of ordinary differential equations with constant coefficients using Laplace transforms

Total Hours: 45+15

TEXT BOOKS:

1. Boyce, Diprima and Meade, "Elementary Differential Equations and Boundary Value Problems", 12th Edition, John Wiley & Sons, 2021.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley and Sons, 2017

REFERENCE BOOKS:

1. T. Hillen, "Partial Differential Equations", 2nd Edition, Friesen Press, 2019.
2. Dennis G. Zill, "Advanced Engineering Mathematics", 7th Edition, Jones and Bartlett Publishers, 2020.
3. Richard Haberman, "Applied Partial Differential Equations with Fourier Series and Boundary Value Problems", 5th Edition, Pearson, 2021.
4. Grewal B.S., "Higher Engineering Mathematics", 44thEdition, Khanna Publishers, New Delhi, 2018.

WEB SITES:

1. www.infocobuild.com/education/audio-video-courses/mathematics/Transform TechniquesForEngineers-IIT-Madras/lecture-01.html
2. www.infocobuild.com/education/audio-video-courses/mathematics/ordinary-and-partial-differential-equations-iit-roorkee.html
3. www.electrical4u.com/laplace-transformation/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	1	1	-
CO2	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO4	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO5	3	2	1	-	-	-	-	-	-	-	-	1	1	-
Average	**2.8**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-II

24BECS241 PHYSICS FOR COMPUTING ENGINEERS 5H-4C
(THEORY & LABORATORY)

Instruction Hours/week: L:3 T:0 P:2 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

PRE-REQUISITES: Nil

i) THEORY

COURSE OBJECTIVES

The goal of this course is for students to:

- Instil knowledge on physics of semiconductors, determination of charge carriers and device applications
- Establish a sound grasp of knowledge on different properties of materials such as magnetic and super conducting
- Make the students to understand the nano materials and its applications

COURSE OUTCOMES

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

- Relate the quantum concepts in quantum computing K2
- Identify the types of semiconductors and its carrier concentration using Hall effect K3
- Examine the performance of light, laser and optical fibres K4
- Utilize magnetic properties for finding B - H Curve K3
- Illustrate the properties of nano materials and its fabrication methods K2

UNIT I – QUANTUM COMPUTING 9

Black body radiation - Energy Distribution laws (Qualitative): Stefan Boltzmann's law, Wein's Displacement law-Rayleigh Jeans Law – De Broglie hypothesis - uncertainty principle – Heisenberg uncertainty principle – physical significance of wave function - Schrödinger's Time dependent wave equation - Schrödinger's Time independent wave equation – Particle in one dimensional box – Introduction to quantum computing – History of quantum computation and quantum information – Quantum bits – Global perspectives – Future directions.

UNIT II SEMICONDUCTORS 9

Properties of semiconductor, Types: Intrinsic and extrinsic semiconductors – Intrinsic carrier concentration, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier transport: diffusion and drift - Hall Effect – Determination of Hall coefficient – Applications

UNIT III LASER AND FIBER OPTICS 9

LASER: Introduction - characteristics - Einstein's co-efficients derivation Principle of laser action- population inversion- pumping methods - Nd: YAG - Applications of LASER in industry and medicine.Fiber optics - principle– modes of propagation of light in optical fibers – numerical aperture and acceptance angle – types of optical fibers (Material, refractive index and mode) – fiber optical communication system (block diagram).

UNIT IV MAGNETIC AND SUPER CONDUCTING MATERIALS 9

Magnetic moment, magnetic dipoles - magnetic permeability and susceptibility, types of magnetic materials - Ferromagnetism, Domain Theory, Hysteresis on the basis of domains, hysteresis loss, soft and Hard magnetic materials - Superconductivity – Properties – Meissner effect – Effect of magnetic field – Types of superconductors – BCS theory of superconductivity — Applications of superconductors, cryotron and magnetic levitation.

UNIT V NANOMATERIALS 9

Low-dimensional systems such as quantum wells, wires, and dots – Nanostructures: Synthesis of nanomaterials- top-down approach (Ball milling, Pulsed laser deposition and bottom-up approach (Chemical Vapour Deposition, Physical Vapour Deposition) – Carbon nanotubes: Properties and applications.

TOTAL: 45 Hours

ii) LABORATORY

LIST OF EXPERIMENTS

1. Determination of Band gap of a semiconductor.
2. Characteristics of photo diode.
3. Viscosity of liquids - Determination of co-efficient of viscosity of a liquid by Poiseuille's flow.
4. Laser- Determination of the wave length of the laser using grating
5. Laser – Determination of Particle size
6. Optical Fiber – Determination of Numerical Aperture and Acceptance angle of the optical fiber
7. Air wedge – Determination of thickness of a thin sheet/wire.

TOTAL: 30 Hours

TEXT BOOKS

1. Bhattacharya D.K. & Poonam T., Engineering Physics, Oxford University Press, (2015).
2. B.K. Pandey, S. Chaturvedi, Engineering Physics, Cengage Learning India Pvt. Ltd. 2 nd Edition, (2022).
3. S.O. Pillai, "Solid State Physics", 9th Edition. New Age International Publishers, 2020.
4. S.M. Sze, Kwok K. Ng, Physics of Semiconductor Devices, wiley Publishers, (2006).
5. William T Silfvast, Laser Fundamentals, Cambridge Univ Press. 2012.

REFERENCE BOOKS:

1. Halliday.D. Resnick R. & Walker. J, Principles of Physics, Wiley, 2015.
2. Charles Kittel, Kittel's, Introduction to Solid State Physics, Wiley India Edition, 2019.
3. Donald A. Neamen, Semiconductor Physics and Devices, McGraw Hill Education private limited; 4 edition, (2021).
4. LeszekMalkinski, Advanced Magnetic Materials, Published by InTech, (2012).
5. Michael Shur, Physics of Semiconductor Devices, Published by Pearson Education; First edition, (2019).
6. Kulkarni, Sulabha K, Nanotechnology: Principles and Practices, Springer International Publishing, (2015).
7. R P Khare, Fiber Optics and Optoelectronics, Oxford, 2012

WEBSITES:

1. www.nptel.ac.in/courses/115102025/
2. www.nptel.ac.in/courses/108/108/108108122/
3. www.ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-fall-2009/lecture-notes/MIT6_012F09_lec01.pdf

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	2	2	-	1	-	1
CO2	3	2	-	-	-	-	-	-	2	2	-	1	-	1
CO3	3	2	-	-	-	-	-	-	2	2	-	1	-	1
CO4	3	3	2	-	-	1	-	-	2	2	-	1	-	1
CO5	2	1	-	-	-	-	-	-	-	1	-	1	-	1
Average	**2.8**	**2.0**	**2.0**	**-**	**-**	**1.0**	**-**	**-**	**2.0**	**1.8**	**-**	**1.0**	**-**	**1.0**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-II

24BECS242 WEB TECHNOLOGY 5H-4C

(THEORY & LABORATORY)

Instruction Hours/week: L:3 T:0 P:2 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PRE-REQUISITES: Nil

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Understand the principles of web design
- Acquire basic knowledge of HTML elements, CSS and various layouts for styling a web page
- Understand designing interactive web pages using JavaScript and Bootstrap

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Outline the components for web development K2
- Demonstrate structural aspects of HTML, CSS and JavaScript for interactive web pages K2
- Apply CSS and layouts for styling web pages K3
- Build dynamic web pages using JavaScript K3
- Develop responsive web pages by using Bootstrap framework K3

UNIT I ESSENTIALS OF WEB DESIGN AND HTML 9

Web design – Internet versus the web – Web browsers – Design process – Design principles – HTML – Document structure – Paragraphs – Headings – Lists – iFrame – div – span – Hyperlinks – Adding images – Table markup – Forms – HTML5 Advanced Elements – Embedded media.

UNIT II CASCADING STYLE SHEETS 8

CSS – Units of measurement – Formatting text with css3 – Colors and backgrounds – Padding – Borders – Margins – Floating and positioning – CSS layout with flexbox and grid - CSS Animations and Transitions – Responsive Design with Media Queries.

UNIT III DYNAMIC WEB PAGES USING JAVA SCRIPT 9

JavaScript – JavaScript Fundamentals – Variables – Data types – Operators – Control Structures – Functions Function expressions – Arrow functions – Objects – Object methods – Constructor – Strings – Arrays – Array methods – Destructuring – JSON – Error handling – Closures

UNIT IV ADVANCED JAVASCRIPT CONCEPTS 8

Browser object – Events – DOM – Promises – Callbacks – Promises chaining – Promise API – Fetch API – Async/await – Modules – Export and Import – Polyfills – JavaScript libraries : jQUERY.

UNIT V RESPONSIVE WEB DESIGN USING BOOTSTRAP 8

Bootstrap – Setting up bootstrap – Structuring web page using bootstrap – Grid system- Typography – Tables Forms – Images – Effects – Icons – Components

CONTEMPORARY TOPICS 3

TOTAL: 45 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Develop static web pages using HTML.
2. Create an HTML-based web page to demonstrate the use of inline, internal, and external CSS.
3. Develop web pages using HTML and CSS Flexbox.
4. Create dynamic web pages using JavaScript.
5. Implement a web page that includes JavaScript code to demonstrate arrays, strings, and JSON.
6. Write JavaScript code to work with Promises, Async/Await, and Modules.
7. Develop a responsive website using Bootstrap components.

TOTAL: 30 Hours

TEXT BOOKS:

1. Jennifer Niederst Robbins, “Learning Web Design”, 5th Edition, O’Reilly Media, Inc, 2018.
2. Jorg Krause, “Introducing Bootstrap 4”, 2nd Edition, A press Media LLC, 2020.

REFERENCE BOOKS:

1. Jason Beaird, James George and Alex Walker, “The Principles of Beautiful Web Design”, 4th Edition, Site Point Pty. Ltd., 2020.
2. Ben Frain, “Responsive Web Design with HTML5 and CSS”, 3rd Edition, Packt Publishing, 2020.
3. Sufyan bin Uzayr, “Mastering Bootstrap A Beginner's Guide”, 1st Edition, CRC Press, 2022.

WEB SITES:

1. www.w3schools.com/html/
2. www.udacity.com/course/responsive-web-design-fundamentals--ud893
3. www.getbootstrap.com/docs/4.6/getting-started/introduction/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	2
CO2	2	1	-	-	-	-	-	-	2	2	-	2	-	2
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO5	3	2	1	-	1	-	-	-	2	2	-	2	-	2
Average	**2.6**	**1.6**	**1**	**-**	**1**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-II

24BECS243A DATA STRUCTURES AND ALGORITHMS 5H-4C

(THEORY & LABORATORY)

Instruction Hours/week: L:3 T:0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PRE-REQUISITES: Programming in C

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Understand the concepts of abstract data types
- Learn linear and non-linear data structures
- Understand sorting, searching and hashing algorithms

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Interpret the concepts of linear and non-linear data structures K2
- Identify appropriate linear/non–linear data structure operations for solving a given problem K3
- Experiment with linear and non-linear data structure operations to understand their implementation, performance, and practical applications K3
- Apply searching and sorting algorithms for solving a problem K3
- Develop the application using suitable data structures K3

UNIT I LISTS **8**

Abstract Data Types (ADTs) – Elementary Data types – List ADT – Array-based implementation – Linked list implementation – Singly linked lists – Doubly-linked lists – Circularly linked lists –Applications of lists – Polynomial ADT – Multilists – Sparse Matrices.

UNIT II STACKS AND QUEUES **8**

Stack ADT – Operations – Applications – Balancing symbols – Evaluating arithmetic expressions – Infix to Postfix conversion – Function calls – Queue ADT – Operations – Circular queue – Deque – Applications of queues.

UNIT III TREES **8**

Tree ADT – Tree traversals – Binary tree ADT – Expression trees – Binary search tree ADT– AVL Trees – Red-Black trees – Priority queue (Heaps) – Binary heap.

UNIT IV MULTIWAY SEARCH TREES AND GRAPHS **9**

B-Tree – B+ Tree – Tries – Graph definition – Representation of graphs – Types of graphs – Breadth-first traversal – Depth-first traversal – Bi-connectivity – Euler circuits – Topological sort – Dijkstra's algorithm – Minimum spanning tree – Prim's algorithm – Kruskal's algorithm

UNIT V SEARCHING, SORTING AND HASHING TECHNIQUES **9**

Searching – Linear search – Binary search – Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort – Quick sort – Merge sort – Heap sort – Radix sort – Hashing – Hash functions – Separate chaining – Open addressing – Rehashing – Extendible hashing.

CONTEMPORARY TOPICS **3**

TOTAL: 45 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Implement array implementation of Stack, Queue, and Circular Queue ADTs.
2. Develop the implementation of a singly linked list.
3. Create linked list implementation of stack and linear queue ADTs.
4. Implement the evaluation of postfix expressions and infix to postfix conversion.
5. Develop the implementation of binary search trees and AVL Trees.
6. Implement insertion sort, merge sort and quick sort.
7. Create open addressing (Linear probing and Quadratic probing).

TOTAL: 30 Hours

TEXT BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2019.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, "Introduction to Algorithms", 4th Edition, MIT Press, 2022.

REFERENCE BOOKS:

1. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy", 1st Edition, Career monk Publications, 2019.
2. Langsam, Augenstein and Tanenbaum, "Data Structures Using C and C++", 2nd Edition, Pearson Education, 2020.
3. Jan Wengrow, "A Common–Sense Guide to Data Structures and Algorithm", 2nd Edition, O'Reilly Publications, 2020.
4. Yashavant Kanetkar, "Data Structures Through C", 4th Edition, BPB publications, 2022.

WEBSITES:

1. https://nptel.ac.in/courses/106102064
2. www.coursera.org/learn/data-structures
3. www.cs.usfca.edu/~galles/visualization/Algorithms.html

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	3	-
CO2	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO3	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO4	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO5	3	2	1	-	-	-	-	-	2	2	-	2	3	-
Average	**2.8**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**3**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-II

24BECS243B PYTHON PROGRAMMING (THEORY & LABORATORY) 5H-4C

Instruction Hours/week: L:3 T:0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PRE-REQUISITES: Nil

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Learn about basic python syntax and semantics like control structures and functions
- Develop logical thinking abilities and to propose novel solutions for real world problems through object–oriented programming concepts
- Deepen the empirical knowledge on applying programming on business domains

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Interpret the representation of the data structures and sequential programming in solving complex problems K2
- Outline the need for control statements in data structure to understand their role in managing program flow and enhancing computational efficiency K2
- Develop functions, modules, and packages for code reusability K3
- Identify the possible error-handling constructs for unanticipated states K3
- Build exemplary applications on the real-world problems K3

UNIT I PYTHON BASICS 8

Fundamentals of computing – Building blocks of algorithms – Introduction to programming – Elements of python – Variables – Data types – Operators – Operator precedence – Expressions – Conditional statement – Loops – Break, Continue and Pass – Illustrative problems: square root, GCD, Exponentiation, Sum an array of numbers, Linear search, Binary search.

UNIT II PYTHON DATA STRUCTURES 8

Mutable vs immutable data types – String – Indexing and slicing – String functions – List – List slices – List methods – Iterate over a list – Mutability – Aliasing – Cloning lists – List parameters – List comprehension– Tuples– Tuple assignment – Tuple as return value – Dictionaries – Operations and methods

UNIT III FUNCTIONS, MODULES AND PACKAGES 9

Built–in functions – User defined functions – Creating function – Calling functions – Types of function arguments – Recursion and lambda or anonymous functions – Packages: Defining – Creating and accessing a package – Importing packages and user defined modules; Illustrative programs: Factorial, Maximum element, Palindrome, Armstrong number

UNIT IV FILE HANDLING, CLASS AND OBJECT 9

Introduction to files – File path – Opening and closing files – Reading and writing files – File position – Decorators – Introduction to elements of OOP – Class – Object – Inheritance-Data abstraction – Encapsulation – Polymorphism – UML class diagram – Access specifiers-Creating classes – Creating object – Accessing members – init() method – Instance, static and class methods – Importance of self – Implementing encapsulation. Illustrative programs: File operations on TEXT and CSV, Scientific calculator using class and objects

UNIT V INHERITANCE, ABSTRACTION AND EXCEPTION HANDLING 9

Inheritance: Implementing inheritance – Types of inheritance. Polymorphism: Implementing polymorphism – Method overloading – Method overriding – Operator overloading – Abstraction – Abstract classes – Association and aggregation – Exception handling: Errors vs exceptions – Handling exceptions – Raising exception – Creating user defined exception. Illustrative programs: Banking applications using inheritance

CONTEMPORARY TOPICS 2

TOTAL: 45 Hours

ii) LABORATORY
LIST OF EXPERIMENTS:

1. Create and manipulate strings using indexing, slicing, and various string functions.
2. Develop and manipulate lists using operations, slices, methods, list comprehension, and looping.
3. Develop and manipulate tuples, dictionaries, and sets, distinguishing between mutable and immutable types.
4. Implement user-defined functions and categorize different types of function arguments, such as positional, keyword, and default arguments.
5. Implement inheritance and classify different types of inheritance.
6. Develop polymorphism through method overloading, overriding, and operator overloading.
7. Write programs in Python to handle exceptions and create custom exceptions.

TOTAL: 30 Hours

TEXT BOOKS:

1. Allen B Downey, Jeffrey Elkne, Chris Meyers, “How to Think Like a Computer Scientist: Learning with Python 3 Documentation”, 3rd Edition, Green Tea Press, 2020.
2. Steven F. Lott, Dusty Phillips, “Python Object-Oriented Programming: Build robust and maintainable object-oriented Python applications and libraries”4th Edition, Packt Publishing Limited, 2021.

REFERENCE BOOKS:

1. R. Nageswara Rao,” Core Python Programming”, 3rd Edition, Dream tech Press, 2022.
2. Mark Lutz, “Learning Python”, 5th Edition, O’Reilly Publication, 2018.
3. Mark and Summerfield, “Programming in Python 3”, 2nd Edition, Dorling Kindersley India Pvt. Ltd, 2019.

WEBSITES:

1. www.realpython.com/
2. www.w3schools.com/python/
3. www.geeksforgeeks.org/python-programming-language/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	3
CO2	2	1	-	-	-	-	-	-	2	2	-	2	-	3
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO5	3	2	1	-	-	-	-	-	2	2	-	2	-	3
Average	**2.6**	**1.6**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

24BECC301A DISCRETE MATHEMATICS AND STOCHASTIC PROCESS 4H-4C

Instruction Hours/week: L:3 T:1 P:0 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PRE-REQUISITES: Graph Theory

COURSE OBJECTIVES:

The goal of this course is for students to:

- Inculcate the concepts of Number theory.
- Extend student's logical and mathematical maturity and ability to deal with abstraction.
- Synthesize methods of solving problems in summation of series and recurrence relations.
- Introduce the concept of Theoretical Distributions and interpret the importance of correlation function and spectral studies.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Interpret the concepts of divisibility, prime number, congruence and number theorem. K2
- Solve a given problem using propositional logic. K3
- Explain the concept of Mathematical induction and the fundamentals of Probability. K2
- Infer standard distributions of random variables. K2
- Explain the perceptions of correlation and spectral densities. K2

UNIT I NUMBER THEORY 12

Divisibility – Fundamental Properties – Euclidean algorithm – Euclid's lemma – Fundamental theorem of arithmetic – Congruence – Fermat's Little theorem (statement only) and the Chinese remainder theorem (statement only).

UNIT II PROPOSITIONAL CALCULUS 12

Propositional Calculus: Propositions – Logical connectives - compound propositions – conditional and biconditional propositions - Truth tables - Tautologies and contradictions- contrapositive – Logical equivalences and implications – Demorgan's Laws – Normal forms – Principal conjunctive and disjunctive normal forms.

UNIT III COMBINATORICS 12

Mathematical Induction – Permutations and combinations - Recurrence Relation – Formation of Recurrence relation – Solution of recurrence relation by Generating Functions

UNIT IV THEORETICAL DISTRIBUTIONS **12**

Concept of Probability – Conditional– Theorem of Total Probability – Baye's theorem – One dimensional Random Variables – Discrete and Continuous Random variables – Probability distribution function – Probability density function - Mathematical Expectations – Moments –. Mean and Variance – Moment generating function of Binomial, Poisson and Normal distributions

UNIT V STOCHASTIC PROCESS **12**

Classification of Random Process – Discrete and Continuous cases — Auto Correlation Functions – Properties – Stationary Random processes – WSS and SSS processes – Power spectral density – properties of power spectral density – Cross-power spectral density and properties – Auto-correlation function and power spectral density of a WSS random sequence.

TOTAL HOURS: 45+15

TEXT BOOKS:

1. Ralph P Grimaldi, "Discrete and Combinatorial Mathematics: An Applied Introduction,5th Edition, Pearson New International Edition,2019.
2. Kenneth H. Rosen and Dr. Kamala Krithivasan, "Discrete Mathematics and Applications",8th Edition, Tata Mcgraw Hill, Education,2021.
3. Roy D Yates and David J Goodman, "Probability and Stochastic processes",3rd Edition, Wiley India Pvt Ltd,2021.

REFERENCE BOOKS:

1. Kenneth H Rosen, "Discrete Mathematics and its Applications with Combinatorics and Graph Theory",7th Revised Edition, Tata McGraw – HillPub Co Ltd,2017.
2. Randolph Nelson, "A Brief Journey in Discrete Mathematics", Springer Nature Switzerland AG; 1st Edition, 2020.
3. Oscar Levin, "Discrete Mathematics: An Open introduction",3rd Edition, Createspace Independent Pub,2019.
4. Grimaldi. R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 5th Edition, Pearson Education Asia, Delhi, 2013.

WEBSITES:

1. www.geeksforgeeks.org/proposition-logic/
2. www.classcentral.com/subject/number-theory
3. www.mathworld.wolfram.com

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	1	1	1
CO2	3	2	-	-	-	-	-	-	-	-	-	1	2	2
CO3	2	1	-	-	-	-	-	-	-	-	-	1	1	1
CO4	2	1	-	-	-	-	-	-	-	-	-	1	1	1
CO5	2	1	-	-	-	-	-	-	-	-	-	1	1	1
Average	**2.2**	**1.2**	-	-	-	-	-	-	-	-	-	**1**	**1.2**	**1.2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

24BECC301B NUMERICAL METHODS 4H-4C

Instruction Hours/week: L:3 T:1 P:0 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PRE-REQUISITES: Computational methods for Engineers/Transforms and its Applications

COURSE OBJECTIVES:

The goal of this course is for students to:

- Inculcate the basic concepts of solving algebraic and transcendental equations.
- Understand the numerical techniques of interpolation in various intervals
- Provide the knowledge of numerical differentiation and integration
- Provide the knowledge of solving ordinary differential equations and partial differential equations numerically

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Solve the systems of linear and nonlinear equations by iterative methods. K3
- Make use of interpolation methods for finding the missing terms. K3
- Apply numerical methods for finding differentiation and integration of a given function. K3
- Solve ordinary differential equations using Euler's, Taylor's, RungeKutta and Milne Thomson's method. K3
- Utilize implicit and explicit methods in heat and wave equations. K3

UNIT I SOLUTION OF EQUATIONS 12

RegulaFalsi Method - Newton Raphson method for solving algebraic and transcendental equations -Solution of system of linear equations - Gauss elimination method - Gauss Jordan method -Gauss Seidel method.

UNIT II INTERPOLATION 12

Interpolations with unequal intervals-Lagrange's interpolation -Newton's divided interpolation - Interpolation with equal intervals-Newton's forward and backward interpolation.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Approximation of derivatives using Newton's forward and backward interpolation - Numerical integration using Trapezoidal, Simpson's 1/3 and 3/8 rule

UNIT IV NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 12

Single step method- Euler's method-Taylor's series method-Fourth order Runge – Kutta method –Multi step method-Milne's predictor corrector method

UNIT V NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS **12**

Solutions of one-dimensional heat equation by Bender-Schmidt and Crank Nicholson methods – Numerical solutions of one-dimensional wave equation by explicit method

TOTAL: 45+15 Hours

TEXT BOOKS:

1. Steven C.Chapra, Raymond P.Canale, Numerical Methods for Engineers,8thEdition , Tata McGraw Hill Education,2021
2. Curtis F. Gerald and Patrick O. Wheatley,Applied Numerical Analysis,Addison Wesley, Thirteenth Edition,2004.

REFERENCE BOOKS:

1. Richard L. Burden and J. Douglas Faires, Numerical Methods, 4th Edition, Brooks/Cole 2012.
2. Boyce, Di Prima and Meade, "Elementary Differential Equations and Boundary value problem", 12th Edition, John Wiley & Sons, 2021.
3. Steven Chapra, "Applied Numerical Methods with MATLAB", 5th Edition, Mcgraw-Hill Education, 2022.
4. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, Tenth Edition, 2011.

WEBSITES:

1. www.classcentral.com/course/numerical-methods-engineers-32822
2. http://www.infocobuild.com/education/audio-video-courses/mathematics/numerical-analysis-iit-madras.html
3. http://www.infocobuild.com/education/audio-video-courses/mathematics/ NumericalMethods-FiniteDifference-IIT-Roorkee/lecture-06.html

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	1	1
CO2	3	2	1	-	-	-	-	-	-	-	-	1	1	1
CO3	3	2	1	-	-	-	-	-	-	-	-	1	1	1
CO4	3	2	1	-	-	-	-	-	-	-	-	1	1	1
CO5	3	2	1	-	-	-	-	-	-	-	-	1	1	1
Average	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

24BECS302 COMPUTER ARCHITECTURE 3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PREREQUISITES: Digital Logic Circuits

COURSE OBJECTIVES:

The goal of this course for students is to:

- Be familiar with fundamentals of computer system
- Understand the concepts of RISC, CISC instructions and pipelining
- Learn binary arithmetic operations and memory management systems

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

• Infer the instruction sets and memory operations to understand their fundamental	K2
• Interpret the basic organization, design, and specification of computer operations	K2
• Solve the design issues related to clock periods, performance, and instruction throughput for processors to optimize the processing efficiency	K3
• Develop an arithmetic processing unit with pipelining and memory management to enhance computational capabilities and system performance.	K3
• Make use of memory hierarchy design and performance improvement techniques for sophisticated computer architecture.	K3

UNIT I BASIC STRUCTURE OF A COMPUTER SYSTEM 9

Functional units – Basic operational concepts – Number representation and arithmetic and operations Character representation – Performance – Historical perspective – The assembly process – Linker Compiler – Debugger –Operating System.

UNIT II ARITHMETIC FOR COMPUTERS 9

Addition and subtraction of signed numbers – Design of fast adders – Multiplication of unsigned numbers –Multiplication of signed numbers – Fast Multiplication – Integer division – Floating point numbers and operations.

UNIT III BASIC PROCESSING UNIT AND PIPELINING 9

Basic Processing units – Fundamentals concepts –Instruction execution – Hardware components – Instruction fetch and execution steps – Control Signals – Hardware Control – CISC instruction sets – RISC and CISC styles – processors – Basic concepts of Pipelining – Pipeline Organization – Pipelining issues – Data Dependencies – Pipelining in CISC Processor.

UNIT IV MEMORY AND I/O **9**

Memory locations and addresses – Memory operations – Instruction and instruction sequencing – Addressing modes – Assembly language – Stacks-Subroutines – Additional instructions – Dealing with 32 – Bit immediate values –Memory System – Basic concepts – Semiconductor Ram memories Direct memory access – Memory hierarchy –Cache memories –Virtual Memory – Memory Management requirements – Secondary storage.

UNIT V ADVANCED COMPUTER ARCHITECTURE **9**

RAID architecture – Storage systems – Parallel processing – Hardware multithreading – Vector (SIMD) processing –Shared-Memory multiprocessors – Cache coherence– Message-passing multicomputer – Introduction to Graphics Processing Units – Clusters and Warehouse scale computers – Introduction to Multiprocessor network topologies.

TOTAL: 45 Hours

TEXT BOOKS:

1. Jim Ledin, "Modern Computer Architecture and Organization - Learn x86, ARM, and RISC-Architectures and the design of smartphones, PCs, and cloud servers", 2nd Edition, Kindle, 2022.
2. Smruti R Sarangi, "Advanced Computer Architecture", 1st Edition, McGraw Hill Education, 2021.

REFERENCE BOOKS:

1. David A Patterson and John L Hennessy, "Computer Organization and Design: The Hardware /Software Interface, 6th Edition, Morgan Kaufmann Publishers In**,** 2020.
2. John Aravindhar D, Veena S and Mohandas R, "Computer Architecture and Organization", 1st Edition, Notion Press, 2022.

WEBSITES:

1. https://www.javatpoint.com/computer-organization-and-architecture-tutorial
2. www.https://onlinecourses.nptel.ac.in/noc23_cs67/preview
3. https://www.geeksforgeeks.org/computer-organization-and-architecture-tutorials/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	1	1	-	2	2	-
CO2	2	1	-	-	-	-	-	-	1	1	-	2	2	-
CO3	3	2	1	-	-	-	-	-	1	1	-	2	2	-
CO4	3	2	1	-	-	-	-	-	1	1	-	2	2	-
CO5	3	2	1	-	-	-	-	-	1	1	-	2	2	-
Average	**2.6**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**2**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

24BECS341 DATABASE MANAGEMENT SYSTEMS 5H-4C
(THEORY & LABORATORY)

Instruction Hours/week: L:3 T:0 P:2 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

PREREQUISITES: NIL

i) THEORY

COURESE OBJECTIVES:

The goal of this course for students is to:

- Understand the data models, conceptualize and design a database system using E-R diagrams
- Acquire the knowledge on the design principles of a relational database system, SQL and Indexing
- Impart knowledge in transaction processing, concurrency control and recovery techniques

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Illustrate the fundamental principles of database management systems and sketch an ER model for a real-world context K2
- Interpret the basic issues of transaction processing, concurrency control, deadlock and its recovery schemes and security schemes K2
- Construct queries in SQL or Relational algebra, relational calculus for providing query-based solutions K3
- Design databases with designed structures and enforce normalization principles in relational databases to eliminate anomalies K3
- Build database storage and access techniques for file organization, indexing methods and query processing K3

UNIT I INTRODUCTION 8

Introduction: Database Architecture – Database design and ER model: Overview of the design process–The ER Model – Constraints – Removing redundant attributes in Entity Sets–ER Diagram – Reduction to Relational Schemas – ER Design Issues. Introduction to Relational Model – Formal Relational Query Languages: Relational Algebra, Relational Calculus: Tuple and Domain Relational Calculus.

UNIT II DATABASE DESIGN & NORMAL FORMS 8

Introduction to SQL: DDL, DML, TCL, DCL– Basic structure of SQL Queries – Set operations – Aggregate functions Nested subqueries – Intermediate SQL: Joins–Views – Integrity Constraints – Functional dependencies – Normal forms based on primary keys – General Definition of Second and Third Normal Form – Boyce Codd Normal Form – Multi valued dependencies and Fourth Normal Form.

UNIT III DATA STORAGE AND INDEXING 8

Data Storage & Indexing: File Organizations Organization of Records in Files Indexing Structures Primary & Secondary Indexes Tree – structured Indexes – Multidimensional Indexes –Hashing – Static hashing – Dynamic hashing – Query Processing and Optimization: Heuristic optimization – Cost based optimization.

UNIT IV TRANSACTION AND RECOVERY 9

Transactions: Transaction concept –Transaction Atomicity and Durability – Transaction Isolation–Serializability –Transaction Isolation and Atomicity– Transaction Isolation levels-Implementation of Isolation Levels –Concurrency Control: Lock based protocols – Deadlock handling –Timestamp based protocols – Recovery system: Failure classification-Storage - Recovery and atomicity.

UNIT V DATABASE SECURITY AND RECENT DBMS 9

Database Security: Common Threats and Challenges – Access Control – DAC, MAC and RBAC models – Intrusion Detection – SQL Injection – Recent DBMS: In-memory databases – Graph database – Open-source DBMS– Databases as a service.

CONTEMPORARY TOPICS 3

TOTAL: 45 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Design E-R Diagram for the relational database.
2. Write a SQL Queries to implement Data Definition Language commands.
3. Write a SQL Queries to implement to implement Data Manipulation Language (DML).
4. Write a SQL Queries to implement to implement Data Control Language (DCL) and TCL commands.
5. Implement Nested Queries and Joins.
6. Querying using Aggregate Functions (COUNT, SUM, AVG, MAX and MIN)
7. Create and manage views and integrity constraints.

TOTAL: 30 Hours

TEXT BOOKS:

1. Silberschatz A, Korth H F and Sudarshan S, “Database System Concepts”, 6th edition, Tata Mc-Graw Hill, 2022.
2. Date C J, “Database Design and Relational Theory”, 2nd Edition, A press Berkeley, CA, 2019.

REFERENCE BOOKS:

1. Ramakrishna R. & Gehrke J, “Database Management Systems”, 3rd Edition, Mc-Graw Hill, 2022.
2. Ramez Elmasri and Shamkant B Navathe, “Fundamental Database Systems”, 7th Edition, Pearson Education, 2021.
3. Robinson, I, Webber, J, & Eifrem E, “Graph Databases”, 3rd Edition, O’Reilly, 2019.

WEBSITES:

1. www.geeksforgeeks.org/dbms/
2. www.guru99.com/dbms-tutorial.html
3. www.javatpoint.com/dbms-tutorial

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	2	2	-	3
CO2	3	2	1	-	-	-	-	-	2	2	2	2	-	3
CO3	3	2	1	-	-	-	-	-	2	2	2	2	-	3
CO4	3	2	1	-	-	-	-	-	2	2	2	2	-	3
CO5	3	2	1	-	-	-	-	-	2	2	2	2	-	3
Average	**2.8**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**-**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

24BECS342 JAVA PROGRAMMING (THEORY & LABORATORY) 5H-4C

Instruction Hours/week: L:3 T:0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PREREQUISITES: C Programming

i) THEORY

COURSE OBJECTIVES:

The goal of this course for students is to:

- Learn the fundamental concepts of Java programming
- Acquire the knowledge of inheritance, abstraction, exception and package in Java
- Obtain the knowledge of Java Collection API, Multithreading, JDBC and Lambda expression in Java

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Infer the fundamental concepts, architecture, and features of Java Programming K2
- Solve programming challenges using object-oriented paradigms K3
- Build applications using multi-tasking mechanisms, and exception handling strategies K3
- Construct robust and efficient Java applications using JDBC, lambda expressions and interface K3
- Develop Java applications by amalgamating object-oriented design, collection usage and advanced data manipulation. K3

UNIT I INTRODUCTION TO JAVA 9

History of Java – Features of Java – Java Architecture – Comments – Data Types – Variables – Operators – Type Conversion and Casting – Flow Control Statements – Reading Input from keyboard – Command Line Arguments – Using Scanner Class – Arrays – Classes and Objects – UML Class diagram – Methods – Constructors – static variables and Methods – this Keyword – Encapsulation – Concept of Access Control.

UNIT II INHERITANCE 9

Inheritance – Types of Inheritance – Super and Sub Classes – super keyword – final class and methods – Object class –Polymorphism – Types of polymorphism – Method Overloading – Constructor Overloading – Method Overriding – Dynamic Method Dispatching – garbage collection – String class –String Buffer class –String Builder class.

UNIT III DATA ABSTRACTION **9**

Packages – Introduction to Packages – User Defined Packages – Accessing Packages – Abstract classes and Methods – Interface – Defining an interface – implementing interfaces-extending interfaces – Multiple Inheritance Using Interface – Exception Handling – Errors vs Exceptions – Exception hierarchy – usage of try – catch – throw – throws and finally – built in exceptions – user defined exceptions.

UNIT IV COLLECTION API AND LAMBDA **9**

Introduction to wrapper classes – Predefined wrapper classes – Conversion of types – Concept of Auto boxing and unboxing – Java Collections API – Introduction to Collection-Generics – List implementations – Set implementations – Map implementations – Functional Interfaces – Lambda Expressions – Accessing local variables – Accessing class variables – Predicates – Functions – Suppliers – Consumers – Stream API – Filter – Sorted- Map – Reduce – Count – Parallel Streams.

UNIT V JDBC AND MULTITHREADING **9**

JDBC – Introduction to JDBC – Establishing connection – Executing query – Processing results – Prepared Statement – Callable Statement – Transactions – Meta Data objects – Multithreading: Introduction to Multithreading – Process Vs Thread –Thread life cycle – Thread class – Runnable Interface – Thread creation – Thread control and priorities – Thread synchronization.

TOTAL: 45 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Develop programs using flow control statements and arrays to manage execution flow and data organization effectively.
2. Implement programs using inheritance and polymorphism to promote code reusability and dynamic method binding.
3. Develop programs incorporating packages, abstract classes, and interfaces to structure code modularly and enforce abstraction.
4. Implement programs using exception handling mechanisms to ensure robust error detection and graceful recovery.
5. Create programs using the Collection API and lambda expressions to manage groups of objects with flexibility and high performance.
6. Implement programs using JDBC to establish and manage database connections for data persistence and retrieval.
7. Develop programs using multithreading to achieve concurrent execution and improve application performance.

TOTAL: 30 Hours

TEXT BOOKS:

1. Herbert Scheldt, " Java: The Complete Reference", 12th edition, Tata McGraw-Hill, 2022.
2. Cay S Horstmann and Gary Cornell, "Core Java: Volume I – Fundamentals", 12th edition, Prentice Hall, 2021.

REFERENCE BOOKS:

1. David Flanagan and Benjamin Evans, "Java in Nutshell", 8th edition, O'Reilly Media, 2022.
2. Kathy Sierra, Bert Bates, Trisha Gee, "Head First Java ", 3rd edition, O'Reilly Media, Inc, 2022.
3. Joshua Bloch, "Effective Java", 3rd Edition, Addison-Wesley Professional, 2018.

WEBSITES:

1. www.https://docs.oracle.com/javase/tutorial/java/nutsandbolts
2. www. https://javabeginner.com/learn-java
3. www. https://dev.java/learn
4. https://www.w3schools.com/java/java_intro.asp

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	3
CO2	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO5	3	2	1	-	-	-	-	-	2	2	-	2	-	3
Average	**2.8**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

24BECS343A DATA STRUCTURES AND ALGORITHMS (THEORY & LABORATORY) 5H-4C

Instruction Hours/week: L:3 T:0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PRE-REQUISITES: Programming in C

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Understand the concepts of abstract data types
- Learn linear and non-linear data structures
- Understand sorting, searching and hashing algorithms

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Interpret the concepts of linear and non-linear data structures K2
- Identify appropriate linear/non–linear data structure operations for solving a given problem K3
- Experiment with linear and non-linear data structure operations to understand their implementation, performance, and practical applications K3
- Apply searching and sorting algorithms for solving a problem K3
- Develop the application using suitable data structures K3

UNIT I LISTS 8

Abstract Data Types (ADTs) – Elementary Data types – List ADT – Array-based implementation – Linked list implementation – Singly linked lists – Doubly-linked lists – Circularly linked lists –Applications of lists – Polynomial ADT – Multilists – Sparse Matrices.

UNIT II STACKS AND QUEUES 8

Stack ADT – Operations – Applications – Balancing symbols – Evaluating arithmetic expressions – Infix to Postfix conversion – Function calls – Queue ADT – Operations – Circular queue – Deque – Applications of queues.

UNIT III TREES 8

Tree ADT – Tree traversals – Binary tree ADT – Expression trees – Binary search tree ADT– AVL Trees– Red-Black trees – Priority queue (Heaps) – Binary heap.

UNIT IV MULTIWAY SEARCH TREES AND GRAPHS 9

B-Tree – B+ Tree – Tries – Graph definition – Representation of graphs – Types of graphs – Breadth-first traversal – Depth-first traversal – Bi-connectivity – Euler circuits –

Topological sort – Dijkstra's algorithm – Minimum spanning tree – Prim's algorithm – Kruskal's algorithm

UNIT V SEARCHING, SORTING AND HASHING TECHNIQUES 9

Searching – Linear search – Binary search – Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort – Quick sort – Merge sort – Heap sort – Radix sort – Hashing – Hash functions – Separate chaining – Open addressing – Rehashing – Extendible hashing.

CONTEMPORARY TOPICS 3

TOTAL: 45 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Implement array implementation of Stack, Queue, and Circular Queue ADTs.
2. Develop the implementation of a singly linked list.
3. Create linked list implementation of stack and linear queue ADTs.
4. Implement the evaluation of postfix expressions and infix to postfix conversion.
5. Develop the implementation of binary search trees and AVL Trees.
6. Implement insertion sort, merge sort and quick sort.
7. Create open addressing (Linear probing and Quadratic probing).

TOTAL: 30 Hours

TEXT BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2019.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, "Introduction to Algorithms", 4th Edition, MIT Press, 2022.

REFERENCE BOOKS:

1. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy", 1st Edition, Career monk Publications, 2019.
2. Langsam, Augenstein and Tanenbaum, "Data Structures Using C and C++", 2nd Edition, Pearson Education, 2020.
3. Jan Wengrow, "A Common–Sense Guide to Data Structures and Algorithm", 2nd Edition, O'Reilly Publications, 2020.
4. Yashavant Kanetkar, "Data Structures Through C", 4th Edition, BPB publications, 2022.

WEBSITES:

1. https://nptel.ac.in/courses/106102064
2. www.coursera.org/learn/data-structures
3. www.cs.usfca.edu/~galles/visualization/Algorithms.html

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	3	-
CO2	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO3	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO4	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO5	3	2	1	-	-	-	-	-	2	2	-	2	3	-
Average	**2.8**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**3**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

24BECS343B DESIGN AND ANALYSIS OF ALGORITHMS 5H-4C
(THEORY & LABORATORY)

Instruction Hours/week: L:3 T:0 P:2 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

PREREQUISITES: Data Structures and Algorithms

i) THEORY

COURSE OBJECTIVES:

The goal of this course for students is to:

- Understand and apply the algorithm analysis techniques on searching and sorting algorithms
- Recognize the various algorithm design techniques and analyze its efficiency
- Solve programming problems using state space tree and concepts behind NP Completeness, Approximation algorithms and randomized algorithms

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Utilize asymptotic notions and recurrence relations for assessment of time and space complexities of non-recursive and recursive algorithms K3
- Implement searching and pattern-matching algorithms for development of solutions to complex computational problems K3
- Construct optimal solutions for real-world applications using greedy techniques and dynamic programming. K3
- Develop solutions for combinatorial problems and travelling salesman problem by using state space search algorithms. K3
- Compute the complexity and feasibility of NP complete and approximation algorithms for computational contexts. K4

UNIT I INTRODUCTION 8

Algorithm analysis: Time and space complexity – Asymptotic Notations and its properties – Best case – Worst case and average case analysis – Mathematical analysis of non-recursive and recursive algorithms – Recurrence relation: substitution method – Masters theorem Sorting – Analysis of Insertion sort and heap sort.

UNIT II BRUTE FORCE APPROACH AND DIVIDE AND CONQUER 8

Searching: linear search – binary search – interpolation Search – Pattern search: The naive string-matching algorithm – Rabin – Karp algorithm – Knuth–Morris – Pratt algorithm. Divide and Conquer methodology: Finding maximum and minimum – Merge sort – Quick sort – Strassen matrix multiplication.

UNIT III GREEDY AND DYNAMIC PROGRAMMING 8

Greedy Technique: Activity-selection problem – Fractional knapsack problem – Huffman Trees – Minimum spanning tree: Kruskal's and Prim's algorithm – Shortest

path – Dijkstra's algorithm – Dynamic programming: Longest common subsequence – Matrix-chain multiplication – All pair shortest path – Floyd's algorithm – Optimal Binary Search Trees.

UNIT IV STATE SPACE SEARCH ALGORITHMS 9

Backtracking: n – Queens problem – Hamiltonian Circuit Problem – Subset Sum Problem – Graph colouring problem Branch and Bound: Solving 15-Puzzle problem – Assignment problem – Knapsack Problem – Travelling Salesman Problem.

UNIT V NP-COMPLETE AND APPROXIMATION ALGORITHM 9

Tractable and intractable problems: Polynomial time algorithms – Venn diagram representation – NP algorithms – NP-hardness – NP-completeness –Bin Packing problem – Problem reduction: TSP–3CNF problem – Approximation Algorithms: TSP – Randomized Algorithms: concept and application – primarily testing – randomized quick sort – Finding k^{th} smallest number.

CONTEMPORARY TOPICS 3

TOTAL: 45 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Analyze Linear Search and Binary Search algorithms with Complexity Analysis.
2. Create implementations of Pattern Matching algorithms.
3. Develop Dijkstra's algorithm for shortest path.
4. Implement dynamic programming solution to find the length of longest common subsequence.
5. Create N Queens problem solution using Backtracking.
6. Implement backtracking solution for Subset Sum Problem.
7. Develop solution for Traveling Salesperson problem.

TOTAL: 30 Hours

TEXT BOOKS:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 4th Edition, Mcgraw Hill/ MIT Press, 2022.
2. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson Education, 2019.

REFERENCE BOOKS:

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Computer Algorithms/ C++", 2nd Edition, Orient Blackswan, 2019.
2. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy: Data Structures and Algorithms
3. S. Sridhar, "Design and Analysis of Algorithms", 2nd Edition, Oxford university Press, 2023.
4. Algorithms: Design and Analysis Oxford higher education, Harsh Bhasin, Oxford University,2015.

WEBSITES:

1. www.https://nptel.ac.in/courses/106106131
2. www.https://geeksforgeeks.org/
3. www.javatpoint.com/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO2	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO3	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO4	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO5	3	3	2	1	-	-	-	-	2	2	-	2	3	-
Average	**3**	**2.2**	**1.2**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**3**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

24BECS344 OPERATING SYSTEMS (THEORY & LABORATORY) 5H-4C

Instruction Hours/week: L:3 T:0 P:2 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PRE-REQUISITES: Computer Architecture

i) THEORY

COURSE OBJECTIVES:

The goal of this course for students is to:

- Provide basic knowledge of computer operating system structures and functioning
- Compare different approaches to memory management, file management and process management
- Understand various problems related to concurrent operations and their solutions

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

• Interpret the functionality of the Operating Systems to monitor, access and control the hardware for the user applications	K2
• Solve the conflict of resource access by processes using process synchronization and deadlock handling techniques	K3
• Build scheduling algorithms to utilize the resources of the system efficiently	K3
• Apply Virtualization approach to achieve portability with appropriate File System	K3
• Analyze the allocation and access strategy of memory for the processes to achieve high performance.	K4

UNIT I BASICS OF OPERATING SYSTEMS AND PROCESS MANAGEMENT 9

Basics of operating systems: Generations – Types – Structure – Services - System Calls - System Boot - System Programs - Protection and Security - Process management: Process Concepts - Process States, Process Control Block –Operation on Process - Scheduling-Criteria - Scheduling Algorithms and their Evaluation – Threads - Threading Issues.

UNIT II PROCESS SYNCHRONIZATION AND DEADLOCK 9

Process synchronization: Background - Critical-Section Problem - Peterson's Solution - Synchronization Hardware – Semaphores - Classic Problems of Synchronization - Monitors. Deadlock: System Model - Deadlock Characterization - Deadlock Prevention - Detection and Avoidance - Recovery form Deadlock.

UNIT III MEMORY MANAGEMENT 9

Main Memory - Swapping - Contiguous Memory Allocation - Paging - Structure of Page Table - Segmentation - Virtual Memory - Demand Paging - Page Replacement Algorithms- Allocation of Frames - Thrashing.

UNIT IV STORAGE MANAGEMENT AND SYSTEM PROTECTION 9

Disk structure and attachment – Disk scheduling algorithms (seek time, rotational latency based) - System threats and security – Policy vs mechanism - Access vs authentication - System protection: Access matrix – Access Control - Capability based systems - OS: performance, scaling, future directions in mobile OS.

UNIT V VIRTUALIZATION AND FILE SYSTEM MANAGEMENT 9

Virtual Machines - Virtualization (Hardware/Software, Server, Service, Network - Hypervisors - Container virtualization - Cost of virtualization - File system interface (access methods, directory structures) - File system implementation (directory implementation, file allocation methods) - File system recovery - Journaling - Soft updates- Log-structured file system - Distributed file system.

TOTAL: 45 Hours

ii) LABORATORY

LIST OF EXPERIMENTS

1. Practice Unix and Shell commands, develop shell scripts and simulate a shell
2. Implement any two CPU scheduling algorithms, simulate and record the process state using SOsim
   a) FCFS
   b) SJF
   c) Priority
   d) Round Robin
3. Implement Bankers Algorithm for Dead Lock Avoidance
4. Implement Semaphore for Producer Consumer Problem
5. Implement any two of the following page replacement algorithms
   a) FIFO
   b) LRU
   c) LFU
6. Implement any two of the following file organization Techniques
   a) Single level directory structure
   b) Two level directory structure
   c) Tree structure
   d) Acyclic graph structure
7. Implement a few Disks Scheduling Algorithms

TOTAL: 30 Hours

TEXT BOOKS:

1. William Stallings, “Operating Systems: Internals and Design Principles”, 10th Edition, Pearson Education, 2021.
2. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, “Operating System Concepts”, 10th Edition, Wiley, 2021.

REFERENCE BOOKS:

1. Charles Crowley, "Operating Systems: A Design-Oriented Approach",1st Edition, CRC Press, 2020.
2. Remzi H. Arpaci-Dusseau, Andrea C. Arpaci-Dusseau, "Operating Systems: Three Easy Pieces", 2nd Edition, Arpaci-Dusseau Books, 2018.
3. Andrew S. Tanenbaum, Herbert Bos, "Modern Operating Systems", 5th Edition, Pearson Education, 2022.

WEBSITES:

1. https://www.coursera.org/courses?query=operating%20system
2. https://www.tutorialspoint.com/operating_system/index.htm
3. https://edu.gcfglobal.org/en/computerbasics/understanding-operating-systems/1/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	3
CO2	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO5	3	3	2	1	-	-	-	-	2	2	-	2	-	3
Average	**2.8**	**2**	**1.2**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24BECC401A PROBABILITY AND STATISTICS 4H-4C

Instruction Hours/week: L:3 T:1 P:0 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

PRE-REQUISITES: Numerical Methods

COURSE OBJECTIVES:

The goal of this course for students is to:

- Provide the required fundamental concepts of probability theory, Random variables and its distributions.
- Impart the knowledge of Measures of Central tendencies and Dispersions
- Impart the knowledge of correlation and Regression
- Inculcate the knowledge of testing of hypothesis using small and large sampling tests.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Infer the fundamentals of probability and random variables K2
- Explain standard distributions of random variables. K2
- Make use of statistical data for finding the measures of central tendency and measures of dispersion. K3
- Interpret the data using correlation and regression. K2
- Apply small and large sample tests in testing of hypothesis. K3

UNIT I PROBABILITY AND RANDOM VARIABLES 12

Concept of Probability – Addition and multiplication laws – Conditional probability – Total Probability – Baye's theorem and its applications – One dimensional Random Variables (Discrete and Continuous) – Mathematical Expectation.

UNIT II THEORETICAL DISTRIBUTIONS 12

Discrete distributions – Binomial, Poisson, Geometric Distributions – Continuous distributions – Uniform, Exponential and Normal Distributions.

UNIT III DESCRIPTIVE STATISTICS 12

Measures of Central Tendency – Mean, Median, Mode – Measures of Dispersion – Mean deviation – Standard deviation – Coefficient of variation

UNIT IV CORRELATION AND REGRESSION 12

Correlation – Pearson's Correlation coefficient – Spearman's Rank correlation coefficient Regression – Regression lines- Linear, Multiple Regression- Logistic Regression - Polynomial Regression.

UNIT V TESTING OF HYPOTHESIS 12

Large sample tests based on normal distribution – Test for single mean – Difference between means – Proportion – Difference between proportions – Small sample test –

Student-t test – Test for single mean – Difference between means – Snedecor's F test – Chi-square test for goodness of fit, independence of attributes.

TOTAL: 45+15 Hours

TEXT BOOKS:

1. Geoffrey Grimmett and David Stirzaker, "Probability and Random Processes", Oxford University Press, 4th Edition, 2020.
2. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, "Introduction to Mathematical Statistics", Pearson, 8th Edition, 2019

REFERENCE BOOKS:

1. Sheldon M Ross, "Introduction to Probability and statistics for Engineers and scientists", Elsevier, 6thEdition, 2021.
2. Douglas C. Montgomery and George C. Runger, "Applied Statistics and Probability for Engineers", John Wiley, 7th Edition, 2019.
3. Allen Craig Robe V Hogg, Joseph W Mckean, "Introduction to Mathematical Statistics", Pearson, 8th Edition, 2021.

WEB SITES:

1. www.britannica.com/science/probability
2. www.britannica.com/science/density-function
3. www.khanacademy.org/math/statistics-probability

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	1	1
CO2	2	1	-	-	-	-	-	-	-	-	-	2	1	1
CO3	3	2	1	-	-	-	-	-	-	-	-	2	2	2
CO4	2	1	-	-	-	-	-	-	-	-	-	2	1	1
CO5	3	2	1	-	-	-	-	-	-	-	-	2	2	2
Average	**2.4**	**1.4**	**1**	-	-	-	-	-	-	-	-	**1**	**1.4**	**1.4**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-IV

24BECC401B STATISTICS AND OPTIMIZATION TECHNIQUES 4H-4C

Instruction Hours/week: L:3 T:1 P:0 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PRE-REQUISITES: Discrete Mathematics and Stochastic Process

COURSE OBJECTIVES:

The goal of this course for students is to:

- Understand the concept of statistical tools and statistical techniques from both applied and theoretical points of view.
- Solve the linear programming problem using Graphical method, Simplex method and Dual simplex method.
- Impart the knowledge of transportation and assignment models.
- Afford the adequate knowledge on networking models and game theory.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Explain the concept of measures of central tendency and measures of dispersion K2
- Apply small and large sample tests in testing of hypothesis. K3
- Make use of Graphical method, Simplex method and Dual simplex method in linear programming models. K3
- Interpret solutions for transportation and assignment problems K2
- Solve the network models, 2xn and mx2 games with and without saddle point. K3

UNIT I DESCRIPTIVE STATISTICS 12

Measures of central tendency – Mean, median, mode, geometric mean and harmonic mean – Dispersions – Range, mean deviation, variance, standard deviation, coefficient of variation – Relative measures – Coefficient of correlation – Pearson's correlation coefficient – Lines of regression.

UNIT II TESTING OF HYPOTHESIS 12

Test of hypothesis – Large sample tests based on normal distribution – Test for single mean – Difference between means – Proportion – Difference between proportion – Small sample test – Student-t test – Test for single mean – Difference between means – Snedecor's F test – Chi-square test for goodness of fit, independence of attributes.

UNIT III LINEAR PROGRAMMING PROBLEM 12

Advantages and disadvantages of LP - Formulation of LP - Algebric solution of a LP - Graphical method - The simplex method - Principle of duality - Dual and primal problems - Dual simplex method.

UNIT IV TRANSPORTATION AND ASSIGNMENT MODELS 12

Initial basic feasible solution - North west corner rule, row-minima, column minima, matrix minima and Vogel's approximation methods - MODI method for finding optimum solution - Unbalanced transportation problems – Assignment Model - Initial basic feasible solution - Hungarian algorithm - Unbalanced Assignment Problem - Maximization in assignment problems.

UNIT V NETWORK MODELS AND GAME THEORY 12

CPM & PERT techniques - Critical path method - PERT approach - Expected length of a project - Probability of project completion by due date - Game theory – Pay-off matrix-Pure strategies: Games with saddle point - The rules of dominance - mixed strategies: Games without saddle point Solution of 2xn and mx2 games.

TOTAL: 45+15 Hours

TEXT BOOKS:

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, "Introduction to Mathematical Statistics",18th Edition, Pearson Education Limited, 2019.
2. Geoffrey Grimmett and David Stirzaker, "Probability and Random Processes", Oxford UniversityPress,4th Edition, 2020.

REFERENCE BOOKS:

1. S.C. Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics", 12th Edition, Sultan Chand & Sons, 2020.
2. Frederick S. Hillier Gerald J. Lieberman Bodhibrata Nag PreetamBasu, "Introduction to Operations Research", 10th Edition, Tata McGraw-Hill Education, 2017.
3. Ronald L Rardin, "Optimization in Operations Research", 2nd Edition, Pearson, 2017.

WEBSITES:

1. www.classcentral.com/course/udacity-intro-to-descriptive-statistics-2309
2. www.classcentral.com/course/open-edatpsu-stat-506-sampling-theory-and-methods-116656
3. www.classcentral.com/course/swayam-operations-research-14219

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	1	1	1
CO2	3	2	1	-	-	-	-	-	-	-	-	1	2	2
CO3	3	2	1	-	-	-	-	-	-	-	-	1	2	2
CO4	2	1	-	-	-	-	-	-	-	-	-	1	1	1
CO5	3	2	1	-	-	-	-	-	-	-	-	1	2	2
Average	**2.6**	**1.6**	**1**	-	-	-	-	-	-	-	-	**1**	**1.6**	**1.6**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-IV

24BECS441 COMPUTER NETWORKS 5H-4C

(THEORY & LABORATORY)

Instruction Hours/week: L:3 T:0 P:2 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PREREQUISITE: Nil

i) THEORY

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Understand the concept of data communication, functionalities of layers and switching techniques.
- Impart knowledge in wired & wireless communication protocols, flow control and congestion control mechanisms.
- Gain knowledge of application layer the data encryption and decryption techniques.

COURSE OUTCOMES:

Upon Completion of this course the students will be able to:

- Summarize the functionalities and roles of OSI, TCP/IP models in network communication. K2
- Apply routing techniques to address issues of congestion and flow control in network protocols K3
- Differentiate between routing techniques using TCP and UDP protocols to understand their impact on data transmission efficiency and reliability. K3
- Identify the purpose of protocols and standards to ensure interoperability and efficiency K3
- Apply public key cryptosystems to encrypt and decrypt process K3

UNIT I DATA COMMUNICATION AND NETWORKS 9

Data Communication: Components Data Representation – Data Flow - Networks: Categories of network - Protocols and Standard - Network Topologies - OSI Model - TCP/IP Protocol suite- Digital Signals - Digital Transmission: Digital to digital transmission - Transmission Modes – Multiplexing - Transmission Media

UNIT II DATA LINK AND PHYSICAL LAYERS 9

Data Link Layer – Framing – Flow control – Error control – Data-Link Layer Protocols – HDLC – PPP - Media Access Control – Ethernet Basics – CSMA/CD – Virtual LAN – Wireless LAN (802.11) - Physical Layer: Data and Signals - Performance – Transmission media- Switching – Circuit Switching Data Link Layer – Framing – Flow control – Error control – Data-Link Layer Protocols – HDLC – PPP - Media Access Control – Ethernet Basics – CSMA/CD – Virtual LAN – Wireless LAN (802.11) - Physical Layer: Data and Signals - Performance – Transmission media- Switching – Circuit Switching. Data Link Layer – Framing – Flow control – Error

control – Data- Link Layer Protocols – HDLC –PPP - Media Access Control – Ethernet Basics – CSMA/CD – Virtual LAN – Wireless LAN (802.11) - Physical Layer: Data and Signals - Performance – Transmission media- Switching – Circuit Switching.

UNIT III NETWORK LAYER AND ROUTING 9

Switching: Packet Switching - Internet protocol - IPV4 – IP Addressing – Subnetting - IPV6, ARP, RARP, ICMP, DHCP Switching: Packet Switching - Internet protocol - IPV4 – IP Addressing – Subnetting - IPV6, ARP, RARP, DHCP - Routing and protocols: Unicast routing - Distance Vector Routing - RIP - Link State Routing – OSPF – Path-vector routing - BGP

UNIT IV TRANSPORT LAYER 9

Transport Layer: Process to Process Delivery - User Datagram Protocol – TCP - Congestion control- Congestion control in TCP and Frame Relay - Congestion avoidance (DECbit, RED) – SCTP - Techniques to improve QoS.

UNIT V APPLICATION LAYER AND SECURITY 9

Application Layer protocols: HTTP – FTP – Email protocols (SMTP - POP3 - IMAP - MIME) – DNS – SNMPApplication Layer protocols: HTTP - WWW – FTP – Email protocols (SMTP - POP3 IMAP - MIME) – DNS – SNMP - Cryptography: Introduction – Categories of cipher techniques. Application Layer protocols: HTTP – FTP – Email protocols (SMTP - POP3 - IMAP - MIME) – DNS – SNMP

TOTAL: 45 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Implement a network topology with NS2 involving a set of nodes (4 nodes).
2. Develop implementations of the stop-and-wait protocol and sliding window protocol.
3. Implement Subnetting techniques to optimize network addressing.
4. Design and implement routing algorithms for efficient data transmission.
5. Implement Transmission Control Protocol (TCP) and User Datagram Protocol (UDP).
6. Develop a File Transfer Protocol (FTP) implementation.
7. Simulate error correction codes (e.g., CRC) for data integrity in communication protocols.

TOTAL: 30 Hours

TEXT BOOKS:

1. Behrouz A. Forouzan, Data communication and Networking, Tata McGraw –Hill, Sixth Edition, 2022.
2. William Stallings, Cryptography and Network security – Principles and Practices, Pearson Education, Seventh Edition,2017.

REFERENCE BOOKS:

1. Andrew S. Tanenbaum, Nick Feamster, David J Wetherall, Computer Networks, Pearson Education, Sixth Edition, 2022
2. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Morgan Kaufmann Publishers, Sixth Edition, 2018.
3. James F. Kurose, Keith W. Ross, Computer Networking – A Top-Down Approach Featuring the Internet, Pearson Education, Seventh Edition, 2017.

WEB SITES:

1. https://www.javatpoint.com/computer-network-tutorial.
2. https://www.coursera.org/courses?query=computer%20network
3. https://archive.nptel.ac.in/courses/106/105/106105183//

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	2
CO2	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO5	3	2	1	-	-	-	-	-	2	2	-	2	-	2
Average	**2.8**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-IV

24BECS442 ARTIFICIAL INTELLIGENCE 5H-4C
(THEORY & LABORATORY)

Instruction Hours/week: L:3 T:0 P:2 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

PREREQUISITES: - Probability and Statistics

i) THEORY

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Impart knowledge about Artificial Intelligence.
- Understand the main abstractions and reasoning for intelligent systems.
- Learn the basic principles of Artificial Intelligence in various applications

COURSE OUTCOMES:

Upon Completion of this course the students will be able to:

- Interpret the structures of Learning concepts and use of PROLOG in AI. K2
- Apply the AI intelligent agents to a given real time dataset K3
- Analyze the search strategies and its types K4
- Examine the structures and algorithms selection in Artificial Intelligence techniques related to knowledge representation and reasoning. K4
- Compare AI with human intelligence and traditional information processing to complex and human-centered problems. K4

UNIT I INTRODUCTION TO AI 9

Introduction - Definition - Characteristics of Intelligent Agents - Typical Intelligent Agents - Problem Solving Approach to Typical AI problems, History of Artificial Intelligence, The State of the Art, Future of Artificial Intelligence, Risks and Benefits of AI.

UNIT II INTELLIGENT AGENTS 9

Agents and Environment, The Concept of Rationality: Performance measures, Rationality, Omniscience, learning, and autonomy, Agent architectures (e.g., reactive, layered, cognitive), The Nature of Environments: Specifying the task environment, Properties of task environments, The Structure of Agents.

UNIT III PROBLEM-SOLVING 9

Solving Problems by Searching: Problem-Solving Agents, Search problems and solutions, formulating problems, Search Algorithms, Breadth-first search, Depth-first search, A* search, the effect of heuristic accuracy on performance, Generating heuristics from relaxed problems. Local Search and Optimization Problem, Hill-climbing search, Constraint Satisfaction Problem, Variations on the CSP formalism.

UNIT IV KNOWLEDGE AND REASONING 9

Logical Agents: Knowledge-Based Agents, Logic, Propositional Logic: A Very Simple Logic, Syntax, Semantics, A simple knowledge base, A simple inference procedure, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Conjunctive normal form, A resolution algorithm, Completeness of resolution, Forward and backward chaining.

UNIT V ADVERSARIAL SEARCH AND GAMES 9

Game theory, classification of games, game playing strategies, prisoner's Dilemma, Game playing techniques, minimax procedure, alpha-beta cut-offs, Complexity of alpha-beta search, Limitations of game search algorithms.

TOTAL: 45 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Installation and working on various AI tools viz Scikit Learn, Tensorflow, Keras, CNTK.
2. Data pre-processing and annotation and creation of datasets.
3. Implementation of Breadth First and Depth First searching techniques.
4. Implementation of Hill climbing algorithm.
5. Implementation of A* Algorithm.
6. Designing a Chat bot application.
7. Write a program for problem solving methods.

TOTAL: 30 Hours

TEXT BOOKS:

1. S.Russell and P.Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, Fourth Edition, 2021.
2. I. Bratko, Prolog: Programming for Artificial Intelligence, Fourth edition, Addison-Wesley Educational Publishers Inc, 2011

REFERENCE BOOKS:

1. David L. Poole and Alan K. Mackworth, Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2023.
2. Deepak Khemani, Artificial Intelligence, Tata McGraw Hill Education 2013.
3. Mishra R B, Artificial Intelligence, PHI Learning Pvt. Ltd., New Delhi, 2013.

WEBSITES:

1. https://plato.stanford.edu/entries/artificial-intelligence/
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2010/
3. https://oli.cmu.edu/learn-with-oli/see-all-oli-courses/
4. https://aitopics.org/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	2	-
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CO3	3	3	2	1	-	-	-	-	2	2	-	2	2	-
CO4	3	3	2	1	-	-	-	-	2	2	-	2	2	-
CO5	3	3	2	1	-	-	-	-	2	2	-	2	2	-
Average	**2.8**	**2.4**	**1.8**	**1**	-	-	-	-	**2**	**2**	-	2	2	-

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-IV

24BECS443A ADVANCED ALGORITHMS (THEORY & LABORATORY) 5H-4C

Instruction Hours/week: L:3 T:0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PREREQUISITES: Design and analysis of algorithms

i) THEORY

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Learn programming and mathematical backgrounds for design and analysis of algorithm
- Study the concept of designing an algorithm and pattern matching
- Have a complete understanding of the various advanced graph algorithms and applications

COURSE OUTCOMES:

Upon Completion of this course the students will be able to:

- Outline the mathematical properties involved in algorithmic design K2
- Apply the number theory approaches for advanced algorithms K3
- Identify the role of efficient problem solving techniques K3
- Construct optimal algorithms used in competitive programming K3
- Determine the working principles involved in string algorithms for pattern matching, searching, and manipulation tasks K4

UNIT I INTRODUCTION 9

Programming Language Backgrounds: STL in C++ – Data Structure support in python – Mathematical Backgrounds – Logarithmic Exponentiation – Efficient Prime Factorization-Combinatorics – Sieve of Eratosthenes – Geometry – Co-ordinate Compression Binomial Coefficients – Euclid's extended Algorithm – Line intersections.

UNIT II MATHEMATICAL APPROACHES 9

Probability – Modular Multiplicative inverse – Matrix Exponentiation – Miller rabin Primality Test – Heavy light Decomposition – Convex hull – Hungarian Algorithm – Sweep line Algorithm – Gaussian Algorithm – Pollard Rho Factorization – Euler's Totient Function – Burnside lemma.

UNIT III ADVANCED ALGORITHM DESIGN TECHNIQUES 9

Recursion – Dynamic Programming – Backtracking – Branch and Bound – Suffix Automata – Game Theory – Meet in the middle – arbitrary precision integer – Square root decomposition. Knapsack problem – Stable Marriage Problem – N-Queen Problems – Tug of wars – Sudoku problem – Advanced Trees: Binary Indexed Tree – Segment Tree-Lowest common ancestors – Counting Inversions – Suffix Tree – Interval Tree – Sparse table – k-d tree – Treap – Link/cut tree.

UNIT IV ADVANCED GRAPH ALGORITHMS **9**

Advanced Graph Algorithms: Z-algorithm – Union find/Disjoint Set – Cycle Detection – Bellman Ford – Maxflow – Ford – Fulkerson Min cut – min cost flow – Dinic's Algorithm – Edmonds Karp algorithm – Maximum Bipartite Matching – Topological Sorting – Eulerian & Hamiltonian Paths – Graph Coloring – Blossom's Algorithm – Jarvis algorithm – Graham Scan – Johnson's Algorithm.

UNIT V PATTERN MATCHING AND SEARCHING **9**

Searching and Pattern Matching: Rabin-Karp Algorithm – Aho-Corasick String Matching Algorithm – Manacher's Algorithm – Kasai's Algorithm – Levenshtein distance – Sorting- Quick Select.

TOTAL: 45 Hours

ii) LABORATORY
LIST OF EXPERIMENTS:

1. Implement algorithms to solve geometric problems.
2. Develop solutions using dynamic programming.
3. Implement algorithms using backtracking methods.
4. Detect cycles in a graph using appropriate algorithms.
5. Develop algorithms for topological sorting.
6. Implement graph coloring algorithms.
7. Implement pattern matching algorithms.

TOTAL: 30 Hours

TEXT BOOKS:

1. Cormen T H, Leiserson C E, Rivest RL, Stein C, “Introduction to Algorithms”, 4th Edition, MIT Press, 2022.
2. Yonghui Wu, Jiande Wang, “Data structure Practice for Collegiate Programming Contests and Education”, 1st Edition, CRC Press, 2020.

REFERENCE BOOKS:

1. Steven S. Skiena “The Algorithm Design Manual”, 3rd Edition, Springer, 2020.
2. Michael T. Goodrich, Roberto Tamassia, “Design and Analysis of Algorithms, An Indian Adaptation”, 1st Edition, Wiley, 2021.
3. Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, 3rd Edition, Pearson Education, 2019.

WEBSITES:

1. https://ocw.mit.edu/courses/6-854j-advanced-algorithms-fall-2005/
2. https://www.coursera.org/learn/advanced-algorithms-and-complexity
3. https://www.geeksforgeeks.org/advanced-data-structures/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	3	-
CO2	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO3	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO4	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO5	3	3	2	1	-	-	-	-	2	2	-	2	3	-
Average	**2.8**	**2**	**1.3**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**3**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-IV

24BECS443B DESIGN AND ANALYSIS OF ALGORITHMS (THEORY & LABORATORY) 5H-4C

Instruction Hours/week: L:3 T:0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PREREQUISITES: Data Structures and Algorithms

i) THEORY

COURSE OBJECTIVES:

The goal of this course for students is to:

- Understand and apply the algorithm analysis techniques on searching and sorting algorithms
- Recognize the various algorithm design techniques and analyze its efficiency
- Solve programming problems using state space tree and concepts behind NP Completeness, Approximation algorithms and randomized algorithms

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Utilize asymptotic notions and recurrence relations for assessment of time and space complexities of non-recursive and recursive algorithms K2
- Implement searching and pattern-matching algorithms for development of solutions to complex computational problems K3
- Construct optimal solutions for real-world applications using greedy techniques and dynamic programming K3
- Develop solutions for combinatorial problems and travelling salesman problem by using state space search algorithms. K3
- Compute the complexity and feasibility of NP complete and approximation algorithms for computational contexts. K4

UNIT I INTRODUCTION 8

Algorithm analysis: Time and space complexity – Asymptotic Notations and its properties – Best case – Worst case and average case analysis – Mathematical analysis of non-recursive and recursive algorithms – Recurrence relation: substitution method – Masters theorem Sorting – Analysis of Insertion sort and heap sort.

UNIT II BRUTE FORCE APPROACH AND DIVIDE AND CONQUER 8

Searching: linear search – binary search – interpolation Search – Pattern search: The naive string-matching algorithm – Rabin – Karp algorithm – Knuth–Morris – Pratt algorithm. Divide and Conquer methodology: Finding maximum and minimum – Merge sort – Quick sort – Strassen matrix multiplication.

UNIT III GREEDY AND DYNAMIC PROGRAMMING 8

Greedy Technique: Activity-selection problem – Fractional knapsack problem – Huffman Trees – Minimum spanning tree: Kruskal's and Prim's algorithm – Shortest path – Dijkstra's algorithm – Dynamic programming: Longest common subsequence –

Matrix-chain multiplication – All pair shortest path – Floyd's algorithm – Optimal Binary Search Trees.

UNIT IV STATE SPACE SEARCH ALGORITHMS 9

Backtracking: n – Queens problem – Hamiltonian Circuit Problem – Subset Sum Problem – Graph colouring problem Branch and Bound: Solving 15-Puzzle problem – Assignment problem – Knapsack Problem – Travelling Salesman Problem.

UNIT V NP-COMPLETE AND APPROXIMATION ALGORITHM 9

Tractable and intractable problems: Polynomial time algorithms – Venn diagram representation – NP algorithms – NP-hardness – NP-completeness –Bin Packing problem – Problem reduction: TSP –3CNF problem – Approximation Algorithms: TSP – Randomized Algorithms: concept and application – primarily testing – randomized quick sort – Finding k^{th} smallest number.

CONTEMPORARY TOPICS 3

TOTAL: 45 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Analyze Linear Search and Binary Search algorithms with Complexity Analysis.
2. Create implementations of Pattern Matching algorithms.
3. Develop Dijkstra's algorithm for shortest path.
4. Implement dynamic programming solution to find the length of longest common subsequence.
5. Create N Queens problem solution using Backtracking.
6. Implement backtracking solution for Subset Sum Problem.
7. Develop solution for Traveling Salesperson problem.

TOTAL: 30 Hours

TEXT BOOKS:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 4^{th} Edition, Mcgraw Hill/ MIT Press, 2022.
2. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3^{rd} Edition, Pearson Education, 2019.

REFERENCE BOOKS:

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Computer Algorithms/ C++", 2nd Edition, Orient Blackswan, 2019.
2. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy: Data Structures and Algorithms
3. S. Sridhar, "Design and Analysis of Algorithms", 2nd Edition, Oxford university Press, 2023.
4. Algorithms: Design and Analysis Oxford higher education, Harsh Bhasin, Oxford University,2015.

WEBSITES:

1. www.https://nptel.ac.in/courses/106106131
2. www.https://geeksforgeeks.org/
3. www.javatpoint.com/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO2	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO3	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO4	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO5	3	3	2	1	-	-	-	-	2	2	-	2	3	-
Average	**3**	**2.2**	**1.2**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**3**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-IV

24BECS444A WEB APPLICATION DEVELOPMENT (THEORY & LABORATORY) 5H-4C

Instruction Hours/week: L:3 T:0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PREREQUISITES: **JAVA PROGRAMMING**

i) THEORY

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Understand the concepts of Servlet API and JSP
- Gain knowledge of Hibernate for interacting with database
- Learn the concepts of Spring and Spring Boot

COURSE OUTCOMES:

Upon Completion of this course the students will be able to:

- Outline web application frameworks and architecture using Servlets and JSP for building dynamic web applications. K2
- Illustrate JSP and ORM concepts to effectively manage user interfaces and data interactions in web applications, ensuring seamless integration and functionality K2
- Construct effective web applications with database integration using the Spring Framework to achieve robust and scalable solutions K3
- Develop comprehensive web solutions using Spring Boot, focusing on real-world application scenarios to demonstrate practical expertise in modern web development. K3
- Build advanced web technologies across different layers of a web stack to develop sophisticated and high-performance web applications. K3

UNIT I SERVLET API 9

Introduction to MVC - Features - Components. Servlet: Life Cycle – Types - Servlet Configuration – Servlet Context – Servlet Config - Request Dispatcher – send Redirect - Session Tracking: Cookies – HTTP Session - Servlet with JDBC

UNIT II JSP API 9

JSP: Comparison with Servlet – Architecture - Life Cycle - Scripting Elements – Directives - Action Tags - Implicit Objects - Java Beans in JSP - Expression Language (EL) - JSTL Core Tags - Session Management - Exception Handling – JSP with JDBC.

UNIT III HIBERNATE API 9

Hibernate: Architecture - Object Relation Mapping – Annotation – Querying: Hibernate Query Language - Criteria Queries - Native SQL - Basic O/R Mapping - Collection Mapping - Association Mappings.

UNIT IV SPRING MVC **9**

Spring: Introduction – Architecture - Spring MVC Module - Life Cycle of Bean Factory - Constructor Injection - Dependency Injection - Inner Beans - Aliases in Bean- Bean Scopes - Spring Annotations - Spring AOP Module, Spring DAO - Database Transaction Management - Build Tools: Maven - Gradle.

UNIT V SPRING BOOT **9**

Introduction to Spring Boot - Spring Vs. Spring Boot - Internals - Auto Configuration - Annotations - Spring Data - Crud Repository - JPA Repository - Custom Queries in JPA - Spring Boot Profiles - Spring Web MVC - Thymeleaf – Spring boot with ORM.

TOTAL: 45 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Implement a web application using Servlets to handle HTTP requests and responses.
2. Develop dynamic web pages using JavaServer Pages (JSP).
3. Develop application features using Hibernate Collection Mapping and Association Mapping to manage relationships between entities.
4. Create web applications using the Spring MVC framework.
5. Develop Spring MVC applications integrated with a backend database.
6. Develop Spring applications integrated with JPA.
7. Implement RESTful APIs and microservices using Spring Boot.

TOTAL: 30 Hours

TEXT BOOKS:

1. Jim Keogh, "J2EE: The complete Reference", 1st Edition, McGraw-Hill, 2017
2. Santosh Kumar K, "Spring and Hibernate", 2nd Edition, McGraw-Hill, 2013.

REFERENCE BOOKS:

1. Budi Kurniawan, "Servlet & JSP: A Tutorial", 1st Edition, Brainy Software, 2015.
2. Claudio and Greg, "Developing Java Applications with Spring and Spring Boot", 1st Edition, Packt Publishing, 2018.
3. Shagun Bakliwal, "Mastering Spring Boot 2.0: Build modern, cloud-native, and distributed systems using Spring Boot", 1st Edition, Packt Publishing Ltd, 2018.

WEBSITES:

1. https://www.hibernate.org/orm/documentation/6.1/
2. https://www.udemy.com/courses/development/web-development/
3. https://www.codecademy.com/catalog/subject/web-development

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	2	2	-	2
CO2	2	1	-	-	-	-	-	-	2	2	2	2	-	2
CO3	3	2	1	-	1	-	-	-	2	2	2	2	-	2
CO4	3	2	1	-	1	-	-	-	2	2	2	2	-	2
CO5	3	2	1	-	1	-	-	-	2	2	2	2	-	2
Average	**2.6**	**1.8**	**1**	**-**	**1**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-IV

24BECS444B LOW CODE APPLICATION DEVELOPMENT (THEORY & LABORATORY) 5H-4C

Instruction Hours/week: L:3 T:0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PREREQUISITES: **Nil**

i) THEORY

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Identify and explain key low code development components
- Proficiently use low code platforms/tools for app creation and publication
- Analyze data with machine learning tools and present insights

COURSE OUTCOMES:

Upon Completion of this course the students will be able to:

- Interpret the functionality and application of low code tools for web scraping, API integration, automation, and UI/UX design K2
- Infer low code platforms like Zapier, VoiceFlow, and Figma for effective publishing of applications K2
- Utilize data scraping, API manipulation, and data analysis using machine learning tools. K3
- Build voice applications and bots, integrating services like Giphy and Twitter. K3
- Develop user interfaces and experiences with basic UI/UX principles using low code solutions. K3

UNIT I WEB SCRAPING AND API PARABOLA WITH LOW CODE 9

NoCode Stacks - NoCode Fundamentals. Web Scraping: Scrape Data from Websites- Initial Scraper Setup- Defining our data- Using our Scraped Data. APIs: Filtering Data- Numerical Formatting - Exporting – Publishing data.

UNIT II BUILD AUTOMATIONS AND CREATE BOTS WITH LOW CODE 9

Automations using Zapier: Introduction - Connecting Google sheets - Connecting twitter- Publishing Zapier Automation. Bots: Configuring Slack - Creating First bot using slack - Including conditional and helper functions - Connecting Giphy - Connecting slack to bot - Publishing our bot.

UNIT III DATA SCIENCE 9

Introduction - Data flow- Machine learning. Obviously AI: Introduction- Sourcing - Upload -Analyze- Publish using Obviously AI.

UNIT IV VOICE APP 9

Introduction-VoiceFlow-Initial setup- launch sequence -Querying the user-Calling API for data-Returning Data to the user-Testing the application-Publish the voice app.

UNIT V UI / UX DESIGN FOR APPLICATION 9

Introduction-Business Use case-Tools. Figma: Introduction-File setup - Placing Images - Frame- Building Forms- Profile Image- Proportions- Project.

TOTAL: 45 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Set up an automation in Parabola to integrate data from a public API (e.g., weather or news API) and format it for easy analysis.
2. Configure a Zapier automation that connects Google Sheets with Slack, automatically posting updates or notifications.
3. Build a Slack bot using Zapier that responds to user queries with relevant information sourced from an external API (e.g., Giphy).
4. Upload a dataset to Obviously AI, analyze it using machine learning models, and generate predictive insights without coding.
5. Develop a VoiceFlow application that interacts with users to provide real-time information (e.g., weather forecasts) via voice commands.
6. Design a mobile app interface prototype in Figma, focusing on intuitive navigation and user-friendly interactions.
7. Create an interactive dashboard prototype in Figma that visualizes data insights and allows for customizable widgets and filters.

TOTAL: 30 Hours

TEXT BOOKS:

1. David Wilson, " Low-Code Application Development: A Practical Guide ", 1st Edition, ABC Press, 2021

2. Paul E Love, " Mastering No-Code: Create Professional Quality Apps Without Coding (Vol. 1) ", 1st Edition, Independent Publication, 2021.

3. Mikhail Zhilkin, " Data Science Without Makeup", 1st Edition, CRC Press, 2022.

REFERENCE BOOKS:

1. Mittal Akhil, " Getting Started with Chatbots ", 1st Edition, BPB Publications, 2019.

2. Fabio staiano, " Designing and Prototyping Interfaces with Figma ", 1st Edition, Packt Publishing, 2022.

WEBSITES:

1. https://www.udemy.com/courses/development/no-code-development/
2. https://www.nocode.tech/academy
3. https://www.coursera.org/courses?query=mobile%20app%20development

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	2	-	-	-	2	2	-	2	-	2
CO2	2	1	-	-	2	-	-	-	2	2	-	2	-	2
CO3	3	2	1	-	2	-	-	-	2	2	-	2	-	2
CO4	3	2	1	-	2	-	-	-	2	2	-	2	-	2
CO5	3	2	1	-	2	-	-	-	2	2	-	2	-	2
Average	**2.6**	**1.8**	**1**	**-**	**2**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24BECS501 THEORY OF COMPUTATION 3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

PREREQUISITES: Discrete Mathematics and stochastic Process

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Construct Finite Automata and its equivalence regular expressions
- Learn the grammar and the language with their relationships equating it to develop the compiler
- Generate intermediate codes and perform optimization on the code generated.

COURSE OUTCOMES:

Upon Completion of this course the students will be able to:

- Interpret mathematical foundations of computation and construction of abstract machines using finite automata. K2
- Construct finite automata for Regular Expression and languages. K3
- Construct context free grammar and push down automata for regular languages. K3
- Build a Turing machine from their associated languages and grammars. K3
- Analysis the complexity and computability of decidable and undecidable computational problems. K4

UNIT I FINITE AUTOMATA& REGULAR EXPRESSION 10

Introduction to Turing Machine & FA - DFA – NFA –Epsilon NFA – Equivalence of Deterministic and Nondeterministic Finite Automata - Epsilon NFA conversions - Eliminating Epsilon transitions - DFA Minimization - Regular Expressions – Applications of FA and RE.

UNIT II COMPILER & GRAMMAR 10

Structure of Compilers –Lexical Analyzer - Specification and Recognition of tokens – Lexical analyzer generator - LEX tool –CFG: Derivation Trees, Sentential Forms, Rightmost and Leftmost derivations of Strings. Ambiguity in CFG's, Minimization of CFG's, CNF, GNF, Pumping Lemma for CFL's, Enumeration of Properties of CFL – the Chomsky hierarchy

UNIT III SYNTAX ANALYSIS 10

Top-down Parsing: Recursive Descent Parsing – First and Follow – Predictive parsing-Non recursive predictive parsing – Bottom-up parsing: Reduction - SR Parsing – LR Parsing: LR (0) Automation– SLR parsing – CLR and LALR parsers –YACC.

UNIT IV INTERMEDIATE CODE GENERATION 8

Syntax Directed Definition – Evaluation orders: Dependency graph –L and S attributed definitions –Applications – Intermediate Code Generation – Three Address Code – Type expression and equivalence – Type declaration - Expression translation – Type Checking – Back Patching – Run Time environments – Storage Organization.

UNIT V CODE GENERATION, OPTIMIZATION, TURING MACHINE 7

Code generation: issues in the code generator – Address in the target code - DAG– Basic blocks in flow graphs – Simple code generator – Code optimization: Peephole optimization –The Principal sources of optimization – P, NP Problems – NP complete-NP Hard problems.

TOTAL: 45 Hours

TEXT BOOKS:

1. Keith Cooper D, Linda Torczon, "Engineering a Compiler", Third edition, 2022.
2. Douglas Thain, "Introduction to Compilers and Language Design", Springer Second Edition, 2020.

REFERENCE BOOKS:

1. John Martin, "Introduction to Languages and The Theory of Computation", McGraw Hill, Fourth Edition, 2018.
2. Alfred Aho, Monica Lam, Ravi Sethi, and Jeffrey Ullman, "Compilers: Principles, Techniques and Tools", Pearson Education, Third Edition, 2016.
3. Micheal Sipser, "Introduction to the Theory of Computation", Cengage Learning, Third Edition, 2021.

WEBSITES:

1. www.geeksforgeeks.org/introduction-of-finite-automata/
2. www.gate cse.in/category/compiler-design/
3. https://onlinecourses.nptel.ac.in/noc19_cs79/preview
4. https://www.coursera.org/courses?query=theory%20of%20computation

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	1	1	-	2	2	-
CO2	3	2	1	-	-	-	-	-	1	1	-	2	2	-
CO3	3	2	1	-	-	-	-	-	1	1	-	2	2	-
CO4	3	2	1	-	-	-	-	-	1	1	-	2	2	-
CO5	3	3	2	1	-	-	-	-	1	1	-	2	2	-
Average	**2.8**	**2**	**1.3**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**2**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-V

24BECS502 CLOUD COMPUTING 5H-4C

(THEORY & LABORATORY)

Instruction Hours/week: L:3 T:0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PREREQUISITE: Computer Networks

i) THEORY

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Understand the basics of cloud, Data Center, AWS, Docker and Devops
- Learn about CDC, Virtualization, its components and AWS services. scalability and security in cloud storage
- Design, develop and implement Docker Containers and the cloud services with the help of DevOps

COURSE OUTCOMES:

Upon Completion of this course the students will be able to:

- Interpret the design challenges in the cloud and the basics of virtualization. K2
- Experiment with virtualization of hardware resources and Docker. K3
- Develop and deploy services on the cloud and set up a cloud environment. K3
- Identify the security challenges in the cloud environment. K3
- Apply the concept of virtualization and its types for real world problems. K3

UNIT I CLOUD INTRODUCTION **9**

Cloud: Introduction – Characteristics – Models – Applications – Comparison on-Premise and cloud platform – Key elements of CDC – Compute, storage, and network on business continuity – CDC Management.

UNIT II VIRTUALIZATION **9**

Data Center Management – Application – Virtualized Data Center (VDC) – Virtualization: Compute, Storage, Network virtualization techniques – Virtual provisioning – Block and file level storage virtualization –

UNIT III AWS **9**

AWS: Introduction – AWS EC2 – AWS VPC – AWS Storage types and its benefits – AWS Security – identity and Compliance – AWS Networking and Content Delivery.

UNIT IV DOCKER **9**

Docker: Containers – Terminology – Docker Run Static sites – Docker Images – DockerFile – Docker on AWS – Docker Network – Docker Compose – Development Workflow – AWS EC Services.

UNIT V DEVOPS **9**

Devops: Introduction – Test Driven Development – Continuous Integration – Code coverage – Best Practices – Virtual Machines vs Containers – Rolling Deployments – Continuous Deployment – Auto Scaling.

TOTAL: 45 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Install a C compiler in the virtual machine created using a virtual box and execute Simple Programs
2. Install Google App Engine. Create a hello world app and other simple web applications using
   python/java.
3. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in
   CloudSim.
4. Find a procedure to transfer the files from one virtual machine to another virtual machine.
5. Install Hadoop single node cluster and run simple applications like wordcount.
6. Creating and Executing Your First Container Using Docker.
7. Run a Container from Docker Hub

TOTAL: 30 Hours

TEXT BOOKS:

1. Mark Wilkins, Learning Amazon Web Services (AWS): A Hands-On Guide to the Fundamentals of AWS Cloud, Addison-Wesley Professional, First Edition, 2019.
2. Sean P. Kane, Karl Matthias, Docker: Up & Running: Shipping Reliable Containers in Production, O'Reilly Media Inc, Third Edition, 2015.

REFERENCE BOOKS:

1. Jennifer Davis and Ryn Daniels, Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale, O'Reilly Media Inc. First Edition, 2016.
2. Ardian, Using Docker: Developing and Deploying Software with Containers, O'Reilly Media Inc. First Edition ,2016.
3. Lydia Parziale, Berthold Gunreben, Paul W Novak and Ken Werner, The Virtualization Cookbook for IBM Systems Volume 2: Red Hat Enterprise Linux 7.1 Servers, IBM, First Edition, 2015.

WEBSITES:

1. https://www.cloudacademy.com/course/introduction-to-devops/intro-3/
2. https://www.aws.amazon.com/training
3. https://www.udemy.com/topic/cloud-computing/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	1	1	-	2	-	2
CO2	3	2	1	-	-	-	-	-	1	1	-	2	-	2
CO3	3	2	1	-	-	-	-	-	1	1	-	2	-	2
CO4	3	2	1	-	-	-	-	-	1	1	-	2	-	2
CO5	3	2	1	-	-	-	-	-	1	1	-	2	-	2
Average	**2.8**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	1	1	**-**	**2**	**-**	2

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-V

24BECS541 MACHINE LEARNING 5H-4C

(THEORY & LABORATORY)

Instruction Hours/week: L:3 T:0 P:2 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PRE-REQUISITES: Artificial Intelligence

i) THEORY

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Provide a fundamental concepts of data pre-processing, supervised, unsupervised, and reinforcement learning.
- Equip students with tools and techniques for regression and classification models.
- Explore contemporary K-Means and Hierarchical Clustering and neural networks.

COURSE OUTCOMES:

Upon Completion of this course the students will be able to:

- Explain the fundamental concepts of supervised, unsupervised, reinforcement learning and pre-processing techniques. K2
- Compare the performance of various regression models. K2
- Utilize classification and clustering algorithms to frame ML models. K3
- Build a single layer neural network and a multilayer perceptron. K3
- Analyze machine learning techniques to solve complex problems. K4

UNIT I INTRODUCTION AND DATA PRE-PROCESSING 9

Machine learning – Introduction – Supervised learning – Unsupervised learning – Reinforcement learning – Machine learning lifecycle – Data Preprocessing – Importing the libraries – Importing the dataset – Handling missing data – Outlier detection and removal – Handling Imbalance class - Encoding categorical data – Splitting the dataset – Feature scaling.

UNIT II REGRESSION 9

Regression – Simple linear regression – Multiple linear regression – Polynomial regression – Support vector regression – Decision tree regression – Random Forest regression – Evaluating regression models – Regression model selection

UNIT III CLASSIFICATION 9

Classification – Logistic regression – K-Nearest neighbor – Support vector machine – Kernel SVM – Naive Bayes – Decision tree classification – Random Forest classification – XGBoost – Classification model selection – evaluating classification models.

UNIT IV CLUSTERING, ASSOCIATION, REINFORCEMENT LEARNING **9**

Clustering – K-Means clustering – Hierarchical clustering. Association – Apriori-Eclat algorithm. Dimensionality reduction – PCA – LDA – Kernel PCA. Reinforcement learning – Multi armed bandit problem – Upper confidence bound-Thompson sampling. Model selection – K-fold cross validation – Grid search.

UNIT V NEURAL NETWORKS **9**

Basics of Neural Networks - MP neurons - perceptron - weight - bias - activation - loss function - optimizer; Artificial Neural Networks - Single Layer Neural Network - Multilayer Perceptron.

CONTEMPORARY TOPICS **3**

TOTAL: 45 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
2. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
3. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
4. Implement naive Bayesian Classifier model to classify a set of documents and measure the accuracy, precision, and recall.
5. Write a program to construct a Bayesian network to diagnose CORONA infection using standard WHO Data Set.
6. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using the k-Means algorithm. Compare the results of these two algorithms.
7. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select an appropriate data set for your experiment and draw graphs.

   The programs can be implemented in either Python or R.

TOTAL: 30 Hours

TEXT BOOKS:

1. Peter Wlodarczak, “Machine Learning and its Applications”, 1st Edition, John Wiley, 2020.
2. Wei-Meng, “Python Machine Learning”, John Wiley, First Edition, 2019.

REFERENCE BOOKS:

1. Wei-Meng, “Python Machine Learning”, 1st Edition, John Wiley, 2019.
2. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems”, 3rd Edition, O’Reilly Media, 2022.
3. Pratheerth Padman, “Learn Data Science from Scratch: Mastering ML and NLP with Python in a step-by-step approach”, 1st Edition, BPB Publications, 2024.

WEBSITES:

1. https://www.machinelearningmastery.com/
2. https://www.geeksforgeeks.org/machine-learning/
3. https://www.javatpoint.com/machine-learning

CO, PO, PSO Mapping

CO’S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	2	-	-	-	2	2	-	3	-	3
CO2	2	1	-	-	2	-	-	-	2	2	-	3	-	3
CO3	3	2	1	-	2	-	-	-	2	2	-	3	-	3
CO4	3	2	1	-	2	-	-	-	2	2	-	3	-	3
CO5	3	3	2	1	2	-	-	-	2	2	-	3	-	3
Avg	**2.6**	**1.8**	**1.3**	**1**	**2**	-	-	-	**2**	**2**	-	**3**	-	**3**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

SEMESTER-V

24BECS511 OPEN SOURCE SOFTWARE LABORATORY 4H-2C

Instruction Hours/week: L:0 T:0 P:4 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PREREQUISITE: NIL

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Expose students to FOSS environment and introduce them to use open-source packages in open-source platform.
- Gain the knowledge of shell programming and version control system setup using GIT.
- Use Common Unix Printing System (CUPS), samba and share files to windows

COURSE OUTCOMES:

Upon Completion of this course the students will be able to:

- Apply Linux commands and shell scripts for system configuration. K3
- Develop shell scripts and GUI for specific needs. K3
- Make use of GIT tools for version control system setup. K3
- Identify and Install software packages, Common Unix Printing System (CUPS), samba and share files to windows. K3
- Inference server packages over http or ftp. K4

LIST OF EXPERIMENTS:

1. Shell Programming: Write shell script to show various system configuration like
    - Currently logged user and his log name
    - Your current shell
    - Your home directory
    - Your operating system type
    - Your current path setting
    - Your current working directory
    - Show Currently logged number of users
2. Write shell script to show various system configuration like
    - About your OS and version, release number, kernel version
    - Show all available shells
    - Show mouse settings
    - Show computer CPU information like processor type, speed etc
    - Show memory information
    - Show hard disk information like size of hard-disk, cache memory, model etc
3. File system (Mounted)Shell script program for scientific calculator.

4. Write a script called add names that is to be called as follows, where class list is the name of the class list file, and username is a particular student' username./add names class list username.
   The script should
   - Check that the correct number of arguments was received and print an usage message if not,
   - Check whether the classlist file exists and print an error message if not,
   - Check whether the username is already in the file, and then either
   - Print a message stating that the name already existed, or
   - Add the name to the end of the list.
5. Version Control System setup and usage using GIT.
   - Creating a repository
   - Checking out a repository
   - Adding content to the repository
   - Committing the data to a repository
   - Updating the local copy
   - Comparing different revisions
   - Revert
   - Conflicts and solving a conflict
6. GUI programming: Create scientific calculator – using Gambas or try using GTK or QT
7. Kernel configuration, compilation and installation: Download / access the latest kernel source code from kernel.org, compile the kernel and install it in the local system. Try to view the source code of the kernel
8. Virtualization environment (e.g., xen, kqemu, virtualbox or lguest) to test an applications, new kernels and isolate applications. It could also be used to expose students to other alternate OSs like
   BSD
9. Compiling from source: learn about the various build systems used like the auto* family, cmake, ant etc. instead of just running the commands. This could involve the full process like fetching from a cvs and also include autoconf, automake etc.,
10. Introduction to packet management system: Given a set of RPM or DEB, how to build and maintain, serve packages over http or ftp. and also how do you configure client systems to access the package repository.
11. Installing various software packages. Either the package is yet to be installed or an older version is existing. The student can practice installing the latest version. Of course, this might need Internet access.
    - Install samba and share files to windows
    - Install Common Unix Printing System (CUPS)

PROJECT MODULE

12. Deploy Frappe erpnext in local environment and Setup Workspace
13. Customize client-side scripting for your own requirements
14. Customize server-side scripting for your own requirements
15. Write Reports for your own requirements.

TOTAL: 60 Hours

TEXT BOOKS:

1. Richard Blum, “Christine Bresnahan, “Linux Command Line and Shell Scripting Bible”, Wiley, 4th Edition, 2024.
2. Æleen Frisch, “Essential System Administration: Tools and Techniques for Linux and Unix Administration”, O'Reilly Media, 3rd Edition, 2011.

REFERENCE BOOKS:

1. Jasmin Blanchette, Mark Summerfield,” Programming with Qt 6: Cross-Platform Applications and Python GUIs”, Addison-Wesley Professional, 2nd Edition, 2020.
2. Evi Nemeth, Garth Snyder, Trent R. Hein, Ben Whaley, “UNIX and Linux System Administration Handbook”, Addison-Wesley Professional, 5th Edition, 2017.
3. Kenneth H. Rosen, Douglas A. Host, Rachel Klee,” UNIX: The Complete Reference”, McGraw-Hill Education, 2nd Edition, 2010.

WEBSITES:

1. https://www.tutorialspoint.com/unix/shell_scripting.htm
2. https://www.geeksforgeeks.org/
3. https://www.oreilly.com/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	1	1	-	2	-	2
CO2	3	2	1	-	-	-	-	-	1	1	-	2	-	2
CO3	3	2	1	-	-	-	-	-	1	1	-	2	-	2
CO4	3	2	1	-	-	-	-	-	1	1	-	2	-	2
CO5	3	3	2	1	-	-	-	-	1	1	-	2	-	2
Average	**3**	**2.6**	**1.2**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

SEMESTER-V

24BECS512 COMMUNITY ENGAGEMENT AND SOCIAL RESPONSIBILITY 4H-2C

Instruction Hours/week: L:0 T:0 P:4 **Marks: Internal:100 External:0 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students to:

- Achieve socio economic development through active community engagement.
- Improve the quality of both teaching and research for better understanding of issues in the society.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Explain the role of community engagement in the development of the nation.
- Understand the social problems, social contribution of community networking and various government schemes supporting the community engagement.
- Understand the role of Indian citizens towards community development by adopting a village and carrying out the field work

UNIT I

Concept, Ethics and Spectrum of Community engagement-Local community, Rural culture and Practice of community engagement

UNIT II

Stages, Components and Principles of community development, Utility of public resources – Contributions of self-help groups

UNIT III

Rural Development Programs and Rural institutions- Local Administration and Community Involvement

UNIT IV

Social contribution of community networking, various government schemes– Programmes of community engagement and their evaluation.

UNIT V

Community Engaged Research and Ethics in Community Engaged Research- Rural Distress, Rural Poverty, Impact of COVID-19 on Migrant Laborers, Mitigation of Disaster

REFERENCE BOOKS:

1. Principles of Community Engagement, 2nd Edition, NIH Publication No. 11-7782, Printed June 2011.
2. Lando, Lily Ann & Aktar, Shamima & JM, Apgar & Attwood, Simon & J, Brown & Chisonga, Nixon & Chea, Siek & A, Choudhery & Cole, Steven & Clayton, Terry & Crissman, Charles & Douthwaite, Boru & B, Downing & F, Golam & S, Hak & Gareth, Johnstone & Kabir, Kazi Ahmed & K, Kamp & Karim, Manjurul & Waters-

Bayer, Ann. (2015). Research in development: Learning from the CGIAR Research Program on Aquatic Agricultural Systems.

WEBSITES:

1. https://youtu.be/-SQK9RGBt7o
2. https://www.uvm.edu/sites/default/files/community_engagement_handout.pdf (Community Engagement)
3. https://www.atsdr.cdc.gov/communityengagement/pce_concepts.html(Perspectives of Community)
4. https://egyankosh.ac.in/bitstream/123456789/59002/1/Unit1.pdf(community concepts)
5. https://sustainingcommunity.wordpress.com/2013/07/09/ethics-and-community-engagement/(Ethics of community engagement)

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	-	1	-	-	-	1	-	-
CO2	-	-	-	-	-	1	-	1	-	-	-	1	-	-
CO3	-	-	-	-	-	1	-	1	-	-	-	1	-	-
CO4	-	-	-	-	-	1	-	1	-	-	-	1	-	-
CO5	-	-	-	-	-	1	-	1	-	-	-	1	-	-
Avg	-	-	-	-	-	**1**	-	**1**	-	-	-	**1**	-	-

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-VI

24BECC601 UNIVERSAL HUMAN VALUES 2H-2C

Instruction Hours/week: L:2 T:0 P:0 Marks: Internal: 40 External:60 Total:100

End Semester Exam:3 Hours

PRE-REQUISITE: NIL

COURSE OBJECTIVES:

The goal of this course is for students to:

- Help students to understand the need, basic guidelines, content and process of value education.
- Help students distinguish between values and skills
- Help students initiate a process of dialog within themselves to know what they 'really want to be in their life and profession
- Help students understand the meaning of happiness within their selves.
- Help students understand the meaning of happiness and prosperity for a human being

COURSE OUTCOMES:

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

• Illustrate the significance of value inputs in a classroom, distinguish between values and skills.	**K2**
• Interpret the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society.	**K2**
• Distinguish between the Self and the Body; understand the meaning of Harmony in the Self the Co-existence of Self and Body.	**K4**
• Illustrate the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships.	**K2**
• Identify their role in ensuring a harmonious society.	**K3**

UNIT I COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION 5

Understanding the need, basic guidelines, content and process for Value Education, Self Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

UNIT II UNDERSTANDING HARMONY IN THE HUMAN BEING HARMONY IN MYSELF **5**

Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

UNIT-III UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY HARMONY IN HUMAN-HUMAN RELATIONSHIP **5**

Understanding harmony in the Family- the basic unit of human interaction , Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay- tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society Undivided Society (AkhandSamaj), Universal Order (SarvabhaumVyawastha)- from family to world family

TOTAL HOURS: 15

TEXT BOOKS:

1. R R Gaur, R Sangal and G P Bagaria(2009)."A Foundation Course in Human Values and Professional Ethics"
2. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
3. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
4. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
5. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
6. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
7. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
8. A N Tripathy, 2003, Human Values, New Age International Publishers.

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	3	2	-	-	2	-	2
CO2	-	-	-	-	-	-	-	3	2	-	-	2	-	2
CO3	-	-	-	-	-	1	-	3	2	-	-	2	-	2
CO4	-	-	-	-	-	-	-	3	2	-	-	2	-	2
CO5	-	-	-	-	-	-	-	3	2	-	-	2	-	2
Average	-	-	-	-	-	**1**		**3**	**2**	-	-	**2**	-	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24BECS602 CRYPTOGRAPHY AND NETWORK SECURITY 4H-4C

Instruction Hours/week: L:3 T:1 P:0 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

PRE-REQUISITES: Computer Networks

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Learn basic knowledge about number theory and classical encryption techniques.
- Use symmetric key encryption and public key encryption for encryption and decryption.
- Infer in-depth knowledge on authentication mechanism and application security.

COURSE OUTCOMES:

Upon Completion of this course the students will be able to:

- Interpret OSI security services, security attacks and security mechanism. K2
- Apply symmetric key cryptography algorithms for encryption and decryption process. K3
- Build public key cryptography algorithms for encryption and decryption process. K3
- Make use of digital signature and authentication protocols for message authentication and integrity. K3
- Analyze security solutions for Electronic Mail Security, IP security, and web security. K4

UNIT I OSI SECURITY ARCHITECTURE 9

Overview – OSI security architecture – Attacks and services – Security mechanism – Classical encryption techniques – Basic concepts in number theory and finite fields – Prime numbers – Fermat and Euler's theorem – Primality testing.

UNIT II SYMMETRIC KEY CRYPTOGRAPHY 9

Data Encryption Standard – Block cipher design principles – DES example – The Strength of DES – Triple DES – AES – Modes of operation.

UNIT III PUBLIC KEY CRYPTOGRAPHY 9

RSA – Attacks – Diffie-hellman key exchange – Elliptic curve arithmetic – Elliptic curve cryptography – ElGamal Public key cryptosystems.

UNIT IV MESSAGE AUTHENTICATION AND INTEGRITY 9

Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords - Authentication applications – Kerberos.

UNIT V SECURITY PRACTICE AND SYSTEM SECURITY 9

Electronic Mail security – PGP, S/MIME – IP security – Web Security – System Security: Intruders – Malicious software – viruses – Firewalls.

TOTAL: 45 Hours

TEXT BOOKS:

1. William Stallings, "Cryptography and Network Security Principles and Practices", Pearson/PHI, Eighth Edition ,2023
2. Jonathan Katz, Yehuda Lindell, "Introduction to Modern Cryptography: Principles and Protocols", Chapman and Hall/CRC,Third Edition, 2021.

REFERENCE BOOKS:

1. W. Mao, Modern Cryptography – Theory and Practice, Pearson Education, Third Editon,2018.
2. Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing – Prentice Hall of India, Fifth Edition,2018.
3. Sarhan M. Musa, Network Security and Cryptography, Mercury Learning and Information, Second Edition, 2022.

WEBSITES:

1. https://www.onlinecourses.nptel.ac.in/noc22_cs03.
2. www.geeksforgeeks.org/
3. https://www.scaler.com/topics/computer-network/cryptography-and-network-security.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	1	1	-	2	2	-
CO2	3	2	1	-	-	-	-	-	1	1	-	2	2	-
CO3	3	2	1	-	-	-	-	-	1	1	-	2	2	-
CO4	3	2	1	-	-	-	-	-	1	1	-	2	2	-
CO5	3	3	2	1	-	-	-	-	1	1	-	2	2	-
Average	**2.8**	**2**	**1.3**	**1**	**-**	**-**	**-**	**-**	1	1	**-**	**2**	2	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24BECS603 AGILE SOFTWARE DEVELOPMENT 3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES

The goal of this course for the students is to:

- Equip students with a comprehensive understanding of Agile methodologies
- Learn from industry examples, enhancing student ability to apply theoretical Scrum and Extreme Programming concepts to practical scenarios.
- Gain the knowledge of Agile software design and development in real time applications.

COURSE OUTCOMES

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

- Interpret the fundamental principles and practices associated with each of the agile development methods. K2
- Compare agile software development model with traditional development models and identify the benefits and pitfalls. K2
- Make use of techniques and skills to establish and mentor Agile Teams for effective software development. K3
- Implement Agile Framework SCRUM and Extreme Programming. K3
- Apply core values and principles of Agile Methods in software development. K3

UNIT-I FUNDAMENTALS OF AGILE PROCESS 9

Introduction and background, Agile Manifesto and Principles, Stakeholders and Challenges, Overview of Agile Development Models: Scrum, Extreme Programming (XP), Feature Driven Development, Crystal, Kanban, and Lean Software Development.

UNIT-II AGILE PROJECTS 9

Planning for Agile Teams: Scrum Teams, XP Teams, General Agile Teams, Team Distribution; Agile Project Lifecycles: Typical Agile Project Lifecycles, Phase Activities, Product Vision, Release Planning: Creating the Product Backlog, User Stories, Prioritizing and Estimating, Creating the Release Plan; Monitoring and Adapting: Managing Risks and Issues, Retrospectives.

UNIT-III SCRUM 9

Agile Scrum Framework, Scrum Artifacts, Meetings, Activities and Roles, Scrum Team Simulation, Scrum Planning Principles, Product and Release Planning, Sprinting: Planning, Execution, Review and Retrospective; User story definition and Characteristics, Acceptance tests and Verifying stories, Burn down chart, Daily scrum, Scrum Case Study.

UNIT-IV EXTREME PROGRAMMING (XP) 9

XP Lifecycle, The XP Team, XP Concepts: Refactoring, Technical Debt, Timeboxing, Stories, Velocity; Adopting XP: Pre-requisites, Challenges; Applying XP: Thinking- Pair Programming, Collaborating, Release, Planning, Development; XP Case Study.

UNIT-V AGILE SOFTWARE DESIGN AND DEVELOPMENT 9

Agile design practices, Role of design Principles, Need and significance of Refactoring, Refactoring Techniques, Continuous Integration, Automated build tools, Version control; Agility and Quality Assurance: Agile Interaction Design, Agile approach to Quality Assurance, Test Driven Development, Pair programming: Issues and Challenges.

TOTAL: 45 Hours

TEXT BOOKS:

1.Johnny Schneider, "Understanding Design Thinking, Lean and Agile", O'Reilly Media, 2017.

2.Robert C. Martin, Agile Software Development- Principles, Patterns and Practices, Prentice Hall, First Edition, 2014.

REFERENCE BOOKS:

1. James Shore and Shane Warden, The Art of Agile Development, O'Reilly Media, 2007.

2. Craig Larman, ―Agile and Iterative Development: A manager's Guide, Addison-Wesley, 2004.

3. Ken Schawber, Mike Beedle, Agile Software Development with Scrum, Pearson, 2001.

4. Cohn, Mike, Agile Estimating and Planning, Pearson Education, 2006.

5. Cohn, Mike, User Stories Applied: For Agile Software Development Addison Wisley, 2004.

WEBSITES:

1. https://www.coursera.org/learn/agile-software-development
2. https://nptel.ac.in/courses/106105182
3. https://www.geeksforgeeks.org/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	2	2	3	-
CO2	2	1	-	-	-	-	-	-	2	2	2	2	3	-
CO3	3	2	1	-	-	-	-	-	2	2	2	2	3	-
CO4	3	2	1	-	-	-	-	-	2	2	2	2	3	-
CO5	3	2	1	-	-	-	-	-	2	2	2	2	3	-
Average	**2.6**	**1.6**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**3**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24BECS641 COMPILER DESIGN 5H-4C

Instruction Hours/week: L:3 T:0 P:2 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

PREREQUISITE: Theory of Computation

COURSE OBJECTIVES

The goal of this course for the students is to:

- Learn the various phases of compiler, intermediate code generation and run-time environment.
- Gain the knowledge to implement the front-end of the compiler.
- Implement code generator and code optimization techniques.

COURSE OUTCOMES

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

- Outline the techniques in different phases of a compiler. K2
- Build a lexical analyzer for a sample language using the LEX tool. K3
- Make use of YACC tool to implement parser techniques. K3
- Identify semantics rules (SDT), intermediate code generation and run-time environment. K3
- Apply code generation and code optimization techniques in real time applications K3

UNIT I INTRODUCTION TO COMPILERS & LEXICAL ANALYSIS 8

Introduction- Translators- Compilation and Interpretation- Language processors -The Phases of Compiler – Lexical Analysis – Role of Lexical Analyzer – Input Buffering- Specification of Tokens – Recognition of Tokens – Finite Automata – Regular Expressions to Automata NFA, DFA – Minimizing DFA - Language for Specifying Lexical Analyzers – Lex tool.

UNIT II SYNTAX ANALYSIS 11

Role of Parser – Grammars – Context-free grammars – Writing a grammar Top Down Parsing - General Strategies - Recursive Descent Parser Predictive Parser-LL(1) - Parser-Shift Reduce Parser-LR Parser- LR (0)Item Construction of SLR Parsing Table - Introduction to LALR Parser - Error Handling and Recovery in Syntax Analyzer-YACC tool - Design of a syntax Analyzer for a Sample Language

UNIT III SYNTAX DIRECTED TRANSLATION & INTERMEDIATE CODE GENERATION 9

Syntax directed Definitions-Construction of Syntax Tree-Bottom-up Evaluation of S-Attribute -Definitions- Design of predictive translator - Type Systems-Specification of a simple type Checker- Equivalence of Type Expressions-Type Conversions. Intermediate Languages: Syntax Tree, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking, Back patching.

UNIT IV RUN-TIME ENVIRONMENT AND CODE GENERATION 9

Runtime Environments – source language issues – Storage organization – Storage Allocation Strategies: Static, Stack and Heap allocation - Parameter Passing-Symbol Tables - Dynamic Storage Allocation - Issues in the Design of a code generator – Basic Blocks and Flow graphs - Design of a simple Code Generator - Optimal Code Generation for Expressions– Dynamic Programming Code Generation.

UNIT V CODE OPTIMIZATION 8

Principal Sources of Optimization – Peep-hole optimization - DAG- Optimization of Basic Blocks - Global Data Flow Analysis - Efficient Data Flow Algorithm – Recent trends in Compiler Design.

TOTAL:45 Hours

LIST OF EXPERIMENTS:

1. Using the LEX tool, Develop a lexical analyzer to recognize a few patterns in C. (Ex. identifiers, constants, comments, operators etc.). Create a symbol table, while recognizing identifiers.
2. Implement a Lexical Analyzer using LEX Tool
3. Generate YACC specification for a few syntactic categories.

a. Program to recognize a valid arithmetic expression that uses operator +, -, * and /.
b. Program to recognize a valid variable which starts with a letter followed by any number of letters or digits.
c. Program to recognize a valid control structures syntax of C language (For loop, while loop, if-else, if-else-if, switch-case, etc.).
d. Implementation of calculator using LEX and YACC

4. Generate three address code for a simple program using LEX and YACC.
5. Implement type checking using Lex and Yacc.
6. Implement simple code optimization techniques (Constant folding, Strength reduction and Algebraic transformation)
7. Implement back-end of the compiler for which the three address code is given as input and the 8086 assembly language code is produced as output.

TOTAL: 30 Hours

TEXT BOOKS:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, “Compilers: Principles, Techniques and Tools”, Second Edition, Pearson Education, 2023.
2. M. Ganaga Durga, T. G. Manikumar, Principles of Compiler Design, MJP Publisher, 2019.

REFERENCE BOOKS:

1. Randy Allen, Ken Kennedy, Optimizing Compilers for Modern Architectures: A Dependence based Approach, Morgan Kaufmann Publishers, 2002.
2. Steven S. Muchnick, Advanced Compiler Design and Implementation‖, Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint 2003.
3. Keith D Cooper and Linda Torczon, Engineering a Compiler‖, Morgan Kaufmann Publishers Elsevier Science, Third Science, 2022.

WEBSITES:

1. https://onlinecourses.nptel.ac.in/noc21_cs07/preview
2. https://www.geeksforgeeks.org/last-minute-notes-compiler-design-gq/
3. https://www.tutorialspoint.com/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	3
CO2	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO5	3	2	1	-	-	-	-	-	2	2	-	2	-	3
Average	**2.8**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-VII

24BECS701 PRINCIPLES OF MANAGEMENT AND ENGINEERING ETHICS 3H-3C

Instruction Hours/week: L: 3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PRE-REQUISITE: NIL

COURSE OBJECTIVES

The goal of this course for the students is to:

- Develop a comprehensive understanding of the fundamental aspects of management
- Understand the roles and responsibilities of a manager
- Acquire knowledge in various verticals of management
- Cultivate students' awareness of engineering ethics and human values
- Instill values, foster loyalty, and promote respect for others' rights

COURSE OUTCOMES

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

- Outline the fundamental aspects of management K2
- Apply the acquired skill sets for formulating better business management processes in organizations K3
- Make use of the skills to plan, organize, direct, control and work in teams for efficient outcomes K3
- Illustrate the significance of ethics in the professional & real life. K2
- Analyze situations and make unbiased decisions considering social, environmental and technological impacts K4

UNIT I INTRODUCTION TO MANAGEMENT 9

Management – Science or Art – Manager Vs Entrepreneur – Managerial Roles, skills, and styles – Evolution of Management Thought – Types of Business Organization – Current Trends and Issues in Management.

UNIT II FUNDAMENTALS OF ORGANIZATIONAL PLANNING 9

Planning – Nature and Purpose of Planning – Planning Process – Types of Planning – Strategic Management – MBO – Decision Making Process – Organizing – Nature and Purpose of Organizing – Formal and Informal Organization – Organization Chart – Organization Structure – Line and Staff Authority – Centralization and Decentralization – HRM – Career Planning

UNIT III LEADERSHIP, COMMUNICATION, AND CONTROLLING IN MANAGEMENT 9

Directing – Nature and Purpose of Directing – Motivation – Motivation Theories – Job Satisfaction – Job Enrichment – Leadership – Communication – Process and Barrier of Communication – Controlling – System and Process of Controlling – Budgetary and Non-budgetary Control Techniques – Control Performance – Direct and Preventive Control – Reporting.

UNIT IV ETHICS AND PROFESSIONALISM 9

Scope of Engineering Ethics – Accepting and Sharing Responsibility – Resolving Ethical Dilemmas – Making Moral Choices – Rights Ethics - Duty Ethics – Virtue Ethics – Workplace Responsibilities and Rights – Teamwork – Rights of Engineers – Whistle-Blowing – Truthfulness and Trustworthiness

UNIT V ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as Responsible Experimenters – Research Ethics and Integrity - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study

Total: 45 Hours

REFERENCE BOOKS:

1. Harold Koontz and Heinz Welhrich, "Essentials of Management - An International, Innovation and Leadership Perspective", McGraw Hill, Tenth Edition, 2015.
2. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 2005.
3. Tripathi P C and Reddy P N, "Principles of Management", Tata McGraw Hill, Fifth Edition, 2012.
4. Robbins S.P, Coulter M., and Vohra, N., Management, Pearson (India), Tenth Edition, 2016.
5. Christoper P Neck, Jeffery D Houghton, Emma Murray and Charles L Lattimer, "Management", Wiley, Second Edition, 2016.
6. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Thompson Learning, 2000.
7. R. Subramanian, "Professional Ethics", Oxford University Press, 2017.

WEBSITES:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	1	-	1	2	1
CO2	3	2	1	-	-	-	-	-	-	1	-	1	2	1
CO3	3	2	1	-	-	-	-	-	-	1	-	1	1	1
CO4	2	1	-	-	-	-	-	-	-	1	-	1	2	1
CO5	3	3	2	1	-	-	-	-	-	1	-	1	2	1
Average	**2.6**	**1.8**	**1.3**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**1.8**	**1**

1. **1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

SEMESTER-VII

24BECS702 MULTICORE ARCHITECTURE AND PROGRAMMING 3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PREREQUISITE: Computer Architecture

COURSE OBJECTIVES

The goal of this course for the students is to:

- Understand the challenges in parallel and multithreaded programming and need for multi-core processors, and their architecture.
- Learn about the various parallel programming paradigms.
- Develop multicore programs and design parallel solutions.

COURSE OUTCOMES

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

- Outline the multicore architectures, characteristics and challenges. K2
- Identify the issues in programming Parallel Processors. K3
- Implement the algorithms of Parallel and Distributed Computing using OpenMP and MPI K3
- Design parallel programming solutions to common problems K3
- Analysis the difference between serial processors and parallel processors. K4

UNIT IMULTI-CORE PROCESSORS 9

Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks – Symmetric and Distributed Shared Memory Architectures – Cache coherence – PerformanceIssues – Parallel program design.

UNIT II PARALLEL PROGRAM CHALLENGES 9

Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).

UNIT III SHARED MEMORY PROGRAMMING WITH OpenMP 9

OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs – Library functions – Handling Data and Functional Parallelism – Handling Loops – Performance Considerations.

UNIT IV DISTRIBUTED MEMORY PROGRAMMING WITH MPI 9

MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived datatypes – Performance evaluation

UNIT V PARALLEL PROGRAM DEVELOPMENT 9

Case studies – n-Body solvers – Tree Search – OpenMP and MPI-Implementations and comparison.

TOTAL:45 Hours

TEXT BOOKS:

1. Darryl Gove, "Multicore Application Programming for Windows, Linux, and Oracle Solaris, Pearson, 2011 (unit 2)
2. Michael J Quinn, "Parallel programming in C with MPI and OpenMP, Tata McGraw Hill,2004.

REFERENCE BOOKS:

1. Peter S. Pacheco, "An Introduction to Parallel Programming, Morgan-Kauffman/Elsevier, 2021.
2. Victor Alessandrini, Shared Memory Application Programming, 1st Edition, Concepts and Strategies in Multicore Application Programming, Morgan Kaufmann, 2015.
3. Yan Solihin, Fundamentals of Parallel Multicore Architecture, CRC Press, 2015.

WEBSITES:

1. https://www.studocu.com/
2. https://www.geeksforgeeks.org/
3. https://onlinecourses.nptel.ac.in/noc23_cs113/preview

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	1	-	-	2	2	-
CO2	3	2	1	-	-	-	-	1	1	-	-	2	2	-
CO3	3	2	1	-	-	-	-	1	1	-	-	2	2	-
CO4	3	2	1	-	-	-	-	1	1	-	-	2	2	-
CO5	3	3	2	1	-	-	-	1	1	-	-	2	2	-
Average	**2.8**	**2**	**1.3**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**2**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

B.E. COMPUTER SCIENCE AND ENGINEERING

PROFESSIONAL ELECETIVES

SEMESTER-IV

24BECS4E41 DEEP LEARNING 4H-3C

(THEORY & LABORATORY)

Instruction Hours/week: L:2 T:0 P:2 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

Pre requisites: Nil

i) THEORY

COURSE OBJECTIVES

The goal of this course is for the student is to:

- Provide fundamental concepts of Neural Networks fundamentals.
- Equip students with tools and techniques for optimization techniques and data analysis advanced algorithms.
- Explore contemporary Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs)

COURSE OUTCOMES

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

- Demonstrate proficiency in building and training Neural Networks for various tasks. K2
- Interpret optimization techniques effectively to improve model performance. K2
- Solve advanced algorithms for data analysis and dimensionality reduction. K3
- Develop expertise in Convolutional Neural Networks (CNNs) for image recognition. K3
- Survey the appropriate metrics and validation technique for Recurrent Neural Networks (RNNs) K3

UNIT I INTRODUCTION TO NEURAL NETWORKS 6

Introduction to Neural networks – Biological neuron – McCulloch pitts neuron – Perceptron – Error and error surfaces – Perceptron learning algorithm – Linearly separable Boolean functions – Sigmoid neuron- Multilayer network of sigmoid neurons – Feed forward neural networks – Output functions and loss functions – Back propagation – Activation function – Information content, Entropy, cross entropy

UNIT II OPTIMIZATION TECHNIQUES 6

Gradient descent – Contour maps – Momentum based gradient descent – Nesterov accelerated gradient descent – Stochastic and mini batch gradient descent – Adjusting learning rate and momentum – Adaptive learning rate – Bias correction in Adam.

UNIT IIIDEEP DIVE INTO VARIOUS ALGORITHMS 6

Eigen value decomposition - Principal component analysis – Singular value decomposition. Auto encoders – Introduction – Regularization – Denoising auto encoders – Sparse auto encoders -Contractive auto encoders. Ensemble methods – dropout – unsupervised pretraining –

better activation functions – Initialization strategies – Batch normalization.

UNIT IV CONVOLUTIONAL NEURAL NETWORKS 6

Convolutional neural networks – Input layers – Convolution layers – Pooling layers – Dense layers- LeNet – AlexNet – VGG16 – ResNet – Transfer learning with image data – Oxford VGG Model – Google Inception model – R-CNN – Fast R-CNN – Faster R-CNN – Mask R-CNN – YOLO.

UNIT V NATURAL LANGUAGE PROCESSING USING RNN 6

Language modeling – Vector space model – Continuous Bag of words – Skip gram model. RNN: Introduction – Bidirectional RNN – Artificial Neural Network (ANN)-large language model (LLM)-Long Short Term Memory – Bidirectional LSTM – Sequence to sequence models – Gated recurrent unit.

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Simulate the functioning of McCulloch Pitts neurons in a programming environment.
2. Implement the Perceptron learning algorithm to classify linearly separable Boolean functions.
3. Construct and train a multilayer feedforward neural network for pattern recognition tasks.
4. Implement various gradient descent optimization algorithms
5. Implement auto encoders and explore regularization techniques
6. Construct and train CNNs with different architectures for image classification.
7. Implement recurrent neural networks (RNNs) for sequence modeling tasks.

TOTAL: 30 Hours

TEXT BOOKS:

1. Francois Chollet, Adam Gibson, “Deep Learning with Python”, 2nd Edition, Manning Publications, 2021.
2. Magnus Ekman, “Learning Deep Learning: Theory and Practice of Neural Networks, Computer Vision, Natural Language Processing, and Transformers Using TensorFlow”, 1st Edition, Addison-Wesley Professional, 2021.

REFERENCE BOOKS:

1. Vinita Silaparasetty, “Deep learning projects using tensorflow”, 2 Edition, Apress,2020.
2. David Foster, “Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play”, 2nd edition, Thomson Learning, 2023.

WEBSITES:

1. https://www.archive.nptel.ac.in/noc/courses/noc18/SEM2/noc18-cs41/
2. https://www.deeplearningcourses.com/
3. https://www.coursera.org/learn/neural-networks-deep-learning

CO, PO, PSO Mapping

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	3	-	3
CO2	3	2	1	-	-	-	-	-	2	2	-	3	-	3
CO3	3	2	1	-	-	-	-	-	2	2	-	3	-	3
CO4	3	2	1	-	-	-	-	-	2	2	-	3	-	3
CO5	3	2	1	-	-	-	-	-	2	2	-	3	-	3
Avg	**2.8**	**1.8**	**1**	-	-	-	**-**	**-**	**2**	**2**	**-**	**3**	**-**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-IV

24BECS4E42 PARALLEL AND DISTRIBUTED COMPUTING 4H-3C
(THEORY & LABORATORY)

Instruction Hours/week: L: 2 T: 0 P:2 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

PREREQUISITE: Nil

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to**:**

- Provide an overview of key concepts and principles related to parallel and distributed computing.
- Explore the analytical modeling of parallel programs and performance metrics.
- Utilize CUDA Programming to implement Parallel and Distributed Techniques.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Outline the basics of parallel and distributed computing platforms. K2
- Identify the models and frameworks best suited to workloads. K3
- Solve parallel and distributed computing problems. K3
- Make use of CUDA Programming to implement the algorithms using Parallel and distributed techniques. K3
- Develop Analytical Models of Parallel Programs. K3

UNIT I INTRODUCTION **6**

Latency vs. Bandwidth, Applications and Challenges, Types of architecture, Flynn's taxonomy, Basic concepts: cores, nodes, threads, processes, speedup, efficiency, overhead, strong and weak scaling (Amdahl's law, Gustafson's law), Cache, Principle of Locality, Programming Models.

UNIT II DISTRIBUTED COMPUTING **6**

Distributed Memory, Message Passing Interface, Asynchronous/Synchronous computation/communication, concurrency control, fault tolerance, Distributed Programming with OpenMPI.

UNIT III PARALLEL COMPUTING **6**

Shared memory, data and task parallelism, Synchronization, Concurrent Data Structures, Shared Memory Programming with available APIs: PThreads, OpenMP, TBB.

UNIT IV CUDA PROGRAMMING **6**

GPU Architecture, Programming Models: CUDA/OpenCL, Basic Concepts: Threads, Blocks, Grids, GPU memory hierarchy, Thread Scheduling, Warps and Control divergence, Memory Coalescing, Programming with CUDA, Using CUDA Libraries: CuBLAS, CuFFT.

UNIT V ANALYTICAL MODELING OF PARALLEL PROGRAMS **6**

Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, The Effect of Granularity on Performance, Scalability of Parallel Systems, Minimum Execution Time and Minimum Cost Optimal Execution Time.

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Create the shared memory for parallel computing with APIs.
2. Demonstrate Memory Coalescing technique in CUDA.
3. Create analytical model of parallel programs.
4. Implement the Dense Matrix Algorithms using parallel and distributed programming techniques with CUDA programming.
5. Implement Search Algorithms for Discrete Optimization Problem using parallel and distributed programming techniques with CUDA programming.
6. Implement Graph Algorithms for Discrete Optimization Problem using parallel and distributed programming techniques with CUDA programming.

TOTAL: 30 Hours

TEXT BOOKS:

1. The Art of Multiprocessor Programming by Maurice Herlihy and NirShavit, Morgan Kaufmann Publishers, 2020.(Unit 1,2)
2. Kshemkalyani Ajay D, Mukesh Singhal, "Distributed Computing: Principles, Algorithms and Systems", Cambridge Press, 2011 (Unit 3)
3. Wen-Mei W Hwu, David B Kirk, Programming Massively Parallel Processors A Hands-on Approach, Morgann Kaufmann, 4e, 2022. (Unit 4)
4. A Grama, A Gupra, G Karypis, V Kumar. Introduction to Parallel Computing (2^{nd} ed.). Addison Wesley, 2022. (Unit 5)

REFERENCE BOOKS:

1. C Lin, L Snyder. Principles of Parallel Programming. USA: Addison-Wesley Publishing Company, 2009.
2. J Jeffers, J Reinders. Intel Xeon Phi Coprocessor High-Performance Programming. Morgan Kaufmann Publishing and Elsevier, 2013.
3. T Mattson, B Sanders, B Massingill. Patterns for Parallel Programming. Addison Wesley Professional, 2004.

WEBSITES:

1. https://www.gacbe.ac.in/pdf/ematerial/18MCS35E-U1.pdf
2. https://mrcet.com/downloads/digital_notes/CSE/IV%20Year/PDC%20DIGITAL%20NOTES.pdf
3. https://lastmomenttuitions.com/course/pds-pdc-distributed-system/.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	2	-
CO2	3	2	1	-	-	-	-	-	2	2	-	2	2	-
CO3	3	2	1	-	-	-	-	-	2	2	-	2	2	-
CO4	3	2	1	-	-	-	-	-	2	2	-	2	2	-
CO5	3	2	1	-	-	-	-	-	2	2	-	2	2	-
Average	**2.8**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-IV

24BECS4E43 ETHICAL HACKING 4H-3C

(THEORY & LABORATORY)

Instruction Hours/week: L:2 T:0 P:2 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PREREQUISITE: Nil

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Understand the basics of computer based vulnerabilities
- Explore different foot printing, reconnaissance and scanning methods
- Expose the enumeration and vulnerability analysis methods

COURSE OUTCOMES:

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

- Understand the Core Concepts of Computer-Based Vulnerabilities K2
- Illustrate the foot printing, reconnaissance and scanning method. K3
- Apply the enumeration and vulnerability analysis methods in ethical hacking K3
- Utilize the hacking options available in Web and wireless applications K3
- Make use of tools to perform ethical hacking to expose the vulnerabilities K3

UNIT I INTRODUCTION 6

Ethical Hacking Overview - Role of Security and Penetration Testers .- Penetration-Testing Methodologies- Laws of the Land - Overview of TCP/IP- The Application Layer - The Transport Layer - The Internet Layer - IP Addressing .- Network and Computer Attacks - Malware - Protecting Against Malware Attacks.- Intruder Attacks - Addressing Physical Security

UNIT II FOOT PRINTING, RECONNAISSANCE AND SCANNING NETWORK 6

Footprinting Concepts - Footprinting through Search Engines, Web Services, Social Networking Sites, Website, Email - Competitive Intelligence - Footprinting through Social Engineering - Footprinting Tools - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyond IDS

UNIT III ENUMERATION AND VULNERABILITY ANALYSIS 6

Enumeration Concepts - NetBIOS Enumeration – SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities- Vulnerabilities of Embedded Oss

UNIT IV SYSTEM HACKING **6**

Hacking Web Servers - Web Application Components- Vulnerabilities - Tools for Web Attackers and Security Testers Hacking Wireless Networks - Components of a Wireless Network – Wardriving- Wireless Hacking - Tools of the Trade

UNIT V NETWORK PROTECTION SYSTEMS **6**

Access Control Lists. - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Analysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems - Network- Based and Host-Based IDSs and IPSs - Web Filtering - Security Incident Response Teams – Honeypots.

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Install Kali or Backtrack Linux and use the networking commands
2. Install Metasploit and apply its tools
3. Practice the basics of reconnaissance.
4. Using FOCA / Search Diggity tools, extract metadata and expanding the target list
5. Information gathering using the tool- Robtex.
6. Scan the target using the tool -Nessus.

TOTAL: 30 Hours

TEXT BOOKS:

1.The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS, Elsevier, 2013.
2.The Web Application Hacker’s Handbook: Finding and Exploiting Security Flaws, Dafydd Stuttard and Marcus Pinto, 2011.

REFERENCE BOOKS:

1.Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz, 2014.
2. Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010.
3. Kimberly Graves, “CEH Official Certified Ethical hacker Review Guide”, Wiley Publishers, 2007

WEBSITES:

1. https://www.geeksforgeeks.org/ethical-hacking-tutorial/
2. https://www.tutorialspoint.com/ethical_hacking/index.htm
3. https://www.javatpoint.com/ethical-hacking

CO, PO, PSO Mapping

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	3	-
CO2	2	1	-	-	-	-	-	-	2	2	-	2	3	-
CO3	3	2	1	-	-	-	-	2	2	2	-	2	3	-
CO4	3	2	1	-	-	-	-	2	2	2	-	2	3	-
CO5	3	2	1	-	-	-	-	2	2	2	-	2	3	-
Avg	**2.6**	**1.6**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**2**	-	**2**	**3**	-

Semester IV

24BECS4E44 DEVOPS 4H-3C

(THEORY & LABORATORY)

Instruction Hours/week: L:2 T:0 P:2 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PREREQUISITE: Nil

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to**:**

- Know DevOps terminology, Continuous Integration and Deployment using Jenkins and Ansible.
- Manage and collaborate code efficiently with teams using Git and GitHub.
- Illustrate the benefits and drive the adoption of cloud-based DevOps tools to solve real world problems.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Interpret the collaborative culture between DevOps teams and gain information of cloud service providers. K2
- Develop a strong foundation in version control, collaboration, and project management. K3
- Build automating test cases in Jenkins and Maven. K3
- Make use of Jenkins and Ansible for continuous integration and deployment. K3
- Deploy the applications in Cloud platform using DevOps tools. K3

UNIT I INTRODUCTION TO DEVOPS 6

Software process models - Iterative Agile software development –DevOps Essentials – Lifecycle, Stages, Workflow and Principles - Roles, Responsibilities, and Skills of a DevOps Engineer - DevOps on cloud - AWS- GCP- Azure.

UNIT II VERSION CONTROL WITH GIT AND GITHUB 6

Git and GitHub - Version Control System and Types - Difference between CVCS and DVCS - GIT Basic - GIT Command Line - Installing Git - Initial setup - Git Essentials - Creating repository - Cloning - check- in and committing - Fetch pull and remote - Branching, Creating, Switching and Merging the branches.

UNIT III CONTINUOUS INTEGRATION USING JENKINS 7

Understanding continuous integration - Introduction about Jenkins: Build Cycle, Jenkins Architecture - Jenkins Installation - Overview of Maven – Maven project Structure – Maven Plugins – Project Object Model (POM) – Maven Build life cycle – Adding external dependencies to maven pom.xml – Maven build and test project - Exploring Jenkins Dashboard, Jobs - Creating Jobs, Running the Jobs - Setting up the global environments for Jobs - Disabling and deleting jobs - Build Deployments.

UNIT IV CONFIGURATION MANAGEMENT USING ANSIBLE **5**

Ansible Introduction – Installation - Ansible master/slave architecture - Ansible modules-Ansible Inventory files - Adhoc commands - YAML basics – Ansible Playbook – Creating Roles using Ansible Galaxy, Include vs Import.

UNIT V DEVOPS ON AWS **6**

AWS DevOps Architecture - Thinking in DevOps: The Build, The Test - Automate Testing - Continuous Integration - Build the Pipeline - Deployment Strategies for Virtual Machines - Deployment Strategies for Server less - Deploying to Compute.

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Study and use of DevOps Automation Tools.
2. Perform implementation of various git commands to push and pull a repository, from GitHub.
3. Creating simple Maven project and perform unit test and resolve dependencies.
4. Create CI pipeline using Jenkins.
5. Create a CD pipeline in Jenkins and deploy in Cloud.
6. Create an Ansible playbook for a simple web application infrastructure.

TOTAL: 30 Hours

TEXT BOOKS:

1. Ojasvi Jagtap, Subodh Jain, Getting Started with DevOps, 2017. (Unit 1,2,3)
2. Jeff Geerling, “Ansible for DevOps: Server and configuration management for humans”, First Edition, 2015. (Unit 4)
3. Osama Mustafa, A Complete Guide to DevOps with AWS- Deploy, Build, and Scale Services with AWS Tools and Techniques, Apress Berkeley, CA ,2023(Unit 5)

REFERENCE BOOKS:

1. Emily Freeman, DevOps for Dummies, 1st Edition, For Dummies, 2019.
2. Robert Kernman ,DevOps: Jenkins: The Ultimate Beginner's Guide Kindle Edition,2020
3. John Ferguson Smart, Jenkins: The Definitive Guide, 1st Edition, O′Reilly, 2011.
4. David Johnson, “Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps”, Second Edition, 2016.
5. Roberto Vormittag, “A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises”, Second Edition, Kindle Edition, 2016.

WEBSITES:

1. https://bugfender.com/wp-content/themes/bugfender-wordpress-theme/assets/docs/Jenkins-Starter-Guide-Ebook.pdf
2. https://maven.apache.org/
3. https://www.ansible.com/
4. https://aws.amazon.com/devops/

5. https://www.coursera.org/specializations/aws-devops

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	2	-	-	-	2	2	2	2	-	3
CO2	3	2	1	-	2	-	-	-	2	2	2	2	-	3
CO3	3	2	1	-	2	-	-	-	2	2	2	2	-	3
CO4	3	2	1	-	2	-	-	-	2	2	2	2	-	3
CO5	3	2	1	-	2	-	-	-	2	2	2	2	-	3
Average	**2.8**	**1.8**	**1**	**-**	**2**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**-**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-IV

24BECS4E45 MERN STACK DEVELOPMENT (THEORY & LABORATORY) 4H-3C

Instruction Hours/week: L:2 T:0 P:2 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PREREQUISITE: Nil

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to**:**

- Gain comprehensive knowledge of front-end development using ReactJS
- Understand and apply backend development concepts using Node.js and ExpressJS.
- Learn and manage data storage and manipulation using MongoDB.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

• Utilize ReactJS concepts for front end development and manage state effectively across different components.	K3
• Integrate MongoDB with Node.js applications to perform CRUD operations and handle data storage efficiently.	K3
• Develop RESTful web services using Node.js and Express.js.	K3
• Apply the best practices in ReactJS, Node.js, and Express.js for improving performance and security of web applications.	K3
• Deploy full-stack web applications by using the MERN stack, incorporating front-end, back- end, and database components.	K3

UNIT I INTRODUCTION TO THE MERN STACK & REACT JS BASICS 6

MERN Stack: Overview of MongoDB, Express.js, ReactJS, Node.js. ReactJS Basics: Introduction to ReactJS - DOM and Virtual DOM - Setting Up the Development Environment - React Components: Function Components, Class Components - JSX and Rendering Elements - Handling Events - State and Lifecycle: useState Hook - useEffect Hook - Conditional Rendering - Lists and Keys - Forms and Controlled Components - Lifting State Up - Composition vs Inheritance - Axios for HTTP requests.

UNIT II FRONT END DEVELOPMENT WITH REACT JS ADVANCED 6

React Router: Navigation - Advanced Hooks: useImmer – useContext – useReducer – useRef - useMemo – useCallback – useLayoutEffect - useImperativeHandle - Custom Hooks - Context API for State Management - Introduction to Redux - Higher-Order Components - Error Boundaries - React Performance Optimization - Lazy Loading and Suspense for Code Splitting - Testing with React Testing Library and Jest - Styling: CSS Modules - Styled Components - Material UI

UNIT III – WORKING WITH MONGODB **6**

MongoDB Basics: Introduction to MongoDB - MongoDB Basics - Documents - Collections - Query Language - Installation - The Mongo Shell - Schema Initialization - MongoDB Node.js Driver - Reading from MongoDB - Writing to MongoDB - CRUD - MongoDB Atlas for Cloud Database Management

UNIT IV NODE JS BASICS **6**

Node.js Basics: Introduction to Node.js - Setting Up Node.js: Installation and Version Management, Node.js REPL - Node.js Modules: Built-in Modules (os, fs, path, http) - Creating and Exporting Modules - Using npm - Asynchronous Programming: Callbacks – Promises - Async/Await – Building a Simple Web Server: Using the HTTP Module - Handling Requests and Responses - Working with APIs: Making HTTP Requests - Consuming APIs - Error Handling.

UNIT V EXPRESS JS AND ADVANCED BACKEND DEVELOPMENT **6**

Express.js Basics: Introduction to Express.js - Middleware: Built-in Middleware, Third-party Middleware - Custom Middleware - Routing: Defining Routes - Route Parameters - Handling Different HTTP Methods - Modular Routes - Serving Static Files - Working with Templates: Using Template Engines - Data Access and REST APIs - Authentication and Authorization: JWT Authentication - Error Handling: Error Handling Middleware - Deploy MERN application in Cloud Platform

TOTAL: 30 Hours

ii) LABORATORY
LIST OF EXPERIMENTS:

1. Develop basic React components to understand JSX, state, events and routing.
2. Manage state in a complex application using Context API and Redux.
3. Set up MongoDB and perform basic CRUD operations using MongoDB shell and Mongoose.
4. Create a basic web server with Node.js to handle HTTP requests and serve static files.
5. Develop RESTful APIs using Express.js, including CRUD operations and middleware.
6. Deploy a full-stack MERN application to a cloud platform.

TOTAL: 30 Hours

TEXT BOOKS:

1. Carlos Santana Roldan, “React 18 Design Patterns and Best Practices - Fourth Edition: Design, build, and deploy production-ready web applications with React by leveraging industry-best practices”, Packt Publishing, Fourth Edition, 2023.
2. Vasan Subramanian, “Pro MERN Stack: Full Stack Web App Development with Mongo Express React and Node”, Apress Media LLC, Second Edition, 2019.

REFERENCE BOOKS:

1. Alex Banks and Eve Porcello, “Learning React: Modern Patterns for Developing React Apps”, O'Reilly Media, Third Edition, 2022.

2. Basarat Syed, “Node.js Complete Reference Guide: Master Node.js Frameworks, Libraries and Tools”, Packt Publishing, First Edition, 2020.
3. Shannon Bradshaw, Eoin Brazil, and Kristina Chodorow, “MongoDB: The Definitive Guide”, O'Reilly Media, Third Edition, 2020.

WEBSITES:

1. https://react.dev/
2. https://www.mongodb.com/docs/
3. https://expressjs.com/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	2	2	2	2	-	3
CO2	3	2	1	-	-	-	-	-	2	2	2	2	-	3
CO3	3	2	1	-	-	-	-	-	2	2	2	2	-	3
CO4	3	2	1	-	-	-	-	-	2	2	2	2	-	3
CO5	3	2	1	-	-	-	-	-	2	2	2	2	-	3
Average	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**-**	**3**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

SEMESTER-IV

24BECS4E46 CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES 4H-3C
(THEORY & LABORATORY)

Instruction Hours/week: L:2 T:0 P:2 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

PREREQUISITE: Nil

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Understand the basics of Blockchain
- Learn Different protocols and consensus algorithms in Blockchain
- Learn the Blockchain implementation frameworks

COURSE OUTCOMES:

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

- Interpret the key concepts related to crypto currency and blockchain technologies K2
- Illustrate the concept of a public ledger supporting crypto currency transactions. K2
- Develop a simple blockchain-based application or crypto currency. K3
- Build a decentralized application that interacts with an Ethereum smart contract. K3
- Compare the security features of Proof of Work (PoW) versus Proof of Stake (PoS) consensus algorithms. K3

UNIT I INTRODUCTION TO BLOCKCHAIN 6

Blockchain- Public Ledgers, Blockchain as Public Ledgers – Block in a Blockchain, Transactions- The Chain and the Longest Chain – Permissioned Model of Blockchain, Cryptographic -Hash Function, Properties of a hash function-Hash pointer and Merkle tree.

UNIT II BITCOIN AND CRYPTOCURRENCY 6

A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay

UNIT III BITCOIN CONSENSUS 6

Bitcoin Consensus- Proof of Work (PoW)- Hashcash PoW - Bitcoin PoW- Attacks on PoW- onopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner- Mining Difficulty- Mining Pool-Permissioned model and use cases.

UNIT IV HYPERLEDGER FABRIC & ETHEREUM 6

Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.

UNIT V BLOCKCHAIN APPLICATIONS 6

Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance- Case Study.

TOTAL: 30 Hours

ii) LABORATORY
LIST OF EXPERIMENTS:

1. Install and understand Docker container, Node.js, Java and Hyperledger Fabric, Ethereum and perform necessary software installation on local machine/create instance on cloud to run.
2. Create and deploy a blockchain network using Hyperledger Fabric SDK for Java Set up and initialize the channel, install and instantiate chain code, and perform invoke and query on your blockchain network.
3. Interact with a blockchain network. Execute transactions and requests against a blockchain network by creating an app to test the network and its rules.
4. Deploy an asset-transfer app using blockchain. Learn app development within a Hyperledger Fabric network.
5. Use blockchain to track fitness club rewards. Build a web app that uses Hyperledger Fabric to track and trace member rewards.
6. Car auction network: A Hello World example with Hyperledger Fabric Node SDK and IBM Blockchain Starter Plan. Use Hyperledger Fabric to invoke chain code while storing results and data in the starter plan

TOTAL: 30 Hours

TEXT BOOKS:

1. Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2. Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O’Reilly, 2014.

REFERENCE BOOKS:

1. Daniel Drescher, “Blockchain Basics”, First Edition, Apress, 2017.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
3. Melanie Swan, “Blockchain: Blueprint for a New Economy”, O’Reilly, 2015.
4. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to Build Smart Contracts for Ethereum and Blockchain”, Packt Publishing.
5. Handbook of Research on Blockchain Technology, published by Elsevier Inc. ISBN: 9780128198162, 2020.

WEBSITES:

1.https://consensys.io/blockchain-use-cases/case-studies
2.https://www.ibm.com/blockchain/use-cases/
3.https://blockchain.gov.in/Home/CaseStudy?CaseStudy=PDS

CO, PO, PSO Mapping

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	3	-
CO2	2	1	-	-	-	-	-	-	2	2	-	2	3	-
CO3	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO4	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO5	3	3	2	1	-	-	-	-	2	2	-	2	3	-
Average	**2.6**	**1.8**	**1.3**	**1**	-	-	-	-	**2**	**2**	-	**2**	**3**	-

SEMESTER-V

24BECS5E41 COGNITIVE SCIENCE 4H-3C

(THEORY & LABORATORY)

Instruction Hours/week: L:2 T:0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PRE-REQUISITES: Deep Learning

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for students to:

- Know the theoretical background of cognition
- Understand the link between cognition and computational intelligence
- Explore probabilistic programming language

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Interpret the fundamental of cognitive science concepts and AI applications. **K2**
- Apply planning and learning methods in cognitive systems. **K3**
- Make use of computational intelligence techniques for reasoning and problem solving. **K3**
- Develop cognitive models for memory and language. **K3**
- Analyze the models for cognitive processes and their development. **K4**

UNIT I INTRODUCTION TO COGNITIVE SCIENCE 6

Fundamental Concepts of cognitive science – Computers in Cognitive Science – Applied Cognitive Science – The Interdisciplinary Nature of Cognitive Science – Artificial Intelligence: Knowledge representation, semantic networks, frames, conceptual dependency, scripts, Ontology- Understanding, Common Sense Reasoning.

UNIT II PLANNING AND LEARNING METHODS 6

Planning – Situation Logic- Learning in Cognitive Systems- Rote Learning – Learning by Examples - Incremental Concept Learning – Inductive Learning – Classification Techniques – Statistical Reasoning- Bayesian Classification- Bayesian Networks- Concept Learning- Version Spaces - Discrimination Trees.

UNIT III COMPUTATIONAL INTELLIGENCE 6

Reasoning by analogy – Explanation based reasoning – Case based reasoning- Constraint Satisfaction- Constraint Propagation- Temporal reasoning – Temporal Constraint Networks- Spatial reasoning- Visual Spatial reasoning- Meta reasoning – Learning by correcting mistakes AI ethics

UNIT IV COGNITIVE MODELING **6**

Declarative/ logic-based computational cognitive modelling - connectionist models of cognition- Bayesian models of cognition - Cognitive Models of Memory and Language - Computational models of episodic and semantic memory - modelling psycholinguistics (with emphasis on lexical semantics) - towards deep understanding - modelling the interaction of language, memory and learning.

UNIT V LEARNING MODELS OF COGNITION **6**

Modelling Select Aspects of Cognition Classical models of rationality - symbolic reasoning and decision making under uncertainty - Formal models of inductive generalization causality - Categorization and similarity analysis - Cognitive Development - Child concept acquisition - Child language learning - Acquisition of arithmetic skills – Distributed Cognition and Learning- Simple and Complex Decision Making – Reasoning Under Uncertainty – Natural Language Understanding – Natural Language Processing – Automated

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS

1. Demonstration of Mathematical functions using WebPPL.
2. Implementation of reasoning algorithms.
3. Developing an Application system using generative model.
4. Developing an Application using conditional inference learning model.
5. Application development using hierarchical model.
6. Application development using Mixture model.

TOTAL: 30 Hours

TEXT BOOKS:

1.Jose Luis Bermúdez, Cognitive Science -An Introduction to the Science of the Mind, Cambridge University Press 2020

2.Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, “Probabilistic Models of Cognition”, Second Edition, 2016

REFERENCE BOOKS:

1.Vijay V Raghavan,Venkat N.Gudivada, VenuGovindaraju, C.R. Rao, Cognitive Computing: Theory and Applications: (Handbook of Statistics 35), Elsevier publications, 2016

2.Mallick, Pradeep Kumar, Borah, Samarjeet," Emerging Trends and Applications in Cognitive Computing”, IGI Global Publishers, 2019.

3.Elaine Rich,Kevin Knight, Shivashankar B. Nair, “Artificial Intellegence”, 3rd Edition, TMS, third edirion.

WEBSITES:

1. https://www.geeksforgeeks.org/cognitive-computing/
2. https://ocw.mit.edu/courses/9-66j-computational-cognitive-science-fall-2004
3. https:// elsevier.com/books/cognitive-computing-theory-and-applications/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	2	-
CO2	3	2	1	-	-	-	-	-	2	2	-	2	2	-
CO3	3	2	1	-	-	-	-	-	2	2	-	2	2	-
CO4	3	2	1	-	-	-	-	-	2	2	-	2	2	-
CO5	3	3	2	1	-	-	-	-	2	2	-	2	2	-
Average	**2.8**	**2**	**1.3**	1	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-V

24BECS5E42 INTERNET OF THINGS 4H-3C
(THEORY & LABORATORY)

Instruction Hours/week: L:2 T:0 P:2 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

PREREQUISITE: Parallel and Distributed Computing

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to**:**

- Learn the internal architecture and programming of an embedded processor.
- Build a small low-cost embedded and IoT system using Arduino/Raspberry Pi/Open platform.
- Apply the concept of Internet of Things in real world scenario.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Interpret the architecture of embedded processors. **K2**
- Develop an application using embedded C programs. **K3**
- Design the network of IoT using Arduino. **K3**
- Identify suitable the communication models in IOT for real-world problem. **K3**
- Develop IoT applications using Arduino/Raspberry Pi /open platform. **K3**

UNIT I 8-BIT EMBEDDED PROCESSOR **6**

8-Bit Microcontroller – Architecture – Instruction Set and Programming – Programming Parallel Ports – Timers and Serial Port – Interrupt Handling.

UNIT II EMBEDDED C PROGRAMMING **6**

Memory And I/O Devices Interfacing – Programming Embedded Systems in C – Need For RTOS – Multiple Tasks and Processes.

UNIT III IOT AND ARDUINO PROGRAMMING **6**

Introduction to the Concept of IoT Devices – IoT Devices Versus Computers – IoT Configurations – Basic Components – Introduction to Arduino – Types of Arduino – Arduino Toolchain – Arduino Programming Structure – Sketches – Pins – Input/Output From Pins Using Sketches.

UNIT IV IOT COMMUNICATION AND OPEN PLATFORMS **6**

IoT Communication Models and APIs – IoT Communication Protocols – Bluetooth – WiFi – ZigBee –GSM modules – Open Platform (like Raspberry Pi) – Architecture – Programming – Interfacing – Accessing GPIO Pins – Connecting to the Cloud.

UNIT V APPLICATIONS DEVELOPMENT **6**

Development of IoT Applications – Smart Agriculture – Smart Cities – Smart Healthcare.

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Write 8051 Assembly Language experiments using simulator.
2. Explore different communication methods with IoT devices (Zigbee, GSM, Bluetooth)
3. Interfacing sensors with Raspberry PI
4. Communicate between Arduino and Raspberry PI using any wireless medium
5. Log Data using Raspberry PI and upload to the cloud platform
6. Design an IOT based system

TOTAL: 30 Hours

TEXT BOOKS:

1. Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, "The 8051Microcontroller and Embedded Systems", Pearson Education, Second Edition, 2014. (Unit 1,2)
2. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.(Unit 3,4,5)

REFERENCE BOOKS:

1. Michael J. Pont, "Embedded C", Pearson Education, 2007.
2. Wayne Wolf, "Computers as Components: Principles of Embedded Computer System Design", Elsevier, 2006.
3. Andrew N Sloss, D. Symes, C. Wright, "Arm System Developer's Guide", Morgan Kauffman/ Elsevier, 2006.
4. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015

WEBSITES:

1. https://onlinecourses.nptel.ac.in/noc19_cs65/preview
2. https://www.udemy.com/topic/internet-of-things/
3. https://www.coursera.org/specializations/iot

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	2
CO2	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO5	3	2	1	-	-	-	-	-	2	2	-	2	-	2
Average	**2.8**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

B.E. COMPUTER SCIENCE AND ENGINEERING **2024-2025**

SEMESTER-V

24BECS5E43 DIGITAL AND MOBILE FORENSICS 4H-3C

(THEORY & LABORATORY)

Instruction Hours/week: L:2 T:0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PRE REQUISITES: Operating Systems

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Understand the fundamental concepts of vulnerability assessment and penetration testing.
- Develop skills to identify, analyze, and mitigate vulnerabilities in systems and networks.
- Gain hands-on experience with tools and techniques used in penetration testing and ethical hacking.

COURSE OUTCOMES:

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

- Illustrate the role of digital forensics in criminal and civil investigations **K2**
- Compare the complexities of corporate digital crime evidence **K2**
- Model a methodology for digital forensics using frameworks and readiness **K3**
- Identify challenges in the rapidly evolving field of digital forensics **K3**
- Categorize the digital evidence extraction from iOS and Android devices **K4**

UNIT I INTRODUCTION TO DIGITAL FORENSICS **6**

Forensic Science – Digital Forensics – Digital Evidence – The Digital Forensics Process – Introduction – The Identification Phase – The Collection Phase – The Examination Phase – The Analysis Phase – The Presentation Phase

UNIT II DIGITAL CRIME AND INVESTIGATION **6**

Digital Crime – Substantive Criminal Law – General Conditions – Offenses – Investigation Methods for Collecting Digital Evidence – International Cooperation to Collect Digital Evidence

UNIT III DIGITAL FORENSIC READINESS **6**

Introduction – Law Enforcement versus Enterprise Digital Forensic Readiness – Rationale for Digital Forensic Readiness – Frameworks, Standards and Methodologies – Enterprise Digital Forensic Readiness – Challenges in Digital Forensics

UNIT IV iOS FORENSICS **6**

Mobile Hardware and Operating Systems - iOS Fundamentals – Jail breaking – File System – Hardware – iPhone Security – iOS Forensics – Procedures and Processes – Tools – Oxygen

Forensics – MobilEdit – iCloud

UNIT V ANDROID FORENSICS **6**

Android basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security-Tools – Android Forensics – Forensic Procedures – ADB – Android Only Tools – Dual Use Tools – Oxygen Forensics – MobilEdit – Android App Decompiling

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Installation of Sleuth Kit on Linux. List all data blocks. Analyze allocated as well as unallocated blocks of a disk image.
2. Data extraction from call logs using Sleuth Kit.
3. Data extraction from SMS and contacts using Sleuth Kit.
4. Install Mobile Verification Toolkit or MVT and decrypt encrypted iOS backups.
5. Extract installed applications from Android devices.
6. Extract diagnostic information from Android devices through the adb protocol.
7. Generate a unified chronological timeline of extracted records.

TOTAL :30 Hours

TEXT BOOK:

1. Andre Arnes, “Digital Forensics”, Wiley, 2018.
2. Chuck Easttom, “An In-depth Guide to Mobile Device Forensics”, First Edition, CRC Press, 2022.

REFERENCE BOOKS:

3. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.
4. Gerard Johansen, Kristopher Rush, "Digital Forensics and Incident Response: A Practical Guide to Deploying Digital Forensics and Incident Response", Apress, 2017.
5. EC-Council,Computer Forensics: Investigating Network Intrusions and Cyber Crime", Cengage Learning, 3rd Edition, 2018.

WEB SITES:

6. https://www.geeksforgeeks.org/mobile-forensics-definition-uses-and-principles/
7. https://codehs.com/tutorial/jennifer/digital-forensics
8. https://www.tutorialspoint.com/python_digital_forensics/index.htm

CO, PO, PSO Mapping

CO’S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	-	-	2
CO2	2	1	-	-	-	-	-	-	2	2	-	-	-	2
CO3	3	2	1	-	-	-	-	-	2	2	-	-	-	2
CO4	3	2	1	-	-	-	-	-	2	2	-	-	-	2
CO5	3	3	2	1	-	-	-	-	2	2	-	-	-	2
Avg	**2.6**	**1.8**	**1.3**	**1**	-	-	-	-	**2**	**2**	-	-	-	**2**

1. **1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation**

Semester V

24BECS5E44 VIRTUALIZATION 4H-3C

(THEORY & LABORATORY)

Instruction Hours/week: L:2 T:0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PREREQUISITE: Devops

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to**:**

- Learn the basics and types of Virtualizations
- Understand the Hypervisors and its type.
- Experiment the Virtualization platforms and solutions.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Outline the fundamentals of virtualization and Hypervisor. **K2**
- Experiment the server and desktop virtualization in VM platforms. **K3**
- Utilize Network Virtualization and its tools to allow network administrators to move virtual machines across different domains without reconfiguring the network **K3**
- Build VM with software to simulate hardware functionality and create a virtual computer system. **K3**
- Apply the Virtualization for real-world applications. **K3**

UNIT I INTRODUCTION TO VIRTUALIZATION 6

Virtualization and cloud computing - Need of virtualization – cost, administration, fast deployment, reduce infrastructure cost – limitations- Types of hardware virtualization: Full virtualization – partial virtualization - Para virtualization-Types of Hypervisors

UNIT II SERVER AND DESKTOP VIRTUALIZATION 6

Virtual machine basics- Types of virtual machines- Understanding Server Virtualization- types of server virtualization- Business Cases for Server Virtualization – Uses of Virtual Server Consolidation – Selecting Server Virtualization Platform-Desktop Virtualization-Types of Desktop Virtualization

UNIT III NETWORK VIRTUALIZATION 6

Introduction to Network Virtualization-Advantages- Functions-Tools for Network Virtualization VLAN-WAN Architecture-WAN Virtualization

UNIT IV STORAGE VIRTUALIZATION 6

Memory Virtualization-Types of Storage Virtualization-Block, File-Address space Remapping-Risks of Storage Virtualization-SAN-NAS-RAID

UNIT V VIRTUALIZATION TOOLS **6**

VMWare-Amazon AWS-Microsoft HyperV- Oracle VM Virtual Box - IBM PowerVM-Google Virtualization- Case study.

TOTAL: 30 Hours

ii) LABORATORY
LIST OF EXPERIMENTS:

1. Create type 2 virtualization in VMWARE or any equivalent Open-Source Tool. Allocate memory and storage space as per requirement. Install Guest OS on VMWARE.
2. Configure the following tasks in VMWARE.

a. Shrink and extend virtual disk
b. Create, Manage, Configure and schedule snapshots
c. Create Spanned, Mirrored and Striped volume
d. Create RAID 5 volume

3. Implement Desktop Virtualization using VNC and Chrome Remote Desktop
4. Create type 2 virtualization on ESXI 6.5 server
5. Create a VLAN in CISCO packet tracer
6. Install KVM in Linux
7. Create Nested Virtual Machine (VM under another VM)

TOTAL: 30 Hours

TEXT BOOKS:

1. Cloud computing a practical approach - Anthony T. Velte, Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill, New Delhi – 2010 (Unit 1)
2. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011 (Unit 2, 3)
3. "Virtualization Essentials" by Matthew Portnoy 2012. (Unit 4,5)

REFERENCE BOOKS:

1. David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach
2. Chris Wolf, Erick M. Halter, “Virtualization: From the Desktop to the Enterprise”, A Press, 2005.
3. James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.
4. David Marshall, Wade A. Reynolds, “Advanced Server Virtualization: VMware and Microsoft
Platform in the Virtual Data Center”, Auerbach Publications, 2006.

WEBSITES:

1. https://www.geeksforgeeks.org/virtualization-cloud-computing-types/
2. https://www.coursera.org/learn/network-virtual
3. www.coursera.org/specializations/game-design-and-development
4. https://www.vmware.com/pdf/virtualization.pdf
5. https://aws.amazon.com/whatis/virtualization/#:~:text=Virtualization%20is%20technology%20that%20you,on%20a%20single%20physical%20machine.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	2
CO2	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO5	3	2	**1**	-	-	-	-	-	2	2	-	2	-	2
Average	**2.8**	**1.8**	**1**	-	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester V

24BECS5E45 MOBILE APPLICATION DEVELOPMENT (THEORY & LABORATORY) 4H-3C

Instruction Hours/week: L:2 T:0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PRE-REQUISITES: Operating Systems

i) THEORY

COURSE OBJECTIVES:

The goal of this course for the students is to

- Illustrate android SDK for creating mobile applications
- Understand how to work with layouts in mobile application development frameworks
- Apply android multimedia application to develop android API's.

COURSE OUTCOMES:

Upon completion of this course the students will be able to

• Infer software development kits (SDKs) for iOS, Android, BlackBerry, and Windows	K2
• Identify the methods in storing, sharing and retrieving data in Android applications	K3
• Experiment with responsive and user-friendly interfaces using appropriate layouts and constraints.	K3
• Develop a mobile application by effectively setting up and utilizing the Android SDK environment	K3
• Inspect the mobile app using key features and functions of the Android API	K4

UNIT I MOBILE PLATFORM AND APPLICATIONS 6

Mobile Device Operating Systems — Special Constraints & Requirements — Commercial Mobile Operating Systems — Software Development Kit: iOS, Android, BlackBerry, Windows Phone — MCommerce — Structure — Pros & Cons — Mobile Payment System — Security Issues

UNIT II INTRODUCTION TO ANDROID 6

Introduction to Android: The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building you First Android application, Understanding Anatomy of Android Application, Android Manifest file.

UNIT III ANDROID APPLICATION DESIGN ESSENTIALS 6

Anatomy of Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions.

UNIT IV ANDROID USER INTERFACE DESIGN & MULTIMEDIA 6

User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation. Playing Audio and Video, Recording Audio and Video, Using the Camera to Take and Process Pictures

UNIT V ANDROID APIs **6**

Using Android Data and Storage APIs, Managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World.

Total: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Develop an application that uses GUI components, Font, Layout Managers and event listeners.
2. Develop an application that makes use of databases
3. Develop a native application that uses GPS location information
4. Implement an application that creates an alert upon receiving a message
5. Develop an application that makes use of RSS Feed.
6. Create an android application that converts the user input text to voice.
7. Use debugging tools (e.g., Android Studio Debugger, Xcode Debugger) to identify and fix issues.

Total: 30 Hours

TEXT BOOKS:

1. Lauren Darcey and Shane Conder, “Android Wireless Application Development”, Pearson Education, 3rd Edition. 2012.
2. Google Developer Training, "Android Developer Fundamentals Course – Concept Reference”, Google Developer Training Team, 2017.

REFERENCE BOOKS:

1. Prasanth Kumar Pattnaik, Rajib Mall,” Fundamentals of Mobile Computing”, PHI Learning Pvt.Ltd,New Delhi-2012
2. Reto Meier, “Professional Android 2 Application Development”, Wiley India Pvt Ltd, 2010 Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd, 2009
3. Dawn Griffiths and David Griffiths, “Head First Android Development”, 1st Edition, O“Reilly SPD Publishers, 2015. ISBN-13: 978-9352131341
4. Erik Hellman, “Android Programming – Pushing the Limits”, 1st Edition, Wiley India Pvt Ltd, 2014. ISBN-13: 978-8126547197.
5. Bill Phillips, Chris Stewart and Kristin Marsicano, “Android Programming: The Big NerdRanch Guide”, 4th Edition, Big Nerd Ranch Guides, 2019. ISBN-13: 978-0134706054

WEB SITES:

1. https://www.ibm.com/topics/mobile-application-development
2. https://developer.android.com/studio/intro
3. https://www.coursera.org/learn/introduction-to-android-mobile-application-development

CO, PO, PSO Mapping

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	2	-	-	-	2	2	-	-	2	-
CO2	3	2	1	-	2	-	-	-	2	2	-	-	2	-
CO3	3	2	1	-	2	-	-	-	2	2	-	-	2	-
CO4	3	2	1	-	2	-	-	-	2	2	-	-	2	-
CO5	3	3	2	1	2	-	-	-	2	2	-	-	2	-
Average	**2.8**	**2**	**1.3**	**1**	**2**	-	-	-	**2**	**2**	-	-	**2**	-

1. **1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

Semester V

24BECS5E46	DIGITAL MARKETING (THEORY & LABORATORY)	4H-3C

Instruction Hours/week: L:2 T:0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PREREQUISITE: Nil

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to**:**

- Understand the fundamentals and learn practical strategies in Digital Marketing.
- Explore real-world case studies to gain insights and skills applicable in the digital marketing landscape.
- Provide comprehensive knowledge and actionable steps, ensuring participants are equipped to create effective digital marketing campaigns and strategies.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

• Demonstrate proficiency in optimizing website content for search engines.	**K2**
• Develop a comprehensive digital marketing strategy for a business.	**K3**
• Identify effective search engine marketing campaigns using various platforms.	**K3**
• Apply social media marketing strategies in real world problems.	**K3**
• Make use of best practices in E-Mail marketing.	**K3**

UNIT I INTRODUCTION TO DIGITAL MARKETING **6**

Digital Marketing: Overview - Key Components - Digital Marketing Flow - Digital Marketing Trends and Technologies - Digital Marketing Strategy - Applications

UNIT II SEARCH ENGINE OPTIMISATION **6**

SEO: Introduction - On Page SEO - Technical SEO - Off Page SEO - SEO Tools and Analytics - SEO Strategy and Best Practices

UNIT III SEARCH ENGINE MARKETING **6**

Introduction - Setting Up a Google Ads Campaign - Ad Creation and Copywriting - Campaign Management and Optimization - Performance monitoring - Advanced SEM Strategies

UNIT IV SOCIAL MEDIA MARKETING **6**

Overview - Developing a Social Media Strategy - Content Creation and Curation - Social Media Advertising - Community Engagement and Management - Case Studies

UNIT V EMAIL MARKETING **6**

Email Marketing - Building and Segmenting Email List - Crafting Effective Emails - Automation and Advanced Strategies - Tracking performance - Best Practices and Case Studies

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Develop a digital marketing strategy document for a fictional or real business.
2. Conduct keyword research using tools like Google Keyword Planner or SEMrush and optimize website content or blog posts based on the chosen keywords.
3. Perform a technical SEO audit of a website using tools like Google Search Console and identify and fix issues related to site speed, mobile responsiveness, and indexing.
4. Create a Google Ads campaign for a specific product or service and perform keyword research, ad creation, bidding strategy selection, and budget allocation.
5. Set up A/B tests for different ad creative, ad copy, or landing pages within their Google Ads campaigns and analyze the performance to understand which variations perform better.
6. Create social media content (images, videos, or posts) for a specific social media platform based on the audience and brand they are targeting and schedule the content for posting using social media management tools.

TOTAL: 30 Hours

TEXT BOOKS:

1. Digital Marketing for Dummies by Ryan Deiss & Russ Henneberry, publisher John Wiley first edition 2020.
2. Digital Marketing 2020 by Danny Star, Independently Published, 2019

REFERENCE BOOKS:

1. Epic Content Marketing by Joe Pulizzi, McGraw-Hill Education, 2013
2. New Rules of Marketing and PR byDavid Meerman Scott.Wiley, 2017
3. Social Media Marketing All-in-one Dummies by JanZimmerman, DeborahNg, John Wiley &Sons.

WEBSITES:

1. https://www.smartinsights.com/
2. http://arenacreative.com/
3. http://www.marketingtechblog.com/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	2
CO2	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO5	3	2	1	-	-	-	-	-	2	2	-	2	-	2
Average	**2.8**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-V

24BECS5E47 BIG DATA ANALYTICS 4H-3C

(THEORY & LABORATORY)

Instruction Hours/week: L:2 T:0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PRE-REQUISITES: Database Management Systems

i) THEORY

COURSE OBJECTIVES:

The goal of this course for the students is to

- Provide fundamental concepts of Big Data.
- Equip students with tools and techniques for learn Big Data file systems and Pig Identify basic functions of R-Language
- Explore contemporary to process Big Data information for Hive and Hbase.

COURSE OUTCOMES:

Upon completion of this course the students will be able to

- Explain the evolution of Big Data, characteristics of Big Data challenges. K2
- Apply non-relational databases techniques for storing and processing large volumes of structured and unstructured data. K3
- Analyze data processing and big data analytics approaches . K4
- Examine big data solutions for selecting algorithms and data structures appropriately. K4
- Categorize efficient big data solutions for application areas using selected algorithms and data structures.. K4

UNIT I COMPREHENSIVE GUIDE TO HADOOP 6

Hadoop - cluster architecture - Hadoop cluster modes - Common Hadoop shell commands - Hadoop configuration files - single node cluster - multi node cluster - Hadoop administration - MapReduce - MapReduce Combiner - Demo on de-identifying Health Care Data set, Demo on Weather Data analyzing

UNIT II MASTERING APACHE PIG 6

About Pig - MapReduce Vs Pig - Programming Structure - Pig Running Modes - Pig Components Data Models in Pig - Pig Data Types - Shell and Utility Commands - Pig Latin: Relational Operators, File Loaders - Group Operator - Joins and COGROUP – Union - Diagnostic Operators -Specialized joins in Pig, Load and Store Functions - Math function, String Function, Date Function, Pig Streaming, Pig Demo on Healthcare Data set - Creating jar for assignment

UNIT III UNDERSTANDING APACHE HIVE 6

Hive Background - Hive Vs Pig - Hive Architecture and Components, Metastore in Hive - Limitations of Hive- Comparison with Traditional Database - Hive Data Types and Data Models - Partitions and Buckets,

UNIT IV HIVE & HBASE ESSENTIALS 6

Hive Tables (Managed Tables and External Tables), Importing Data, Querying Data, Managing Outputs, Hive Script, Hive UDF, Retail use case in Hive – Hbase - HBase Data Model, HBase Shell, HBase Client API, Data Loading Techniques

UNIT V EXPLORING HBASE ARCHITECTURE 6

HBase. Knowledge of HBase Architecture and its components. Topics – Hbase - Introduction to NoSQL Databases and HBase - HBase v/s RDBMS - HBase Components - HBase Architecture - HBase Cluster deployment.

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Hadoop Shell Commands to Manage HDFS and Linux Basic Commands.
2. Count the number of occurrences of each word in a text file.
3. Find out successful students using Pig Latin Script.
4. Working with Online Social Networks data.
5. Calculating a Stock's Covariance.
6. Company working data analysis.
7. Government financial dataset analysis.

TOTAL: 30 Hours

TEXT BOOKS:

1. Stuart J Russel and Peter Norvig, "Hadoop: The Definitive Guide", O'Reilly Media, 4th Edition, 2015.
2. Seema Acharya, "Big Data and Analytics", Wiley, First edition, 2015.

REFERENCE BOOKS:

1. Eric Sammer, "Hadoop Operations", O'Reilly Media, First Edition, 2012.
2. Judith S Hurwitz and Alan F Nugent, "Big Data For Dummies", John Wiley & Sons, Inc, First Edition,2013.
3. Naresh Kumar and Prashant Shindgikar, "Modern Big Data Processing with Hadoop", Packt Publishing, First Edition, 2018.

WEBSITES:

1. www.coursera.org/learn/big-data-integration-processing?specialization=big-data
2. www.edx.org/learn/big-data
3. www.ibm.com/analytics/hadoop/big-data-analytics

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	-	3	-
CO2	3	2	1	-	-	-	-	-	2	2	-	-	3	-
CO3	3	3	2	1	-	-	-	-	2	2	-	-	3	-
CO4	3	3	2	1	-	-	-	-	2	2	-	-	3	-
CO5	3	3	2	1	-	-	-	-	2	2	-	-	3	-
Avg	**2.8**	**2.4**	**1.3**	1	-	-	-	-	**2**	**2**	-	-	**3**	-

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-V

24BECS5E48 EDGE COMPUTING 4H-3C

(THEORY & LABORATORY)

Instruction Hours/week: L:2 T:0 P:2 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PREREQUISITE: Computer Networks

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to**:**

- Introduce resource management techniques for edge computing.
- Gain the knowledge of middle ware technology, performance analysis and optimization.
- Explore the latest trends in edge computing.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

• Interpret the fundamental concepts of edge computing and its significance in the context of distributed systems.	**K2**
• Build edge computing with appropriate architectures, models, and platforms.	**K3**
• Utilize task scheduling algorithms, resource allocation algorithms, and load balancing algorithms for resource management.	**K3**
• Apply performance analysis and optimization techniques to evaluate the effectiveness and efficiency of edge computing solutions.	**K3**
• Make use of Edge Computing in Emerging technologies.	**K3**

UNIT I OVERVIEW OF EDGE COMPUTING **6**

Edge computing architectures, models, and platforms. Comparison of edge computing with cloud computing and fog computing. Case studies of edge computing applications

UNIT II RESOURCE MANAGEMENT **6**

Resource management techniques for edge computing: Task scheduling algorithms, resource allocation algorithms, and load balancing algorithms. Case studies and applications of resource management in edge computing, such as mobile edge computing, and autonomous vehicles.

UNIT III PERFORMANCE ANALYSIS AND OPTIMIZATION **6**

Metrics for measuring performance in edge computing: latency, throughput, and energy efficiency. Case studies of performance analysis and optimization in edge computing, such as edge-based video streaming, smart transportation systems, and healthcare IoT devices.

UNIT IVMIDDLEWARE **6**

Need for Middleware, Design goals, State-of-the-Art Middleware Infrastructures, System Model: API Code, Security, Device Discovery, Middleware, Sensor and Actuators.

UNIT V EMERGING TRENDS IN EDGE COMPUTING **6**

Edge intelligence, Server less computing, edge security, Hybrid cloud and edge architectures.

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

Capstone Project:

Use Case with brief description, each batch of students should choose one from the following use case to complete the capstone project in Edge Computing

1. Autonomous Vehicles-Edge computing enables autonomous platooning of truck convoys, potentially eliminating the need for drivers in all trucks except the front one.
2. Remote Monitoring of Oil and Gas Assets- Enables real-time analytics with processing closer to the remote asset, reducing reliance on connectivity to a centralized cloud.
3. Smart Grid- Aids in managing energy consumption by enabling real-time visibility of energy use and analysis of consumption.
4. Predictive Maintenance- Brings processing and storage of data closer to the equipment, allowing for real-time health monitoring and analytics.
5. Virtualised Radio Networks and 5G (vRAN)-Enables complex processing with low latency for virtualised RAN hardware.
6. Traffic Management-Edge computing allows effective city traffic management, optimizing bus frequency, lane usage, and future autonomous car flows.
7. Smart Homes-Bringing processing and storage closer to the smart home can improve performance and security of smart home IoT devices.

TOTAL: 30 Hours

TEXT BOOKS:

1. Rajkumar Buyya and Satish Narayana Srirama, “Fog and Edge Computing Principles and Paradigms”, John Wiley & Sons, Inc. 2019.(Unit 1,2,3,4)
2. K. Anitha Kumari, G. Sudha Sadasivam, D. Dharani and M. NiranjanaMurthy, “Edge Computing
3. Fundamentals, Advances and Applications”, CRC Press, 2022. (Unit 5)

REFERENCE BOOKS:

1. Xin Sun and Amin Vahdat, “Edge Computing: A Primer”, CRC Press, 2019.
2. Daniel Situnayake, Jenny Plunkett, “AI at the Edge”, O'Reilly Media, Inc, 2023.

WEB SITES:

1. https://onlinecourses.nptel.ac.in/noc24_cs66/preview
2. https://www.udemy.com/course/introduction-to-edge-computing/?couponCode=NVDIN35
3. https://www.coursera.org/learn/security-at-the-edge-first-course-1

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	2	-
CO2	3	2	1	-	-	-	-	-	2	2	-	2	2	-
CO3	3	2	1	-	-	-	-	-	2	2	-	2	2	-
CO4	3	2	1	-	-	-	-	-	2	2	-	2	2	-
CO5	3	2	1	-	-	-	-	-	2	2	-	2	2	-
Average	**2.8**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-V

24BECS5E49 MALWARE ANALYSIS 4H-3C

(THEORY & LABORATORY)

Instruction Hours/week: L:2 T:0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PREREQUISITE: Ethical Hacking

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Learn the fundamentals of malware, types and its effects
- Identify and analyze the malware types by static analysis and dynamic analysis
- Know detection, analysis, understanding, controlling, and eradication of malware

COURSE OUTCOMES:

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

- Understand the Core Concepts of Computer-Based Vulnerabilities K2
- Illustrate the foot printing, reconnaissance and scanning method. K2
- Apply the enumeration and vulnerability analysis methods in ethical hacking K3
- Utilize the hacking options available in Web and wireless applications K3
- Make use of tools to perform ethical hacking to expose the vulnerabilities K3

UNIT I INTRODUCTION AND BASIC ANALYSIS 6

Goals of Malware Analysis, AV Scanning, Hashing, Finding Strings, Packing and Obfuscation, PE file format, Static, Linked Libraries and Functions, Static Analysis tools, Virtual Machines and their usage in malware analysis, Sandboxing, Basic dynamic analysis, Malware execution, Process Monitoring, Viewing processes, Registry snapshots

UNIT II ADVANCED STATIC ANALYSIS 7

The Stack, Conditionals, Branching, Rep Instructions, Disassembly, Global and local variables, Arithmetic operations, Loops, Function Call Conventions, C Main Method and Offsets. Portable Executable File Format, The PE File Headers and Sections, IDA Pro, Function analysis, Graphing, The Structure of a Virtual Machine, Analyzing Windows programs, Anti-static analysis techniques, obfuscation, packing, metamorphism, polymorphism.

UNIT III ADVANCED DYNAMIC ANALYSIS 7

Live malware analysis, dead malware analysis, analyzing traces of malware, system calls, API calls, registries, network activities. Anti-dynamic analysis techniques, VM detection techniques, Evasion techniques, Malware Sandbox, Monitoring with Process Monitor, Packet Sniffing with Wireshark, Kernel vs. User-Mode Debugging, OllyDbg, Breakpoints, Tracing, Exception Handling, Patching

UNIT IV MALWARE FUNCTIONALITY **5**

Downloaders and Launchers, Backdoors, Credential Stealers, Persistence Mechanisms, Handles, Mutexes, Privilege Escalation, Covert malware launching- Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection

UNIT V ANDROID MALWARE ANALYSIS **5**

Android Malware Analysis: Android architecture, App development cycle, APKTool, APKInspector, Dex2Jar, JD-GUI, Static and Dynamic Analysis, Case studies

TOTAL: 30 Hours

ii) LABORATORY
LIST OF EXPERIMENTS:

1. Experiment on Sandboxing Malware and Gathering Information from Runtime Analysis
2. Set up an Experiment on Portable Executable (PE32) File Format
3. Apply ProGuard to an Obfuscation APK
4. Install MobSF to identify potential code vulnerabilities
5. Install APKTool for decompiling and recompiling APK files
6. Experiment on Malware traffic analysis for a scenario

TOTAL: 30 Hours

TEXT BOOKS:

1. Dylan Barker, “Malware Analysis Techniques”, Packt Publishing, 2021.
2. Victor Marak, "Windows Malware Analysis Essentials" Packt Publishing, O’Reilly, 2015.
3. Michael Sikorski and Andrew Honig, “Practical Malware Analysis” by No Starch Press,2012.
4. Bill Blunden, “The Rootkit Arsenal: Escape and Evasion in the Dark Corners of the System”, Second Edition, Jones & Bartlett Publishers, 2009.

REFERENCE BOOKS:

1. Ken Dunham, Shane Hartman, Manu Quintans, Jose Andre Morales, Tim Strazzere, "Android Malware and Analysis",CRC Press, Taylor & Francis Group, 2015.
2. Windows Malware Analysis Essentials by Victor Marak, Packt Publishing, 2015.
3. Bruce Dang, Alexandre Gazet, Elias Bachaalany, SébastienJosse, "Practical Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation", 2014.

WEBSITESs:

1. https://www.geeksforgeeks.org/introduction-to-malware-analysis/
2. https://www.udemy.com/course/basic-introduction-to-malware-analysis/
3. https://intellipaat.com/blog/malware-analysis/

CO, PO, PSO Mapping

CO’S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	2
CO2	2	1	-	-	-	-	-	-	2	2	-	2	-	2
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO5	3	2	1	-	-	-	-	-	2	2	-	2	-	2
Avg	**2.6**	**1.6**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

SEMESTER-V

24BECS5E410 CLOUD SERVICES MANAGEMENT 4H-3C
(THEORY & LABORATORY)

Instruction Hours/week: L:2 T:0 P:2 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

PREREQUISITE: Parallel and Distributed Computing

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to**:**

- Understand cloud service management characteristic and models.
- Infer the knowledge of cloud service life cycle, cloud service operations and management.
- Learn Cloud Governance Framework and Cloud Governance Structure.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

• Interpret information technology service management and cloud service management.	K2
• Build cloud strategy management framework and cloud service architectures.	K3
• Identify legacy systems, benchmark services, plan capacity, deploy and migrate services.	K3
• Apply pricing models, cloud service charging and cost models for cloud services.	K3
• Analyze the value of cloud services using various metrics and balanced scorecard.	K4

UNIT I CLOUD SERVICE MANAGEMENT FUNDAMENTALS **6**

Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models

UNIT II CLOUD SERVICES STRATEGY **6**

Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture

UNIT III CLOUD SERVICE MANAGEMENT **6**

Cloud Service Reference Model, Cloud Service Life Cycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management.

UNIT IV CLOUD SERVICE ECONOMICS **6**

Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models

UNIT V CLOUD SERVICE GOVERNANCE AND VALUE **6**

IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix,Understanding Value of Cloud Services, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Create a Cloud Organization in AWS/Google Cloud/or any equivalent Open-Source cloud softwares like Openstack, Eucalyptus, OpenNebula with Role-based access control.
2. Create a Cost-model for a web application using various services.
3. Perform Cost-benefit Analysis created a cost-model for web application.
4. Create alerts for usage of Cloud resources.
5. Create Billing alerts for your Cloud Organization.
6. Compare Cloud cost for a simple web application across AWS, Azure and GCP.

TOTAL: 30 Hours

TEXT BOOKS:

1. Enamul Haque, ”Cloud Service Management and Governance: Smart Service Management in Cloud Era”, Enel Publications, 2023. (UNIT I - V)
2. Thomas Erl, Ricardo Puttini, Zaigham Mohammad, “Cloud Computing: Concepts, Technology & Architecture”, 2nd Edition, 2023. (UNIT - I)

REFERENCE BOOKS:

1. Praveen Ayyappa , “Economics of Cloud Computing “, LAP Lambert Academic Publishing, 2020.
2. Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi , “Mastering Cloud Computing Foundations and Applications Programming” Morgan Kaufmann Publishers In , 2013.
3. Thomas Erl, Robert Cope, Amin Naserpour, “Cloud Computing Design Patterns” Pearson, 2015.

WEBSITES:

1. https://www.tutorialspoint.com/cloud_computing/cloud_computing_management.htm
2. https://onlinecourses.nptel.ac.in/noc21_cs14/preview
3. https://www.servicenow.com/latam/products/it-operations-management/what-is-cloud-management.html

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	3
CO2	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO5	3	3	2	1	-	-	-	-	2	2	-	2	-	3
Average	**2.8**	**2**	**1.2**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24BECS5E411 UI/UX DESIGN 4H-3C
(THEORY & LABORATORY)

Instruction Hours/week: L:2 T:0 P:2 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

PREREQUISITE: Devops
i) THEORY
COURSE OBJECTIVES:

The goal of this course is for the students to**:**

- Provide a sound knowledge in UI & UX design.
- Explore the tools used in UI & UX in creating wireframe and prototype.
- Understand the methods of user evaluation of product with real time scenario.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Demonstrate UX Skills in product development. K2
- Build UI for user applications from research, persona mapping, customer journey mapping. K3
- Apply UI design for any product development. K3
- Make use of interaction design tool for translate the paper concepts into digital wireframes. K3
- Build the process to conduct usability tests and feedback. K3

UNIT I FOUNDATIONS OF DESIGN 6

Overview of UI & UX Design process - Difference between User Interface - (UI) vs User Experience (UX) - Defining problem and vision statement - Persona creation – Primary and Secondary persona - Requirement definition - Creative ideation – brainstorming and ideation techniques - Scenarios and functionality extraction – Solution ideation – Flow diagrams - Case studies on Design Thinking.

UNIT II FOUNDATIONS OF UI AND UX DESIGN 6

Visuals and UI principles - UI Elements and Patterns – Material Design and Human Interface Design - Interaction Behaviors and Principles – Branding - Style Guides - Understanding User Experience - UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research.

UNIT III ELEMENTARY SKETCHING & WIREFRAMING 6

Sketching Principles - Wireframing - Creating Wireflows - Click through Wireframing Prototyping - Wireflow Creation - Work with different tools – Figma - Low-High Fidelity Design: Inclusive Design and Designing for Accessibility - Building High-Fidelity Mockups -

Designing Efficiently with Tools - Interaction Patterns - Designing animations and interactions.

UNIT IV UNDERSTAND STYLE GUIDES, ELEMENTS, PROTOTYPING 6

Building a Design System – Style guides, color palette, fonts, grid, iconography, UI elements, photography or imagery, and illustration - Use of grids in UI design - Design animations and interaction patterns for key UI elements.

UNIT V UASBILITY EVALUATION AND PRODUCT DESIGN 6

Type of usability evaluation - Designing evaluation protocol - Conducting usability evaluation study - Conduct Usability Test explicit - Synthesize Test Findings - Product Design: Types of products & solutions - Design Psychology for e-commerce sites.

TOTAL: 30 Hours

ii) LABORATORY
LIST OF EXPERIMENTS:

1. Designing a Responsive layout for a societal application.
2. Developing an interface with proper UI Style Guides.
3. Developing Wireflow diagram for application using open-source software.
4. Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles).
5. Creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping.
6. Sketch, design with popular tool and build a prototype and perform usability testing and identify improvements.

TOTAL: 30 Hours

TEXT BOOKS:

1. Joel Marsh, “UX for Beginners”, O'Reilly Media, Second Edition, 2016.
2. Jon Yablonski, “Laws of UX: Using Psychology to Design Better Products & Services,” O'Reilly Media, First Edition, 2020.

REFERENCE BOOKS:

1. Jenifer Tidwell, Charles Brewer, Aynne Valencia, “Designing Interfaces,” O'Reilly Media, Third Edition, 2020.
2. Steve Schoger, Adam Wathan, “Refactoring UI,” Self-published, First Edition, 2018.
3. Steve Krug, “Don't Make Me Think, Revisited: A Common-Sense Approach to Web and Mobile Usability,” New Riders, Third Edition, 2014.

WEBSITES:

1. https://www.coursera.org/specializations/ui-ux-design
2. https://www.interaction-design.org/literature
3. https://www.geeksforgeeks.org/user-experience-or-ux-design/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	2	-	-	-	2	2	-	2	-	3
CO2	3	2	1	-	2	-	-	-	2	2	-	2	-	3
CO3	3	2	1	-	2	-	-	-	2	2	-	2	-	3
CO4	3	2	1	-	2	-	-	-	2	2	-	2	-	3
CO5	3	2	1	-	2	-	-	-	2	2	-	2	-	3
Average	**2.8**	**1.8**	**1**	**-**	**2**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-V

24BECS5E412 GAME THEORY 4H-3C
(THEORY & LABORATORY)

Instruction Hours/week: L:2 T:0 P:2 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

PREREQUISITE: Nil
i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to**:**

- Know the basics of 2D and 3D graphics for game development.
- Survey the gaming development environment and tool kits.
- Learn and develop simple games using Pygame environment

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Outline the concepts of 2D and 3d Graphics. **K2**
- Interpret game design principles in storyboard development. **K2**
- Develop gaming engines using appropriate algorithms. **K3**
- Build simple gaming application in Pygame. **K3**
- Analysis of gaming environments and frameworks. **K4**

UNIT I 3D GRAPHICS FOR GAME DESIGN 6

Genres of Games, Basics of 2D and 3D Graphics for Game Avatar, Game Components – 2D and 3D Transformations – Projections – Color Models – Illumination and Shader Models – Animation – Controller Based Animation.

UNIT II GAME DESIGN PRINCIPLES 6

Character Development, Rudiments of game design, Storyboard Development for Gaming, The Anatomy of a Game Designer – Script Design – Script Narration, Game Balancing, Core Mechanics, Principles of Level Design – Proposals – Writing for Preproduction, Production and Post – Production.

UNIT III GAME ENGINE DESIGN 6

Game Engine Architecture, Rendering Concept – Software Rendering – Hardware Rendering – Spatial Sorting Algorithms – Algorithms for Game Engine– Collision Detection – Game Logic – Game AI – Path finding.

UNIT IV GAMING PLATFORMS AND FRAMEWORKS 6

Game Development Technical Aspects, Game Design Team Roles, Pygame Game Development,– Unity – Unity Scripts –Mobile Gaming, Game Studio, Unity Single player and Multi-Player games.

UNIT V GAME DEVELOPMENT USING PYGAME **6**

Developing 2D and 3D interactive games using Pygame – Avatar Creation – 2D and 3D Graphics Programming – Incorporating music and sound – Asset Creations – Game Physics algorithms Development – Device Handling in Pygame – Overview of Isometric and Tile Based arcade Games – Puzzle Games.

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Character design, sprites, movement and character control.
2. Level design: design of the world in the form of tiles along with interactive and collectible objects.
3. Design of interaction between the player and the world, optionally using the physics engine.
4. Developing a 2D interactive using Pygame.
5. Developing a 3D Game using Unreal.
6. Developing a Multiplayer game using unity.

TOTAL: 30 Hours

TEXT BOOKS:

1. Sanjay Madhav, “Game Programming Algorithms and Techniques: A Platform Agnostic Approach”, Addison Wesley,2013.
2. Will McGugan, “Beginning Game Development with Python and Pygame: From Novice to Professional”, Apress,2007.

REFERENCE BOOKS:

1. Paul Craven, “Python Arcade games”, Apress Publishers,2016.
2. David H. Eberly, “3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics”, Second Edition, CRC Press,2006.
3. Jung Hyun Han, “3D Graphics for Game Programming”, Chapman and Hall/CRC, 2011.
4. Steve Krug, “Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile”, Third Edition, 2015.

WEBSITES:

1. https://www.gametheory.net/
2. https://plato.stanford.edu/entries/game-theory/
3. https://ocw.mit.edu/courses/14-126-game-theory-spring-2016

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	2
CO2	2	1	-	-	-	-	-	-	2	2	-	2	-	2
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO4	3	2	1		-	-	-	-	2	2	-	2	-	2
CO5	3	3	2	1	-	-	-	-	2	2	-	2	-	2
Average	**2.6**	**1.8**	**1.3**	1	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-V

24BECS5E413	BUSINESS ANALYTICS (THEORY & LABORATORY)	4H-3C

Instruction Hours/week: L:2 T:0 P:2 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

PREREQUISITE: Database Management Systems

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to**:**

- Understand the Analytics Life Cycle and types of analytics for Business Forecasting.
- Comprehend the process of acquiring Business Intelligence
- Apply analytics for different functions of a business.

COURSE OUTCOMES

Upon completion of this course, the student will be able to:

- Interpret the real-world business problems and model with analytical solutions. **K2**
- Identify the business processes for extracting Business Intelligence. **K3**
- Build predictive analytics for business fore-casting. **K3**
- Apply analytics for supply chain and logistics management. **K3**
- Make use of analytics for marketing and sales. **K3**

UNIT I INTRODUCTION TO BUSINESS ANALYTICS **6**

Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition- Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation- Interpretation – Deployment and Iteration

UNIT II BUSINESS INTELLIGENCE **6**

Data Warehouses and DataMart – Knowledge Management – Types of Decisions – Decision Making Process - Decision Support Systems – Business Intelligence –OLAP – Analytic functions

UNIT III BUSINESS FORECASTING **6**

Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models –Data Mining and Predictive Analysis Modelling –Machine Learning for Predictive analytics.

UNIT IV HR AND SUPPLY CHAIN ANALYTICS **6**

Human Resources – Planning and Recruitment – Training and Development - Supply chain network Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain Applying HR Analytics to make a prediction of the demand for hourly

employees for a year.

UNIT V MARKETING & SALES ANALYTICS **6**

Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales - predictive analytics for customers' behaviour in marketing and sales.

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

Use MS-Excel and Power-BI to perform the following experiments using a business data set, and make presentations.

Students may be encouraged to bring their own real-time socially relevant data set.

MS-Excel

1. Perform Z-test, T-test & ANOVA
2. Perform data pre-processing operations i) Handling Missing data ii) Normalization
3. Perform bivariate and multivariate analysis on the dataset.

Power BI Desktop

4. Explore the features of Power BI Desktop
5. Prepare, Load and prepare report for the given data
6. Perform DAX calculations

TOTAL: 30 Hours

TEXT BOOKS:

1. R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017
2. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016

REFERENCE BOOKS:

1. Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016
2. VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.
3. Mahadevan B, “Operations Management -Theory and Practice”,3rd Edition, Pearson Education, 2018.

WEBSITES:

1. https://www.tutorialspoint.com/business_analysis/business_analysis_introduction.htm
2. https://www.studocu.com/en-us/document/blinn-college-district/business-analysis/business-analysis-study-notes/66999692
3. https://www.simplilearn.com/what-is-a-business-analyst-article.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	2	-
CO2	3	2	1	-	-	-	-	-	2	2	-	2	2	-
CO3	3	2	1	-	-	-	-	-	2	2	-	2	2	-
CO4	3	2	1	-	-	-	-	-	2	2	-	2	2	-
CO5	3	2	**1**	-	-	-	-	-	2	2	-	2	2	-
Average	**2.8**	**1.8**	**1**	-	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-V

24BECS5E414 QUANTUM COMPUTING 4H-3C
(THEORY & LABORATORY)

Instruction Hours/week: L:2 T:0 P:2 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

PREREQUISITE: Nil

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to**:**

- Introduce the principles of quantum mechanics as they relate to computing.
- Learn about quantum computation models and quantum gates.
- Gain practical experience with quantum programming using quantum simulators and quantum hardware.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Interpret the foundational principles of quantum mechanics relevant to computing. **K2**
- Apply quantum algorithms to solve computational problems. **K3**
- Build quantum circuits using quantum gates. **K3**
- Develop quantum algorithms using quantum programming languages and tools. **K3**
- Make use of security aspect in Quantum computing. **K3**

UNIT I QUANTUM COMPUTING BASIC CONCEPTS 7

Classical and Quantum Computing - Global Perspectives Postulates of Quantum Mechanics – Quantum Bits - Representations of Qubits - Superpositions - entanglement – interference

UNIT II QUANTUM COMPUTATION MODELS 5

Quantum bits (qubits) and quantum states - Basic single qubit gates - Multiple qubit gates - Circuit development - Measurement in quantum computing

UNIT III QUANTUM ALGORITHMS 7

Quantum parallelism - Deutsch’s algorithm - The Deutsch–Jozsa algorithm - Quantum Fourier transform and its applications - Quantum Search Algorithms: Grover’s Algorithm

UNIT IV QUANTUM INFORMATION THEORY 6

Data compression - Shannon’s noiseless channel coding theorem - Schumacher’s quantum noiseless channel coding theorem - Classical information over noisy quantum channels

UNIT V QUANTUM APPLICATIONS **5**

Quantum cryptography and quantum key distribution- Shor's Factoring Algorithm - Quantum machine learning

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Single and multiple qubit gate simulation - Quantum Composer
2. Composing simple quantum circuits with q-gates and measuring the output into classical bits.
3. IBM Qiskit Platform Introduction
4. Implementation of Shor's Algorithms and Grover's Algorithm
5. Implementation of Deutsch's Algorithm and Deutsch-Jozsa's Algorithm
6. QKD Simulation

TOTAL: 30 Hours

TEXT BOOKS:

1. Parag K Lala, Mc Graw Hill Education, "Quantum Computing, A Beginners Introduction", FirstEdition (1 November 2020). (Unit 1)
2. Michael A. Nielsen, Issac L. Chuang, "Quantum Computation and Quantum Information", Tenth Edition, Cambridge University Press, 2013.(Unit 1,2,3,4)
3. Chris Bernhardt, The MIT Press; Reprint edition (8 September 2020), "Quantum Computing for Everyone".(Unit 5)

REFERENCE BOOKS:

1. Eleanor G. Rieffel and Wolfgang H. Polak, "Quantum Computing: A Gentle Introduction," The MIT Press, 2014.
2. Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 2013.
3. N. David Mermin, "Quantum Computer Science: An Introduction", Cambridge University Press, 2012.
4. Benenti, Giuliano, Casati, Giulio, and Strini, Giuliano, "Principles of Quantum Computation and Information: Basic Concepts," World Scientific Publishing Company, 2019.

WEBSITES:

1. https://www.udemy.com/topic/quantum-computing/
2. https://www.coursera.org/courses?query=quantum%20computing
3. https://quantum.ibm.com/
4. https://azure.microsoft.com/en-us/solutions/quantum-computing/
5. https://quantumcomputingreport.com/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	2
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CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO5	3	2	1	-	-	-	-	-	2	2	-	2	-	2
Average	**2.8**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-V

24BECS5E415 MODERN CRYPTOGRAPHY 4H-3C
(THEORY & LABORATORY)

Instruction Hours/week: L:2 T:0 P:2 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

PREREQUISITE: Cryptocurrency and Blockchain Technologies

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Learn how cryptographic algorithms and protocols work
- Build a Pseudorandom permutation and construct Basic cryptanalytic techniques
- Use the concepts of block ciphers and message authentication codes

COURSE OUTCOMES:

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

- Interpret the basic principles of cryptography and general cryptanalysis K2
- Illustrate the concepts of symmetric encryption and authentication K2
- Identify the uses of Message Authentication Codes K3
- Apply cryptographic algorithms to compose simple cryptographic solutions K3
- Make use of public key encryption, digital signatures, and key establishment K3

UNIT I INTRODUCTION 6

Basics of Symmetric Key Cryptography, Basics of Asymmetric Key Cryptography, Hardness of Functions. Notions of Semantic Security (SS) and Message Indistinguishability (MI): Proof of Equivalence of SS and MI, Hard Core Predicate, Trap-door permutation, Goldwasser-Micali Encryption. Goldreich-Levin Theorem: Relation between Hardcore Predicates and Trap-door permutations.

UNIT II FORMAL NOTIONS OF ATTACKS 6

Attacks under Message Indistinguishability: Chosen Plaintext Attack (IND-CPA), Chosen Ciphertext Attacks (IND-CCA1 and IND-CCA2), Attacks under Message Non-malleability: NM-CPAand NM-CCA2, Inter-relations among the attack model

UNIT III RANDOM ORACLES 6

Provable Security and asymmetric cryptography, hash functions. One-way functions: Weak and Strong one-way functions. Pseudo-random Generators (PRG): Blum-Micali-Yao Construction, Construction of more powerful PRG, Relation between One-way functions and PRG, Pseudorandom Functions (PRF)

UNIT IV BUILDING A PSEUDORANDOM PERMUTATION 6

The LubyRackoff Construction: Formal Definition, Application of the LubyRackoff Construction to the construction of Block Ciphers, The DES in the light of LubyRackoff Construction.

UNIT V MESSAGE AUTHENTICATION CODES 6

Left or Right Security (LOR). Formal Definition of Weak and Strong MACs, Using a PRF as a MAC, Variable length MAC. Public Key Signature Schemes: Formal Definitions, Signing and Verification, Formal Proofs of Security of Full Domain Hashing. Assumptions for Public Key Signature Schemes: One-way functions Imply Secure One-time Signatures. Shamir's Secret Sharing Scheme.

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Implement Feige-Fiat-Shamir identification protocol.
2. Implement GQ identification protocol.
3. Implement Schnorr identification protocol.
4. Implement Rabin one-time signature scheme.
5. Implement Merkle one-time signature scheme.
6. Implement GMR one-time signature scheme.

TOTAL: 30 Hours

TEXT BOOKS:

1. Introduction to Modern Cryptography, 3rd Edition Katz, Jonathan and Lindell, Yehuda Hardcover, December 2020.
2. Hans Delfs and Helmut Knebl, Introduction to Cryptography: Principles and Applications, Springer Verlag, Second Edition, 2010.
3. Wenbo Mao, Modern Cryptography, Theory and Practice, Pearson Education, 2003.

REFERENCE BOOKS:

1. Shaffi Goldwasser and Mihir Bellare, Lecture Notes on Cryptography, 2008.
2. William Stallings, "Cryptography and Network Security: Principles and Practice", PHI 3rd,Edition, 2006.

WEBSITES:

1. https://www.tutorialspoint.com/cryptography/modern_cryptography.htm
2. https://www.geeksforgeeks.org/cryptography-tutorial/
3. https://www.w3schools.in/cyber-security/modern-encryption

CO, PO, PSO Mapping

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	3
CO2	2	1	-	-	-	-	-	-	2	2	-	2	-	3
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO5	3	3	2	1	-	-	-	-	2	2	-	2	-	3
Avg	**2.6**	**1.8**	**1.3**	**1**	-	-	-	-	**2**	**2**	-	**2**	-	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-V

24BECS5E416 STORAGE TECHNOLOGIES (THEORY & LABORATORY) 4H-3C

Instruction Hours/week: L:2 T:0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PREREQUISITE: Parallel and Distributed Computing

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to**:**

- Understand the fundamentals of storage systems, Intelligent Storage Systems and RAID.
- Interpret the storage networking technologies and virtualization.
- Acquire the knowledge of different backup and recovery strategies and securing storage infrastructure.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

• Interpret the fundamentals of information storage and third platform technologies.	**K2**
• Utilize RAID approach and intelligence in the storage systems.	**K3**
• Apply storage networking technologies and virtualization to optimize storage utilization and management.	**K3**
• Analyze disaster recovery and remote replication technologies.	**K4**
• Examine the security needs and security measures to be employed in information storage management.	**K4**

UNIT I STORAGE SYSTEMS 7

Introduction to Information Storage: Digital data and its types, Information storage, Key characteristics of data center and Evolution of computing platforms. Information Life cycle Management. Third Platform Technologies: Cloud computing and its essential characteristics, Cloud services and cloud deployment models, Big data analytics, Social networking and mobile computing, Characteristics of third platform infrastructure and Imperatives for third platform transformation. Data Center Environment: Building blocks of a data center, Compute systems and compute virtualization and Software-defined data center.

UNIT II INTELLIGENT STORAGE SYSTEMS AND RAID 5

Components of an intelligent storage system, Components, addressing, and performance of hard disk drives and solid-state drives, RAID, Types of intelligent storage systems, Scale-up and scale- out storage Architecture.

UNIT III STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION 6

Block-Based Storage System, File-Based Storage System, Object-Based and Unified Storage. Fibre Channel SAN: Software-defined networking, FC SAN components and architecture, FC SAN

topologies, link aggregation, and zoning, Virtualization in FC SAN environment. Internet Protocol SAN: iSCSI protocol, network components, and connectivity, Link aggregation, switch aggregation, and VLAN, FCIP protocol, connectivity, and configuration. Fibre Channel over Ethernet SAN: Components of FCoE SAN, FCoE SAN connectivity, Converged Enhanced Ethernet, FCoE architecture

UNIT IV BACKUP, ARCHIVE AND REPLICATION **6**

Introduction to Business Continuity, Backup architecture, Backup targets and methods, Data deduplication, Cloud-based and mobile device backup, Data archive, Uses of replication and its characteristics, Compute based, storage-based, and network-based replication, Data migration, Disaster Recovery as a Service (DRaaS).

UNIT V SECURING STORAGE INFRASTRUCTURE **6**

Information security goals, Storage security domains, Threats to a storage infrastructure, Security controls to protect a storage infrastructure, Governance, risk, and compliance, Storage infrastructure management functions, Storage infrastructure management processes.

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Set up accounts on different cloud platforms (AWS, Azure, Google Cloud, etc.)
2. Simulate drive failures and recovery scenarios.
3. Explore features like link aggregation and VLANs in the SAN environment.
4. Evaluate different backup targets (e.g., tape, disk, cloud) and methods (full, incremental, differential).
5. Identify potential vulnerabilities and threats (e.g., unauthorized access, data breaches).
6. Implement security controls such as encryption, access controls, and monitoring tools.

TOTAL: 30 Hours

TEXT BOOKS:

1. EMC Education Services ,"Information Storage and Management: Storing, Managing, and Protecting Digital Information in Classic, Virtualized, and Cloud Environments" by Wiley, India, 2nd Edition, 2012. (UNIT I & IV).
2. Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel and Libor Miklas "Introduction to Storage Area Networks", 9th Edition, IBM - Redbooks, October 2018. (UNIT III & V).

REFERENCE BOOKS:

1. Marc Farley,"Storage Networking Fundamentals: An Introduction to Storage Devices, Subsystems, Applications, Management, and Filing Systems", Cisco, 2004.
2. Ulf Troppens, Rainer Erkens, Wolfgang Muller-Friedt, Rainer Wolafka, Nils Haustein ,"Storage Networks Explained: Basics and Application of Fibre Channel SAN, NAS, iSCSI,

InfiniBand and FCoE" ,2nd Edition, Wiley Edition,2011. (UNIT II & IV)

3. James O'Reilly, "Network Storage Tools and Technologies for Storing Your Company's Data" by Elsevier Science 2016.

WEBSITES:

1. https://home.adelphi.edu/~siegfried/cs170/170l5.pdf
2. https://www.coursera.org/learn/data-storage-microsoft-azure
3. https://www.coursera.org/learn/introduction-to-networking-and-storage
4. https://www.cs.utexas.edu/~byoung/cs429/slides17-storage-technologies-4up.pdf

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	2	-
CO2	3	2	1	-	-	-	-	-	2	2	-	2	2	-
CO3	3	2	1	-	-	-	-	-	2	2	-	2	2	-
CO4	3	3	2	1	-	-	-	-	2	2	-	2	2	-
CO5	3	3	2	1	-	-	-	-	2	2	-	2	2	-
Average	**2.8**	**2.2**	**1.5**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-V

24BECS5E417 C# and .NET PROGRAMMING (THEORY & LABORATORY) 4H-3C

Instruction Hours/week: L: 2 T: 0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PREREQUISITE: Java Programming

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to**:**

- Understand the foundations of CLR execution and technologies of the .NET framework.
- Be aware of Object-Oriented Programming in C#.
- Learn web-based application development using .NET (ASP.NET).

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Interpret the basic features of C# programming language. **K2**
- Apply concepts of Object-Oriented Programming in developing solutions to problems. **K3**
- Make use of exception handling features to safeguard program against runtime anomalies. **K3**
- Develop web-based applications using .NET **K3**
- Make use of modern tools to develop C# programs and applications. **K3**

UNIT I INTRODUCTION TO C# 6

Introducing C# - Understanding .NET - Program Structure and Syntax: Basic Syntax and Variables & Data Types - Control Structures: Conditional Statements and Loops - Implicit and explicit casting - Constant - Arrays: Array Class, Array List - String: String Builder

UNIT II OBJECT ORIENTED ASPECTS OF C# 6

Object-Oriented Programming Concepts: Class, Objects - Constructors and its types - Inheritance - Polymorphism- Sealed class and methods - Interface - Abstract class - Overloading - Threading.

UNIT III APPLICATION DEVELOPMENT ON .NET 6

Building windows application - Creating our own window forms with events and controls - SDI and MDI application, Dialog Box(Modal and Modeless) - Accessing data with ADO.NET, Data Set - Typed dataset - Data Adapter, updating database using stored procedures - SQL Server with ADO.NET - Handling exceptions - Validating controls - Windows application configuration.

UNIT IV WEB BASED APPLICATION DEVELOPMENT ON .NET 6

Introduction to ASP.NET Core - Creating Virtual Directory and Web Application - Session management techniques, web config, web services, passing datasets - Returning datasets from web services - Handling transaction, handling exceptions, returning exceptions from SQL Server.

UNIT V CLR AND .NET FRAMEWORK **6**

Assemblies- Versioning, Attributes, reflection - Viewing meta data - Type discovery - Reflection on type - Marshalling - Remoting- Security in .NET

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Implement a basic console application in C# demonstrating syntax, variables, and data types.
2. Create a class hierarchy in C# involving inheritance and polymorphism.
3. Develop a Windows Forms application using Visual Studio with event handling and basic functionality.
4. Build a CRUD web application using ASP.NET Core MVC, including controllers, views, and data passing.
5. Construct a Windows Forms application that connects to a SQL Server database using ADO.NET for data access and validation.
6. Implement reflection and attributes in a C# application to dynamically inspect types and apply attributes to classes and methods.

TOTAL: 30 Hours

TEXT BOOKS:

1. Herbert Schildt, “The Complete Reference: C# 4.0”, Tata Mc Graw Hill, 2014.
2. Christian Nagel et al. “Professional C# 2012 with .NET 4.5”, Wiley India, 2012.

REFERENCE BOOKS:

1. Andrew Troelsen, “Pro C# 2010 and the .NET 4 Platform, Fifth edition, A Press, 2010.
2. Ian Griffiths, Matthew Adams, Jesse Liberty, “Programming C# 4.0”, Sixth Edition, O’Reilly, 2010.
3. Jon Skeet, "C# in Depth, Fourth Edition", Manning Publications, 2019

WEBSITES:

1. https://learn.microsoft.com/en-us/shows/csharp-fundamentals-for-absolute-beginners/
2. https://www.c-sharpcorner.com/
3. https://learn.microsoft.com/en-us/aspnet/overview

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	3
CO2	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO5	3	2	1	-	-	-	-	-	2	2	-	2	-	3
Average	**2.8**	**1.8**	**1**	-	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**3**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

SEMESTER-V

24BECS5E418 3D PRINTING AND DESIGN (THEORY & LABORATORY) 4H-3C

Instruction Hours/week: L:2 T:0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PREREQUISITE: NIL

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to**:**

- Describe the basic ideas behind the 3D printing process.
- Grasp additive manufacturing and computer-aided design.
- Uses of 3D printing process in real time application

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Interpret the fundamental ideas behind 3D printing technology. **K2**
- Illustrate the process of 3D printing. **K2**
- Identify a certain substance for the specified use in 3D Modeling. **K3**
- Build a product using additive manufacturing (AM) or 3D printing. **K3**
- Analyze the approaches of modeling and designing industrial applications. **K4**

UNIT I INTRODUCTION **6**

Introduction; Design considerations – Material, Size, Resolution, Process; Modelling and viewing - 3D modelling, Data Conversion, and transmission, Checking and preparing, Building, Post processing, RP data formats, Classification of 3D printing process, Applications to various fields.

UNIT II PROCESS **6**

Process, Process parameter, Process Selection for various applications. Additive Manufacturing Application Domains: Aerospace, Electronics, Health Care, Defense, Automotive, Construction, Food Processing, Machine Tools.

UNIT III MATERIALS **6**

Polymers, Metals, Non-Metals, Ceramics, Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties. Support Materials.

UNIT IV ADDITIVE MANUFACTURING EQUIPMENT **6**

Process Equipment- Design and process parameters-Governing Bonding Mechanism Common faults and troubleshooting - Process Design- Post Processing: Requirement and Techniques- Product Quality.

UNIT V INDUSTRIAL APPLICATIONS **6**

Product Models, manufacturing – Printed electronics, Biopolymers, Packaging, Healthcare, Food, Medical, Biotechnology, Displays Future trends

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. 3D Modelling of a single component
2. Assembly of CAD modelled Components
3. Exercise on CAD Data Exchange.
4. Generation of .stl files.
5. Identification of a product for Additive Manufacturing and its process plan.
6. Printing of identified product on an available AM machine.

TOTAL: 30 Hours

TEXT BOOKS:

1. Christopher Barnatt, 3D Printing: The Next Industrial Revolution, CreateSpace Independent Publishing Platform, 2013.
2. Khanna Editorial, "3D Printing and Design", Khanna Publishing House, Delhi.2020
3. CK Chua, Kah Fai Leong, "3D Printing and Rapid Prototyping- Principles and Applications", World Scientific, 2017

REFERENCE BOOKS:

1. Chua, C.K., Leong K.F. and Lim C.S., Rapid prototyping: Principles and applications, second edition, World Scientific Publishers, 2010
2. Ibrahim Zeid, Mastering CAD CAM Tata McGraw-Hill Publishing Co., 2007
3. Joan Horvath, Mastering 3D Printing, APress, 2014Lan Gibson, David W. Rosen and Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010

WEBSITES:

1. https://www.thingiverse.com/
2. https://www.myminifactory.com/
3. https://www.tinkercad.com/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	2
CO2	2	1	-	-	-	-	-	-	2	2	-	2	-	2
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO5	3	3	2	1	-	-	-	-	2	2	-	2	-	2
Average	**2.8**	**1.8**	**1.3**	1	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-VI

24BECS6E41 NATURAL LANGUAGE PROCESSING (THEORY & LABORATORY) 4H-3C

Instruction Hours/week: L:2 T:0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PRE–REQUISITES: Deep Learning

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for students to

- Provide the NLP basics, including history, challenges, and core concepts.
- Build proficiency in speech processing, syntax analysis, and semantic interpretation through practical exercises.
- Stimulate creativity and problem-solving by applying NLP techniques to real-world problems.

COURSE OUTCOMES

Upon completion of this course students will be able to

• Infer a solid grasp of NLP's origins, challenges, and core concepts.	K2
• Outline NLP models for speech processing, syntax analysis, and semantic interpretation	K2
• Develop NLP models for question answering, summarization, and machine translation using appropriate datasets and frameworks.	K3
• Make use of pointers, structures, unions and arrays in C	K3
• Apply evaluation strategies to assess the effectiveness and accuracy of NLP models in real-world scenarios.	K3

UNIT I INTRODUCTION AND WORDS ANALYSIS 6

Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM - Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization- Words – Morphology and Finite State transducers – Computational Phonology and Pronunciation Modeling – Probabilistic models of pronunciation and spelling-Ngram Models of syntax – Hidden Markov and Maximum Entropy models.

UNIT II SPEECH AND SYNTACTIC 6

Speech and Phonetics (ARPAbet, wavefile formats, phonetic dictionaries, and PRAAT) – Automatic Speech Recognition – HMM-based speech recognition – Gaussian Mixture Model acoustic models – Embedded training – Speech Recognition – discriminative training, and human speech recognition –Context-Free Grammars, Treebanks, Normal Forms for grammar-Dependency Grammar – Syntactic Parsing.

UNIT III SYNTAX 6

First Order Predicate Calculus- Representing Linguistically Relevant Concepts -Syntax-Driven Semantic Analysis -Semantic Attachments - Syntax-Driven Analyzer - Robust Analysis - Lexemes and Senses - Internal Structure - Word Sense Disambiguation - Information Retrieval

UNIT IV SEMANTICS AND PRAGMATICS 6

First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Computational Semantics - Lexical Semantics –Pragmatics: Discourse – Dialog and Conversational agents – Natural language generation, Statistical alignment and Machine translation: Text alignment – word alignment – statistical machine translation.

UNIT V APPLICATION 6

Supervised machine learning -Question answering and Summarization – Single document summarization, generic multiple document summarization – Machine Translation.

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Implement algorithms for text tokenization, including techniques such as word tokenization, sentence segmentation, and stemming.
2. Develop language models using Ngrams and explore their application in predicting the next word in a sentence.
3. Implement POS tagging algorithms such as Hidden Markov Models (HMMs) or Maximum Entropy Markov Models (MEMMs) and evaluate their accuracy.
4. Design and implement NER systems to identify and classify named entities (e.g., persons, organizations, locations) in text data.
5. Explore syntactic parsing techniques such as constituency parsing or dependency parsing and analyze their performance on various text corpora.
6. Develop algorithms for WSD to determine the correct sense of ambiguous words in context and evaluate their effectiveness.
7. Implement extractive or abstractive text summarization algorithms to generate concise summaries of longer texts and assess their quality.

TOTAL: 30 Hours

TEXT BOOKS:

1. Steven Bird, Ewan Klein and Edward Loper, "Natural Language Processing with Python", O_Reilly Media, First Edition, 2009.
2. Daniel Jurafsky, James H. Martin,"Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech", Pearson Publication, 2014.

REFERENCE BOOKS:

1. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Chapman and Hall/CRC Press, 2nd Edition, 2010.
2. Breck Baldwin, ―Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
3. Richard M Reese, ―Natural Language Processing with Java‖, O_Reilly Media, 2015.

WEBSITES:

1. www.nptel.ac.in/courses/106105158
2. www.archive.nptel.ac.in/courses/106/106/106106211/
3. www.coursera.org/specializations/natural-language-processing

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	2	-
CO2	2	1	-	-	-	-	-	-	2	2	-	2	2	-
CO3	3	2	1	-	-	-	-	-	2	2	-	2	2	-
CO4	3	2	1	-	-	-	-	-	2	2	-	2	2	-
CO5	3	2	1	-	-	-	-	-	2	2	-	2	2	-
Average	**2.6**	**1.6**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-VI

24BECS6E42 HUMAN COMPUTER INTERACTION (THEORY & LABORATORY) 4H-3C

Instruction Hours/week: L:2 T:0 P:2 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

PREREQUISITE: Computer Architecture

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to**:**

- Learn the foundations of Human Computer Interaction.
- Apply an interactive design process and universal design principles in designing HCI systems.
- Be aware of mobile HCI.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Demonstrate effective HCI for individuals and persons with disabilities. **K2**
- Interpret the HCI implications for designing multimedia, ecommerce and e-learning Web sites. **K2**
- Outline the fundamentals of Human Computer Interaction. **K2**
- Build effective dialog for HCI. **K3**
- Develop web and mobile user interface in HCI. **K3**

UNIT I FOUNDATION OF HCI 6

The Human: I/O channels – Memory – Reasoning and problem solving - Emotion - The Computer: Devices – Positioning, Pointing and Drawing - Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms.

UNIT II DESIGN AND SOFTWARE PROCESS 6

Interactive Design: Basics – process – scenarios – navigation – screen design and layout – Iteration and prototyping. HCI in software process: Software life cycle – usability engineering – Iterative design and prototyping – design rationale. Design rules: principles, standards, guidelines, rules; Evaluation Techniques

UNIT III INTERACTION STYLES 6

Interaction Styles- Direct Manipulation and Virtual Environments, Menu Selection, Form Filling and Dialog Boxes, Command and Natural Languages, Interaction Devices, Collaboration.

UNIT IV MODELS AND THEORIES **6**

Cognitive models - Socio-Organizational issues and stakeholder requirements – Communication and collaboration models - Task Analysis - Hypertext, Multimedia and WWW.

UNIT V WEB INTERFACE DESIGN AND MOBILE HCI **6**

Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages. Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture.

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Design a system based on a user-centered approach.
2. Design the existing GUI with screen complexity.
3. Design web user interface based on Gestalt theory.
4. Implementation of various kinds of menus.
5. Implementation of various kinds of windows.
6. Implementation of various kinds of icons

TOTAL: 30 Hours

TEXT BOOKS:

1. Alan Dix, Janet Finlay, G D Abowd, R Beale, “Human Computer Interaction”, Pearson Education, 3rd Edition, 2009 (Unit 1,2,3,4)
2. Ben Shneiderman “Designing the User Interface - Strategies for Effective Human Computer Interaction”, Pearson Education, 3rd Edition, 2010.(Unit 3)

REFERENCE BOOKS:

1. Brian Fling, “Mobile Design and Development”, First Edition , O‟Reilly Media Inc., 2009
2. Bill Scott and Theresa Neil, “Designing Web Interfaces”, First Edition, O‟Reilly, 2009.
3. Jenifer Tidwell, Designing Interfaces, Second Edition, O′Reilly publishers, 2011.
4. David Benyon, Designing Interactive Systems: A Comprehensive Guide to HCI, UX and Interaction Design, Third Edition, Pearson, 2013.

WEB SITES:

1. https://www.coursera.org/courses?query=human%20computer%20interaction
2. https://hcibib.org/
3. https://uxdesign.cc/
4. https://uxbooth.com/
5. https://uxplanet.org/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	2
CO2	2	1	-	-	-	-	-	-	2	2	-	2	-	2
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO5	3	2	1	-	-	-	-	-	2	2	-	2	-	2
Average	**2.6**	**1.6**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-VI

24BECS6E43 SOCIAL NETWORK SECURITY (THEORY & LABORATORY) 4H-3C

Instruction Hours/week: L:2 T:0 P:2 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PREREQUISITE: Ethical Hacking, Malware Analysis

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students is to

- Develop semantic web related simple applications
- Explain Privacy and Security issues in Social Networking
- Discuss the prediction of human behavior in social communities

COURSE OUTCOMES:

Upon completion of this course the students will be able to

- Illustrate the Privacy and Security issues in Social Networking K2
- Identify key concepts and terminology related to social network security. K3
- Utilize visualization tools to present findings from social network data mining activities. K3
- Make use of security tools and techniques to assess and protect social networks. K3
- Analyze the prediction of human behavior in social communities K4

UNIT I FUNDAMENTALS OF SOCIAL NETWORKING 6

Introduction to Semantic Web- Limitations of current Web- Development of Semantic Web- Emergence of the Social Web- Social Network analysis- Development of Social Network Analysis- Key concepts and measures in network analysis- Historical overview of privacy and security- Major paradigms for understanding privacy and security

UNIT II SECURITY ISSUES IN SOCIAL NETWORKS 6

The evolution of privacy and security concerns with networked technologies- Contextual influences on privacy attitudes and behaviors- Anonymity in a networked world

UNIT III EXTRACTION AND MINING IN SOCIAL NETWORKING DATA 6

Extracting evolution of Web Community from a Series of Web Archive- Detecting communities in social networks- Definition of community- Evaluating communities- Methods for community detection and mining- Applications of community mining algorithms- Tools for detecting communities social network infrastructures and communities- Big data and Privacy

UNIT IV PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES 6

Understanding and predicting human behavior for social communities- User data Management- Inference and Distribution- Enabling new human experiences- Reality mining- Context- Awareness- Privacy in online social networks- Trust in online environment- What is Neo4j- Nodes- Relationships- Properties

UNIT V ACCESS CONTROL, PRIVACY AND IDENTITY MANAGEMENT 6

Understand the access control requirements for Social Network- Enforcing Access Control

Strategies- Authentication and Authorization- Roles-based Access Control- Host- storage and network access control options- Firewalls- Authentication and Authorization in Social Network- Identity & Access Management- Single Sign-on- Identity Federation- Identity providers and service consumers- The role of Identity provisioning

TOTAL:30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Design own social media application
2. Create a Network model using Neo4j
3. Read and write Data from Graph Database
4. Find "Friend of Friends" using Neo4j
5. Implement secure search in social media
6. Create a simple Security & Privacy detector

TOTAL:30 Hours

TEXT BOOKS:

1. Peter Mika, "Social Networks and the Semantic Web, First Edition, Springer 2007.
2. BorkoFurht, "Handbook of Social Network Technologies and Application, First Edition, Springer, 2010.
3. Learning Neo4j 3.x "Second Edition By Jérôme Baton, Rik Van Bruggen, Packt Publishing.
4. David Easley, Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning about a Highly Connected World‖, First Edition, Cambridge University Press, 2010.

REFERENCE BOOKS:

1. Easley D. Kleinberg J., "Networks, Crowds, and Markets – Reasoning about a Highly Connected World", Cambridge University Press, 2010.
2. Jackson, Matthew O., "Social and Economic Networks", Princeton University Press, 2008.

CO, PO, PSO Mapping

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	2
CO2	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO5	3	3	2	1	-	-	-	-	2	2	-	2	-	2
Average	**2.8**	**2**	**1.3**	**1**	-	-	-	-	**2**	**2**	-	**2**	-	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24BECS6E44 **SOFTWARE DEFINED NETWORKS (THEORY & LABORATORY)** **4H-3C**

Instruction Hours/week: L: 2 T: 0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PREREQUISITE: Computer Networks

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to**:**

- Learn the SDN Architecture, Data plane, Control plan and Application plan.
- Infer knowledge on Network Function Virtualization (NFV) Support and benefits.
- Study industrial deployment use-cases of SDN and NFV.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Outline the key benefits of SDN by separation of data and control planes. K2
- Identify the functions of data plane and control plane. K3
- Build network applications using SDN. K3
- Analyze Network Functions Virtualization roles in SDN. K4
- Examine the functionalities of SDN and NFV use cases. K4

UNIT I SDN: INTRODUCTION **6**

Evolving Network Requirements – The SDN Approach – SDN architecture - SDN Data Plane, Control plane and Application Plane

UNIT II SDN DATA PLANE AND CONTROL PLANE **6**

Data Plane functions and protocols – Open Flow Protocol - Flow Table - Control Plane Functions - Southbound Interface, Northbound Interface – SDN Controllers - Ryu, Open Day light, ONOS - Distributed Controllers

UNIT III SDN APPLICATIONS **6**

SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking

UNIT IV NETWORK FUNCTION VIRTUALIZATION **6**

Network Virtualization - Virtual LANs – Open Flow VLAN Support - NFV Concepts – Benefits and Requirements – Reference Architecture

UNIT V NFV FUNCTIONALITY **6**

NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration- NFV Use cases – SDN and NFV

TOTAL:30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Setup your own virtual SDN lab
   i. Virtualbox/Mininet Environment for SDN - http://mininet.org
   ii. https://www.kathara.org
2. Setup your own Virutal SDN Lab using GNS3
3. Create a simple mininet topology with SDN controller and use Wireshark to capture and visualize the OpenFlow messages such as OpenFlow FLOW MOD, PACKET IN, PACKET OUT.
4. Create a SDN application that uses the Northbound API to program flow table rules on the switch for various use cases like L2 learning switch, Traffic Engineering and Firewall.
5. Create a simple end-to-end network service with two VNFs using vim-emu (https://github.com/containernet/vim-emu)
6. Install OSM, onboard and orchestrate network service.

TOTAL: 30 Hours

TEXT BOOKS:

1. William Stallings, “Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud”, Pearson Education, 1st Edition, 2015.
2. Bruce Davie, Carmelo Cascone, Larry Peterson,"Software-Defined Networks", Systems Approach, LLC,2021.

REFERENCE BOOKS:

1. Ken Gray, Thomas D. Nadeau, “Network Function Virtualization”, Elsevier Science, 2016.
2. Thomas Nadeau, Ken Gray,"Sdn: Software Defined Networks: An Authoritative Review of Network Programmability Technologies",O'Reilly Media,2013.
3. Fei Hu, “Network Innovation through OpenFlow and SDN: Principles and Design”, 1st Edition, CRC Press, 2014.

WEBSITES:

1. https://opennetworking.org/sdn-resources/sdn-learning-resources/
2. https://www.electronics-notes.com/articles/connectivity/data-networks/sdn-what-is-it-basics-technology.php
3. https://www.coursera.org/learn/sdn

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	2	-
CO2	3	2	1	-	-	-	-	-	2	2	-	2	2	-
CO3	3	2	1	-	-	-	-	-	2	2	-	2	2	-
CO4	3	3	2	1	-	-	-	-	2	2	-	2	2	-
CO5	3	3	2	1	-	-	-	-	2	2	-	2	2	-
Average	**2.8**	**2.2**	**1.5**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-VI

24BECS6E45 SOFTWARE TESTING AND AUTOMATION 4H-3C
(THEORY & LABORATORY)

Instruction Hours/week: L: 2 T: 0 P:2 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

PREREQUISITE: Nil

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to**:**

- Understand the basics of software testing and planning effectively.
- Focus on wide aspects of testing and understanding multiple facets of testing
- Get an insight about test automation and the tools used for test automation

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Outline the basic concepts of software testing and the need for software testing. K2
- Utilize C constructs for finding solutions for computational problems K3
- Develop effective test cases that can uncover critical defects in the application. K3
- Apply advanced testing for Web and mobile application development. K3
- Experiment with Selenium and TestNG for software test Automation. K3

UNIT I FOUNDATIONS OF SOFTWARE TESTING 6

Introduction to Manual Testing, Black-Box Testing and White-Box Testing, Software Testing Life Cycle, V-model of Software Testing, Agile Model, Program Correctness and Verification, Reliability versus Safety, Failures, Errors and Faults (Defects), Software Testing Principles, Program Inspections, Stages of Testing: Unit Testing, Integration Testing, System Testing

UNIT II TEST PLANNING 6

The Goal of Test Planning, High Level Expectations, Intergroup Responsibilities, Test Phases, Test Strategy, Resource Requirements, Tester Assignments, Test Schedule, Test Cases, Bug Reporting, Metrics and Statistics.

UNIT III TEST DESIGN AND EXECUTION 6

Test Objective Identification, Test Design Strategies, Boundary Value Analysis, Requirement identification, Testable Requirements, Modeling a Test Design Process, Modeling Test Results, Boundary Value Testing, Equivalence Class Testing, Path Testing, Data Flow Testing, Test Design Preparedness Metrics, Test Case Design Effectiveness, Model-Driven Test Design, Test Procedures, Test Case Organization and Tracking, Bug Reporting, Bug Life Cycle.

UNIT IV ADVANCED TESTING CONCEPTS 6

Performance Testing: Load Testing, Stress Testing, Volume Testing, Fail-Over Testing, Recovery Testing, Configuration Testing, Compatibility Testing, Usability Testing, Testing the Documentation, Security testing, testing in the Agile Environment, Testing Web and Mobile Applications.

UNIT V TEST AUTOMATION AND TOOLS **6**

Software test automation, Skills needed for automation – scope of automation, Automate Testing of Web Applications, Selenium: Introducing Web Driver and Web Elements, Locating Web Elements, Actions on Web Elements, Different Web Drivers, Understanding Web Driver Events, Testing: Understanding Testing.xml, Adding Classes, Packages, Methods to Test, Test Reports.

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Develop the test plan for testing an e-commerce web/mobile application (www.amazon.in).
2. Design the test cases for testing the e-commerce application
3. Develop the test plan and design the test cases for an inventory control system.
4. Test the performance of the e-commerce application.
5. Automate the testing of e-commerce applications using Selenium.
6. Mini Project:

a) Build a data-driven framework using Selenium and TestNG
b) Build Page object Model using Selenium and TestNG
c) Build BDD framework with Selenium, TestNG and Cucumber

TOTAL: 30 Hours

TEXT BOOKS:

1. Yogesh Singh, “Software Testing”, Cambridge University Press, 2012
2. Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" - Second Edition 2018

REFERENCE BOOKS:

1. Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition, 2012, John Wiley & Sons, Inc.
2. Paul C. Jorgensen, Software Testing: A Craftsman’s Approach, Fourth Edition, 2014, Taylor & Francis Group.
3. Carl Cocchiaro, Selenium Framework Design in Data-Driven Testing, 2018, Packt Publishing.

WEB SITES:

1. https://nptel.ac.in/courses/106101163
2. https://www.simplilearn.com/tutorials/selenium-tutorial/selenium-automation-testing
3. https://testsigma.com/automated-testing

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	3
CO2	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO5	3	2	1	-	-	-	-	-	2	2	-	2	-	3
Average	**2.8**	**1.8**	**1**	-	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-VI

24BECS6E46 ROBOTICS PROCESS AUTOMATION 4H-3C
(THEORY & LABORATORY)

Instruction Hours/week: L: 2 T: 0 P:2 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

PRE-REQUISTES: Nil

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Understand the basic concepts of Robotic Process Automation.
- Expose to the key RPA design and development strategies and methodologies.
- Identify the Exception Handling, Debugging and Logging operations in RPA.

COURSE OUTCOMES

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

• Outline the benefits of Robotic Process Automation in industrial sectors	K2
• Identify the robotic process automation tools for process mining.	K3
• Utilize RPA control design flows and work flows for the target process	K3
• Build an application to handle exceptions in automation processes	K3
• Develop orchestration to control the bots in RPA process.	K3

UNIT I INTRODUCTION TO ROBOTIC PROCESS AUTOMATION 6

Emergence of Robotic Process Automation (RPA), Evolution of RPA, Differentiating RPA from Automation - Benefits of RPA - Application areas of RPA, Components of RPA, RPA Platforms. Robotic Process Automation Tools - Templates, User Interface, Domains in Activities, Workflow Files.

UNIT II AUTOMATION PROCESS ACTIVITIES 6

Sequence, Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management, File operations Controls: Finding the control, waiting for a control, Act on a control, UiExplorer, Handling Events

UNIT III APP INTEGRATION, RECORDING AND SCRAPING 6

App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboard actions to perform operation, Scraping data from website and writing to CSV. Process Mining.

UNIT IV EXCEPTION HANDLING AND CODE MANAGEMENT 6

Exception handling, Common exceptions, Logging- Debugging techniques, Collecting crash dumps, Error reporting. Code management and maintenance: Project organization, Nesting workflows, Reusability, Templates, Commenting techniques, State Machine.

UNIT V DEPLOYMENT AND MAINTENANCE **6**

Publishing using publish utility, Orchestration Server, Control bots, Orchestration Server to deploy bots, License management, Publishing and managing updates. RPA Vendors - Open-Source RPA, Future of RPA

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Create a Sequence to obtain user inputs display them using a message box
2. Create a State Machine workflow to compare user input with a random number.
3. Build a process in the RPA platform using UI Automation Activities.
4. Implement Automation using System Trigger
5. Automate login to (web) Email account
6. Implement Error Handling in RPA platform

TOTAL: 30 Hours

TEXT BOOKS:

1. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath by Alok Mani Tripathi, Packt Publishing, 2018.
2. Tom Taulli , "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", Apress publications, 2020

REFERENCE BOOKS:

1.Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, Introduction to Robotic Process Automation: A Primer, Institute of Robotic Process, Automation, Amazon Asia-Pacific Holdings Private Limited, 2018
2.Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant, Amazon Asia-Pacific Holdings Private Limited, 2018
3.A Gerardus Blokdyk, "Robotic Process Automation RPA A Complete Guide ", 2020.

WEBSITES:

1. https://www.geeksforgeeks.org/robotics-process-automation-an-introduction/
2. https://www.javatpoint.com/rpa
3. https://www.tutorialspoint.com/robotics-process-automation-an-introduction

CO, PO, PSO Mapping

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	2	-	-	-	2	2	-	-	2	-
CO2	3	2	1	-	2	-	-	-	2	2	-	-	2	-
CO3	3	2	1	-	2	-	-	-	2	2	-	-	2	-
CO4	3	2	1	-	2	-	-	-	2	2	-	-	2	-
CO5	3	3	2	1	2	-	-	-	2	2	-	-	2	-
Avg	**2.8**	**2**	**1.3**	**1**	**2**	**-**	**-**	**-**	**2**	**2**	**-**	**-**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-VI

24BECS6E47 COMPUTER VISION 4H-3C

(THEORY & LABORATORY)

Instruction Hours/week: L: 2 T: 0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PRE-REQUISITE: Deep Learning

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students**:**

- Provide fundamental concepts of computer vision algorithms, stereoscopic imaging and higher-level image processing operations.
- Equip students with tools and techniques for image processing facilities in Octave and open-source tools like OpenCV.
- Explore contemporary with industrial applications, object detection and object tracking algorithms.

COURSE OUTCOMES:

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

• Summarize the basic computer vision algorithms, the proper use of shape and its related cue features for computer vision applications	K2
• Interpret object detection methodologies for image processing.	K3
• Apply Object detection algorithms used in Computer Vision.	K3
• Identify the performance of computer vision algorithms	K3
• Analyze an exemplary application on the real–world computer vision problems	K4

UNIT I IMAGE BASICS 6

Image Formation and Representation–Intensity and Range Images – Camera models – Camera parameters – Light and colour – Color Image Processing - Image Noise – Morphological Image Processing - Image Filtering (spatial domain) – Image Compression - Mask based filtering – Frequency Domain Filtering - Image Smoothing –Image Sharpening.

UNIT II IMAGE DETECTION 6

Point and Line Detection – Hough Transform and Shape detection – Edge Detection – Corner Detection – Harris Detector- Stereopsis – Correspondence Problem –RANSAC and Alignment- Epipolar Geometry.

UNIT III IMAGE FEATURES 6

Image Features – Textures – Deformable Contours – Features Reduction – Principal Component analysis – Feature Descriptors – SIFT and SURF– Motion field of rigid objects – Notation of Optical flow

UNIT IV IMAGE ALGORITHMS **6**

Estimation Motion Field – Horn and Schunck Algorithm – Lucas and Kanade Algorithm - Shape from Shading and shape from Texture Model based Vision – Smooth Surfaces and their Outlines–Aspect Graphs and Range Data.

UNIT V MACHINE LEARNING **6**

Localization – Classification and Evaluation – AdaBoost – Random Decision Forests – Pedestrian Detection. Emotion Recognition – Real Time Object Detection – Gesture Recognition – Face Detection.

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Implementation of Noise removal algorithms
2. Implementation of Object detection based on Edge detection algorithms
3. Implementation of Perspective projection of the lane borders
4. Implementations of Feature Extraction of an object using SIFT.
5. Implementation of Feature Extraction of an object using SURF
6. Implementation of Emotion Recognition
7. Implementation of Object detection using AdaBoost

TOTAL: 30 Hours

TEXT BOOKS:

1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer International, First Edition,2011.
2. Reinhard Klette, “Concise Computer Vision: An Introduction into Theory and Algorithms”, Springer Publishers, First Edition, 2014.

REFERENCE BOOKS:

1. Davies E R, “Computer and Machine Vision”, Elsevier Publication, Fourth Edition, 2012.
2. David Forsyth and Jean Ponce, “Computer Vision: A Modern Approach”, Pearson International, Second Edition, 2012.
3. Richard Hartley and Andrew Zisserman, “Multiple View Geometry in Computer Vision”, Cambridge University Press, Second Edition, 2004.

WEBSITES:

1. www.nptel.ac.in/courses/106/106/106106224/
2. www.nptel.ac.in/courses/108/103/108103174/
3. www.6.869.csail.mit.edu/sp21/

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	2
CO2	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO5	3	2	1	-	-	-	-	-	2	2	-	2	-	2
Avg	**2.8**	**1.8**	**1**	-	-	-	-	-	2	2	-	2	-	2

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-VI

24BECS6E48 AUGMENTED REALITY AND VIRTUAL REALITY (THEORY & LABORATORY) 4H-3C

Instruction Hours/week: L:2 T:0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PREREQUISITE: Nil

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to**:**

- Impart the fundamental aspects and principles of AR/VR technologies.
- Know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
- Learn about the graphical processing units and their architectures.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Interpret the working principle of AR/VR related to Sensor devices. **K2**
- Illustrate the basic concepts of AR and VR. **K2**
- Make use of tools and technologies related to AR/VR. **K3**
- Build real-world asserts using modeling techniques. **K3**
- Develop AR/VR applications in different domains. **K3**

UNIT I INTRODUCTION **7**

Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.

UNIT II VR MODELING **6**

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation–Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management.

UNIT III VR PROGRAMMING **6**

VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D

UNIT IV APPLICATIONS **6**

Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications– Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics– Information Visualization – VR in Business – VR in Entertainment – VR in Education.

UNIT V AUGMENTED REALITY **5**

Introduction to Augmented Reality-Computer vision for AR-Interaction-Modeling and Annotation Navigation-Wearable devices.

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Use the primitive objects and apply various projection types by handling camera.
2. Model three dimensional objects using various modeling techniques and apply textures over them.
3. Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.
4. Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.
5. Develop AR enabled simple applications like human anatomy visualization, DNA/RNA structure visualization and surgery simulation.
6. Develop simple MR enabled gaming applications.

TOTAL: 30 Hours

TEXT BOOKS:

1. Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create compelling VR experiences for mobile”, Packt Publisher, 2018 (Unit 1,2)
2. Dieter Schmalstieg, Tobias Hollerer, “Augmented Reality: Principles & Practice”, Addison Wesley, 2016 (Unit 5)
3. William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design”, Morgan Kaufmann, 2018 (Unit 3,4)

REFERENCE BOOKS:

1. John Vince, “Introduction to Virtual Reality”, Springer-Verlag, 2004.
2. Philippe Fuchs, Pascal Guitton, and Guillaume Moreau, "Virtual Reality: Concepts and Technologies", CRC Press, 1st edition, 2011.
3. Stephen Cawood and Mark Fiala, "Augmented Reality: A Practical Guide", Addison-Wesley Professional, 1st edition, 2013.
4. Jason Jerald, "The VR Book: Human-Centered Design for Virtual Reality", Morgan & Claypool Publishers, 1st edition, 2015.
5. Alan B. Craig, "Understanding Augmented Reality: Concepts and Applications", Morgan Kaufmann, 1st edition, 2013.

WEB SITES:

1. https://archive.nptel.ac.in/courses/121/106/121106013/
2. https://www.udemy.com/course/fundamentals-of-augmented-reality-virtual-reality-101-ar-vr/?couponCode=NVDIN35
3. https://www.coursera.org/courses?query=augmented%20reality
4. https://uploadvr.com
5. https://unity.com/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	2
CO2	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO5	3	2	1	-	-	-	-	-	2	2	-	2	-	2
Average	**2.8**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-VI

24BECS6E49 ENGINEERING SECURE SOFTWARE SYSTEMS (THEORY & LABORATORY) 4H-3C

Instruction Hours/week: L:2 T: 0 P:2 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PREREQUISITE: NIL

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the student is to:

- Know the principles of secure software design and need for software security.
- Understand risk management in secure software development.
- Know the working of tools related to software security.

COURSE OUTCOMES:

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

- Infer vulnerabilities related to memory attacks. K2
- Interpret the extent of risks in the risk management cycle. K2
- Apply the security principles in software development. K3
- Identify testing techniques related to software security during the testing phase of software development. K3
- Make use of tools for securing a software system. K3

UNIT I NEED OF SOFTWARE SECURITY AND LOW-LEVEL ATTACKS 6

Software Assurance and Software Security - Threats to software security - Sources of software insecurity - Benefits of Detecting Software Security - Properties of Secure Software- Memory Based Attacks: Low-Level Attacks against Heap and Stack - Defense Against Memory-Based Attacks

UNIT II SECURE SOFTWARE DESIGN 7

Requirements Engineering for secure software - SQUARE process Model – Requirement elicitation and prioritization- Isolating the Effects of Untrusted Executable Content – Stack Inspection – Policy Specification Languages – Vulnerability Trends – Buffer Overflow – Code Injection - Session Hijacking. Secure Design - Threat Modeling and Security Design Principles

UNIT III SECURITY RISK MANAGEMENT 5

Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management

UNIT IV SECURITY TESTING 8

Traditional Software Testing – Comparison - Secure Software Development Life Cycle – Risk Based Security Testing – Prioritizing Security Testing with Threat Modeling – Penetration Testing – Planning and Scoping - Enumeration – Remote Exploitation – Web Application Exploitation - Exploits and Client-Side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection - Tools for Penetration Testing

UNIT V SECURE PROJECT MANAGEMENT **4**

Governance and security - Adopting an enterprise software security framework - Security and project management - Maturity of Practice

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Implement the SQL injection attack.
2. Implement the Buffer Overflow attack.
3. Implement Cross Site Scripting and Prevent XSS.
4. Perform Penetration testing on a web application to gather information about the system, and then initiate XSS and SQL injection attacks using tools like Kali Linux.
5. Develop and test the secure test cases
6. Penetration test using kali Linux

TOTAL: 30 Hours

TEXT BOOKS:

1. Erik Fretheim, Marie Deschene, "Secure Software Systems', Jones & Bartlett Learning, 2023.
2. Julia H. Allen, "Software Security Engineering", Pearson Education, 2008
3. Evan Wheeler, "Security Risk Management: Building an Information Security Risk, Management Program from the Ground Up", First edition, Syngress Publishing, 2011
4. Chris Wysopal, Lucas Nelson, Dino Dai Zovi, and Elfriede Dustin, "The Art of Software Security Testing: Identifying Software Security Flaws (Symantec Press)", Addison-Wesley Professional, 2006

REFERENCE BOOKS:

1. Mike Shema, "Hacking Web Apps: Detecting and Preventing Web Application Security Problems", First edition, Syngress Publishing, 2012
2. Bryan Sullivan and Vincent Liu, "Web Application Security, A Beginner's Guide", Kindle Edition, McGraw Hill, 2012
3. Lee Allen, "Advanced Penetration Testing for Highly-Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled)", Kindle Edition, Packt Publishing,2012.
4. Jon Erickson, "Hacking: The Art of Exploitation", 2nd Edition, No Starch Press, 2008.

WEB SITES:

1. https://study.com/academy/lesson/secure-software-definition-characteristics.html
2. https://www.geeksforgeeks.org/what-is-software-security-definition-and-best-practice/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	3	-
CO2	2	1	-	-	-	-	-	-	2	2	-	2	3	-
CO3	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO4	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO5	3	2	1	-	-	-	-	-	2	2	-	2	3	-
Average	**2.6**	**1.6**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**3**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-VI

24BECS6E410 SECURITY AND PRIVACY IN CLOUD (THEORY & LABORATORY) 4H-3C

Instruction Hours/week: L: 2 T: 0 P:2 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PREREQUISITE: Cloud Computing

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Gain insights on Cloud Computing terminology, definition and concepts
- Understand the security design and architectural considerations for Cloud
- Visualize,monitor and audit cloud applications for security

COURSE OUTCOMES:

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

- Infer the cloud security concepts. K2
- Interpret the security challenges in the cloud. K2
- Identify the user identities and Access Management. K3
- Apply the risks, audit and monitoring mechanisms in the cloud. K3
- Develop the architectural and design considerations for security in the cloud. K3

UNIT I FUNDAMENTALS OF CLOUD SECURITY CONCEPTS 6

Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Non- repudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures.

UNIT II SECURITY DESIGN AND ARCHITECTURE FOR CLOUD 6

Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key

UNIT III ACCESS CONTROL AND IDENTITY MANAGEMENT 6

Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization - Verified and measured boot - Intruder Detection and prevention

UNIT IV CLOUD SECURITY DESIGN PATTERNS 6

Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud

UNIT V MONITORING, AUDITING AND MANAGEMENT **6**

Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing – Record generation, Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS

1. Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm not present in Cloud Sim
2. Simulate resource management using cloud sim
3. Simulate log forensics using cloud sim
4. Simulate a secure file sharing using a cloud sim
5. Implement data anonymization techniques over the simple dataset (masking, k-anonymization)
6. Implement any encryption algorithm to protect the images

TOTAL: 30 Hours

TEXT BOOKS:

1. Eduardo Fernandez-Buglioni ,"Cloud Security Patterns: Practical Applications of the NIST Cyber security Framework for Cloud Computing" **,** Wiley,2019
2. Mather, Kumaraswamy and Latif, "Cloud Security and Privacy", OREILLY 2011.

REFERENCE BOOKS:

1. Mark C. Chu-Carroll ―Code in the Cloud‖,CRC Press, 2011
2. Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. ThamaraiSelvi
3. Raj Kumar Buyya , James Broberg, andrzej Goscinski, "Cloud Computing:", Wiley
4. 2013.
5. Dave shackleford, "Virtualization Security", SYBEX a Wiley Brand 2013.
6. Ben Halpert ,"Auditing Cloud Computing: A Security and Privacy Guide, Wiley,2011

WEB SITES:

1. https://studytm.wordpress.com/wp-content/uploads/2014/03/hand-book-of-cloud-computing.pdf
2. https://terrorgum.com/tfox/books/cloudcomputingbasics_aselfteachingintroduction.pdf
3. https://dhoto.lecturer.pens.ac.id/lecture_notes/internet_of_things/CLOUD%20COMPUTING%20Principles%20and%20Paradigms.pdf
4. https://samples.jblearning.com/9781284198355/9781284198355_FMxx_Chapple.pdf
5. https://www.researchgate.net/publication/360286722_Cloud_Computing_and_Security_Fundamentals

CO, PO, PSO Mapping

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	2
CO2	2	1	-	-	-	-	-	-	2	2	-	2	-	2
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO5	3	2	1	-	-	-	-	-	2	2	-	2	-	2
Avg	**2.6**	**1.6**	**1**	**-**	-	-	-	-	**2**	**2**	-	**2**	-	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-VI

24BECS6E411 WEB APPLICATION SECURITY (THEORY & LABORATORY) 4H-3C

Instruction Hours/week: L: 2 T: 0 P:2 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PREREQUISITE: Web Technology, Web Application Development

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students is to

- Understand the fundamentals of web application security
- Focus on wide aspects of secure development and deployment of web applications
- Get an insight about Hacking techniques and Tools

COURSE OUTCOMES:

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

- Interpret the basic concepts of web application security and its necessity K2
- Illustrate the process for secure development and deployment of web applications K2
- Make use of vulnerability assessment and penetration testing tools K3
- Apply hacking techniques and tools for social engineering applications K3
- Develop Secure Web Applications that use Secure APIs K3

UNIT I FUNDAMENTALS OF WEB APPLICATION SECURITY 6

The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation

UNIT II SECURE DEVELOPMENT AND DEPLOYMENT 6

Web Applications Security - Security Testing, Security Incident Response Planning, the Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), the Software Assurance Maturity Model (SAMM)

UNIT III SECURE API DEVELOPMENT 6

API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Micro service APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.

UNIT IV VULNERABILITY ASSESSMENT AND PENETRATION TESTING 6

Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database- based vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing,

Mobile Application Testing.

UNIT V HACKING TECHNIQUES AND TOOLS 6

Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite.

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Install wireshark and explore the various protocols

a) Analyze the difference between HTTP vs HTTPS

b) Analyze the various security mechanisms embedded with different protocols.

2. Identify the vulnerabilities using OWASP ZAP tool
3. Create simple REST API using python for following operation

a) GET

b) PUSH

c) POST

d) DELETE

4. Install Burp Suite to do following vulnerabilities:

a) SQL injection

b) cross-site scripting (XSS)

5. Attack the website using Social Engineering method

TOTAL: 30 Hours

TEXT BOOKS:

1. Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, First Edition, O'Reilly Media, Inc, 2020.
2. Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, The McGraw-Hill Companies, 2012.
3. Neil Madden, API Security in Action, Manning Publications Co., NY, USA, 2020.

REFERENCE BOOKS:

1. Ravi Das and Greg Johnson, Testing and Securing Web Applications, Taylor & Francis Group, LLC, 2021.
2. Prabath Siriwardena, Advanced API Security, Apress Media LLC, USA, 2020.

3. Malcom McDonald, Web Security for Developers, No Starch Press, Inc, 2020.

WEB SITES:

1. https://www.geeksforgeeks.org/securing-web-applications/
2. https://www.invicti.com/blog/web-security/getting-started-web-application-security/
3. https://www.synopsys.com/glossary/what-is-web-application-security.html

CO, PO, PSO Mapping

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	2
CO2	2	1	-	-	-	-	-	-	2	2	-	2	-	2
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO5	3	2	1	-	-	-	-	-	2	2	-	2	-	2
Average	**2.6**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-VI

24BECS6E412 GENERATIVE AI 4H-3C

(THEORY & LABORATORY)

Instruction Hours/week: L: 2 T: 0 P:2 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PRE–REQUISITES: Artificial Intelligence**,** Deep Learning

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Understand the foundational concepts of generative models.
- Explore various types of generative models, including GANs, VAEs, and Transformers.
- Gain hands-on experience in implementing and training generative models.

COURSE OUTCOMES:

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

• Compare and Differentiate Generative Models	K2
• Interpret auto encoder architecture in generative AI	K2
• Develop generative adversarial networks for data augmentation.	K3
• Identify transformer models for text generation for neural networks.	K3
• Apply ethical implications and responsible AI practices	K3

UNIT I FOUNDATIONS OF GENERATIVE MODELS 6

Introduction to Generative AI : Overview of generative AI and its applications- Types of generative models- Introduction to deep learning frameworks. Probability and Statistical Methods : Probability distributions and Bayesian inference - Maximum likelihood estimation (MLE) - Variational inference.

UNIT II VARIATIONAL AUTOENCODERS (VAES) 6

Autoencoders: Basic autoencoder architecture- Training autoencoders- Applications of autoencoders. Introduction to VAEs: Structure and theory of VAEs- Latent space representation- Variational inference in VAEs. Advanced Topics in VAEs: Conditional VAEs- Semi-supervised learning with VAEs- Applications of VAEs in data generation and anomaly detection

UNIT III GENERATIVE ADVERSARIAL NETWORKS (GANS) 6

Introduction to GANs: Fundamentals of GANs-Generator and discriminator networks-Training GANs and common challenges. Advanced GAN Architectures: Deep Convolutional GANs (DCGANs)- Conditional GANs (cGANs)- CycleGANs and StyleGANs. Practical Applications of GANs: Image synthesis and editing-Data augmentation-Evaluation metrics for GANs.

UNIT IV TRANSFORMER MODELS AND TEXT GENERATION 6

Introduction to Transformers: Architecture of Transformer Models-Self-attention mechanism-Training Transformers. Language Models and Text Generation: Recurrent neural networks (RNNs) and LSTMs-Generative Pre-trained Transformers (GPT) and applications in text generation and language translation - Chat Bot.

UNIT V ADVANCED APPLICATIONS AND ETHICAL CONSIDERATIONS 6

Generative Models for Images and Audio: Image generation techniques-Neural style transfer Audio synthesis and music generation. Ethical and Societal Implications: Ethical issues in generative AI-Deep fackes and their impact-Responsible AI practices.

TOTAL: 30 Hours

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Implement the encoder and decoder networks for a VAE.
2. Implement a conditional VAE (CVAE).
3. Implement the generator and discriminator networks for a GAN.
4. Implement a Deep Convolutional GAN (DCGAN).
5. Implement a Cycle GAN for image-to-image translation (e.g., converting horses to zebras).
6. Implement a basic Transformer model.

TOTAL: 30 Hours

TEXT BOOKS:

1. David Foster," Deep Learning: Teaching Machines to Paint, Write, Compose and Play", O'Reilly Media, 2nd edition, 2023.
2. Numa Dhamani, "Introduction to Generative AI", Manning, First edition,2024.
3. Carlos Rodriguez, "Generative AI Foundations in Python: Discover key techniques and navigate modern challenges in LLMs", Packt Publishing, First edition, 2024.

REFERENCE BOOKS:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017.
2. Rafael Valle, "Hands-on Generative Adversarial Networks with Keras". Packt Publisher, 2019.

WEBSITES:

1. https://www.coursera.org/learn/generative-ai-introduction-and applications
2. https://www.coursera.org/learn/generative-ai-prompt-engineering-for-everyone
3. https://www.coursera.org/learn/generative-ai-foundation-models-and-platforms

CO, PO, PSO Mapping

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	2	-	-	-	2	2	-	-	2	-
CO2	3	2	1	-	2	-	-	-	2	2	-	-	2	-
CO3	3	2	1	-	2	-	-	-	2	2	-	-	2	-
CO4	3	2	1	-	2	-	-	-	2	2	-	-	2	-
CO5	3	3	2	1	2	-	-	-	2	2	-	-	2	-
Average	**2.8**	**2**	**1.3**	**1**	**2**	-	-	-	**2**	**2**	-	-	**2**	-

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

LIST OF

MANDATORY COURSES

SEMESTER- I

24BEMC151 WOMEN SAFETY AND SECURITY 1H-0C

Instruction Hours/week: L:1 T:0 P:0 Marks: Internal:100 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course is for the students to:

- Highlight the social construction of gender in Indian society and the role of social institutions in the socialization process.
- Make aware about the practical issues concerning gender and politics.
- Classify the students in engendering national policies and programmes.
- Observe the liability of women and women's work in the context of globalization.
- Acquaint knowledge about the political participation of women and the gendered structures of governance and polity.

COURSE OUTCOMES

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

• Infer into the basic concepts related to sex, gender, femininity etc.	K2
• Demonstrate the rationale for women's studies.	K2
• Compare Gender Equality Issues and Movements in Women's Studies.	K2
• Summarize the Social construction of Gender, Gender Roles and Gender stereotyping.	K2
• Illustrate Social Structures, Changing Status of Women in India.	K2

UNIT I FUNDAMENTAL CONCEPTS OF WOMEN'S STUDIES

Definition- Objectives of Women's Studies; Importance of Women's Studies; Women's Studies as an Academic Discipline; Role of UGC Centre for Women's Studies

UNIT II SOCIAL EMPOWERMENT

Women in Higher Education; Gender issues in Health, Environment, Family welfare Measures, Indecent representation of Women in media; Women in Difficult circumstances; Constitutional.

UNIT III POLITICAL EMPOWERMENT

Women leaders in politics-Women in Local Governance- Barriers- Reservation policies-Women'sPolitical Rights, Property Rights - Violence against Women -Women's work

Total :15 Hours

TEXT BOOKS

1. Amy s. Wharton. (2005). “the sociology of gender: an introduction to theory and research”. (key themes in sociology) blackwell publishing, uk, indian reprint, kilaso books, new delhi.
2. Devaki jain and pam rajput (ed). (2003). “narratives from the women‟s studiesFamily: recreating knowledge, sage, and new delhi.
3. Jasbir jain (ed). (2005). “women in patriarchy: cross cultural”. Rawat publication jaipur.

24BEMC152 **தமிழர் மரபும் பண்பாடும்** **1H-0C**

கற்பித்தல் நேரம்/வாரம்: L:1 T:0 P:0 **மதிப்பெண்: இடைத்தேர்வு: 100 மொத்தம்:100**

பாடத்திட்ட பயன் விளைவு:

- வரலாற்றிற்கு முற்பட்ட தமிழகத்தை மாணவர்களுக்கு அறிமுகப்படுத்துதல்
- பழந்தமிழர் பண்பாடு சார்ந்த வாழ்க்கை முறையை மாணவர்கள் அறிய ஊக்குவித்தல்
- தமிழ் மொழியின் பழைமையும், திராவிட மொழிகளில் தமிழ்மொழியின் தனிச்சிறப்பையும் மாணவர்களுக்கு அறிமுகப்படுத்துதல்.
- தமிழர்களின் வாழ்வியல், தமிழர்கலைகள், ஆற்றங்கரைப்பண்பாடுகள் குறித்து மாணவர்கள் அறியச்செய்தல்.
- இந்தியக்குடியுரிமைப்பணி முதலான போட்டித்தேர்வுகளில் விருப்பப்பாடமாக இடம்பெறுகின்ற தமிழ்நாகரிகமும் பண்பாடும் குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்

பாடத்திட்டப் பொதுநோக்கம்:

- இந்தியக்குடியுரிமைப்பணி முதலான போட்டித்தேர்வுகளில், விருப்பப்பாடமாக இடம்பெறுகின்ற, 'தமிழ்இலக்கியவரலாறு' குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்.
- கல்வெட்டியல், ஓலைச்சுவடியியல் மற்றும் தொல்லியல் சார்ந்த ஆவணத்தேடலுக்குரிய ஆய்வுமனப்பான்மையுடன், இலக்கியங்களை அணுகுதல்.
- தமிழின்வளர்ச்சித்துறையாகிய, 'அறிவியல்தமிழ்'; 'இணையதமிழ்' குறித்த பன்நோக்கு அணுகுமுறையிலான ஆய்வுச்சிந்தனை மேம்பாடு.
- வேலைவாய்ப்புக்குரிய சுயதிறன் மேம்பாட்டுடன், படைப்பாக்கத்திறன் மேம்பாடும் பெற்றிருத்தல் .
- சமுதாய மற்றும் வாழ்வியல் மதிப்புகளைப்பேணுவதற்குக்கருவியாக இலக்கியங்களை நாடுகின்ற மனப்பான்மைவளர்ச்சி. மொழிபெயர்ப்புத்துறை சார்ந்த வேலைவாய்புத்திறன் பெற்றிருத்தல்.

அலகு:1 தமிழர் மரபு

மரபு-விளக்கம்-சங்ககால தமிழர் மரபு – திணைப்பகுப்பும் தமிழர் மரபும்-உலகப்பொதுமை – அகத்திணை மரபு – புறத்திணை மரபு- இடைக்காலத்தமிழர் மரபு – பிற்கால மரபும் மாற்றமும் – தற்கால தமிழர்மரபு - வளர்ச்சி.

அலகு: 2 தமிழர் பண்பாடு

பண்பாடு – விளக்கம் – பழந்தமிழர் பண்பாடு – இயற்கை சார்ந்த வாழ்வியல் – தமிழர் சமயம் – அரசியல் நிலை–சமூகப் பழக்கவழக்கங்கள் – நம்பிக்கைகள் – வாழ்வியல் அறங்கள் – வணிகம் போன்றவை.

அலகு:3 தமிழர் கலைகள்

தமிழகத்தில் கலைகளின் வளர்ச்சி – சிற்பக்கலை வளர்ச்சி –கோயில் கலை – கற்கோவில்கள் - ஓவியக்கலை – அழகுக்கலைகள் - கூத்துக்கலை – மருத்துவக்கலை – நாடகக்கலை– இசைக்கலை போன்றவை.

அலகு: 4 தமிழர் சமயம்

பழந்தமிழரின் சமயம் – சங்ககால சமயம் – தொல்காப்பியத்தில் சமயம் – சைவ சமயம்– வைணவம் – தமிழ்ப் பண்பாட்டில் பௌத்தம் – தமிழ்ப் பண்பாட்டில் சமணத்தின் தாக்கம்–தமிழ்ப் பண்பாட்டில் இசுலாம் மற்றும் கிறித்துவ சமயத்தின் தாக்கம்- தமிழர் பண்பாட்டில் விழாக்கள்- கோயில்களும் விழாக்களும்- சமூக ஒருங்கிணைப்பில் விழாக்களின் பங்கு-சங்க இலக்கியத்தில் விழாக்கள் பற்றிய குறிப்புகள்-இடைக்கால இலக்கியங்களில் விழாக்கள் பற்றிய செய்திகள் – விழாக்களின் சமூகப்பங்களிப்பு – தற்காலத்தில் தமிழர் விழாக்கள் - விளையாட்டும் விழாக்களும்.

அலகு: 5 இலக்கியங்களில் தமிழர் பண்பாட்டுப் பதிவுகள்

சங்க இலக்கியமும் வாழ்வியலும்-திருக்குறளில் வாழ்வியல் நெறிகள் – இரட்டைக் காப்பியங்களும் வாழ்வியலும் – சிற்றிலக்கியங்களில் வாழ்வியல் பதிவுகள்-இக்கால இலக்கியமும் வாழ்வியலும்.

பார்வைநூல்கள்:

1. தமிழ் இலக்கிய வரலாறு – தமிழண்ணல், மீனாட்சி புத்தக நிலையம்- மதுரை-இரண்டாம் பதிப்பு-ஜூலை – 2000.
2. தமிழர் நாகரிகமும் பண்பாடும், அ. தட்சிணாமூர்த்தி, ஐந்திணைப் பதிப்பகம், சென்னை, திருத்திய பதிப்பு – 2022.
3. தமிழர் வரலாறும் பண்பாடும், நா. வானமாமலை, நியூசெஞ்சுரி புக் ஹவுஸ், சென்னை, ஆறாம்பதிப்பு - 2007 .
4. தமிழக வரலாறு மக்களும் பண்பாடும், கே.கே. பிள்ளை, உலகத் தமிழராய்ச்சி நிறுவனம், சென்னை.

SEMESTER-II

24BEMC251 YOGA 4H-2C

Instruction Hours/week: L:0 T:0 P:4 **Marks: Internal:100 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course is for the students to:

- Have knowledge of Physical fitness and exercise management to lead better quality life
- Enable to officiate, supervise various sports events and organize sports events
- Acquire the knowledge of Physical Education, Sports and Yoga and understand the purposeand its development
- Gain knowledge to plan, organize and execute sports events

COURSE OUTCOMES

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

- Practice physical activities and yoga for strength, flexibility and relaxation.
- Use techniques for increasing concentration and decreasing anxiety for stronger academicperformance.
- Perform yoga exercises in various combination and forms.
- Improve personal fitness through participation in sports and yoga activities.
- Follow sound nutritional practices for maintaining good health and physical performance.

UNIT I INTRODUCTION TO PHYSICAL FITNESS

Explain importance of physical education - Describe importance of Physical Fitness & Wellness -Explain the components of physical fitness - Demonstrate healthy life style - Prevent health threats by changing life style

UNIT II FUNDAMENTALS OF ANATOMY & PHYSIOLOGY IN SPORTS & YOGA

Explain importance of anatomy and physiology - Describe effects of exercise in various body systems - Describe concept of correct posture - Explain corrective measures for posture deformities.

UNIT III YOGA & PRANAYAMA

Explain importance of yoga - Perform various pranayama for increasing concentration - Usemeditation and other relaxation techniques for improving concentration.

TEXT BOOKS

1. Ajmer Singh, Modern Trends and Physical Education class 11 & class 12, Kalyani Publication, New Delhi
2. B.K.S. Iyengar, Light on Yoga, Thomson's Publication, New Delhi,
3. V.K.Sharma, Health and Physical Education, NCERT Books; Class11,12Saraswati House Publication, New Delhi
4. Acharya Yatendra, Yoga and Stress Management, Fingerprint Publishing
5. Swami Vivekanand, PatanjaliYogaSutras, Fingerprint PublishingISBN:9389567351.
6. Ramdev, PranayamRahasya, Patanjali-DivyaPrakashan, HaridwarISBN:978-8189235017
7. Ramdev, YogaitsPhilosophy&Practice, DivyaPrakashan,Haridwar.

SEMESTER-III

24BEMC351 APTITUDE AND REASONING 1H-0C

Instruction Hours/week: L:1 T:0 P:0 Marks: Internal:100 External:0 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Categorize, apply, and use thought processes to distinguish between concepts of Quantitative methods.
- Prepare and explain the fundamentals related to various possibilities and probabilities related to quantitative aptitude.
- Critically evaluate numerous possibilities related to puzzles.
- Understand and solve puzzle-related questions from specific and other competitive tests.
- Solve questions related to Time and distance and time and work etc.

COURSE OUTCOMES

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

- Explain the basics of quantitative ability. K2
- Solve questions related to Logarithm, Permutation and Combinations, Probability, Basic Accountancy, Time, Speed, distance, work, Ratio and area etc. K3
- Utilize satisfactory competency in Verbal Reasoning Questions. K3
- Solve campus placements aptitude papers covering Quantitative Ability and verbal skills. K3
- Apply Quantitative and Verbal reasoning in puzzle-related questions. K3

UNIT -I 1. QUANTITATIVE ABILITY (BASIC MATHEMATICS)

1.1. Number Systems
1.2. LCM and HCF
1.3. Decimal Fractions
1.4. Simplification
1.5. Square Roots and Cube Roots
1.6. Problems on Ages
1.7. Surds & Indices
1.8. Percentages

UNIT II 2. QUANTITATIVE ABILITY (APPLIED & ENGINEERING MATHEMATICS)

2.1. Logarithm
2.2. Permutation and Combinations
2.3 Probability
2.4 Profit and Loss
2.5 Simple and Compound Interest
2.6. Time, Speed and Distance
2.7. Time & Work

2.8. Ratio and Proportion
2.9. Area
2.10 Mixtures and Allegation

UNIT III 3. VERBAL - APTITUDE

1.1 Words
1.2 Idioms
1.3 Phrases in Context
1.4 Reading comprehension techniques
1.5 Narrative sequencing
1.6 Data interpretation

Total :15 Hours

TEXTBOOKS

1. A Modern Approach to Verbal & Non-Verbal Reasoning By R S Agarwal
2. Analytical and Logical Reasoning BySijwali B S
3. Quantitative aptitude for Competitive examination By R S Agarwal
4. Analytical and Logical Reasoning for CAT and other management entrance tests By Sijwali B S
5. Quantitative Aptitude by Competitive Examinations by AbhijitGuha 4th edition

WEBSITES

1. https://prepinsta.com/
2. https://www.indiabix.com/
3. https://www.javatpoint.com/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	1	2	3	-	2	-	-
CO2	-	-	-	-	-	-	-	1	2	3	-	2	-	-
CO3	-	-	-	-	-	-	-	1	2	3	-	2	-	-
CO4	-	-	-	-	-	-	-	1	2	3	-	2	-	-
CO5	-	-	-	-	-	-	-	1	2	3	-	2	-	-
Average	-	-	-	-	-	-	-	1	2	3	-	2	-	-

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-IV

24BEMC451 FOUNDATION OF ENTREPRENEURSHIP 1H-0C

Instruction Hours/week: L:1 T:0 P:0 Marks: Internal:100 External:0 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Equip and develop the learners' entrepreneurial skills and qualities essential to undertake business.
- Impart the learners entrepreneurial competencies needed for managing business efficiently and effectively.
- Understand basic concepts in the area of entrepreneurship
- Develop personal creativity and entrepreneurial initiative
- Adopt the key steps in the elaboration of business idea

COURSE OUTCOMES

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

- Gain entrepreneurial competence to run the business efficiently.
- Undertake businesses in the entrepreneurial environment
- Prepare business plans and undertake feasible projects.
- Be efficient in launching and develop their business ventures successfully
- Monitor the business effectively towards growth and development

UNIT I ENTREPRENEURIAL COMPETENCE

Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality-Characteristics of Successful Entrepreneurs – Knowledge and Skills of an Entrepreneur.

UNIT II ENTREPRENEURIAL ENVIRONMENT

Business Environment - Role of Family and Society - Entrepreneurship Development

UNIT III BUSINESS PLAN PREPARATION

Sources of Product for Business - Prefeasibility Study - Criteria for Selection of Product - Ownership

UNIT IV LAUNCHING OF SMALL BUSINESS

Finance and Human Resource Mobilization - Operations Planning - Market and Channel Selection -Growth Strategies

UNIT V MANAGEMENT OF SMALL BUSINESS

Monitoring and Evaluation of Business - Effective Management of small Business - Case Studies.

TOTAL:15 Hours

TEXT BOOKS

1. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, NewDelhi, 2016.
2. R.D.Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2018.
3. Rajeev Roy ,Entrepreneurship, Oxford University Press, 2nd Edition, 2011.
4. Donald F Kuratko,T.VRao. Entrepreneurship: A South Asian perspective. Cengage Learning, 2012.

SEMESTER-IV

24BEMC452 ESSENCE OF TRADITIONAL INDIAN KNOWLEDGE AND HERITAGE 1H-0C

Instruction Hours/week: L:1 T:0 P:0 **Marks: Internal:100 External:0 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Impart a holistic understanding about Indian Culture and Thoughts from a Historical perspective.
- Encourage critical appreciation of the Indian thoughts and cultural manifestations.
- Introduce the students to important concepts from the diverse intellectual traditions of India.
- Make use of Indian cultural heritage and various epistemological inquiries.
- Gain knowledge of Indian heritage.

COURSE OUTCOMES

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

- Understand the cultural diversity
- Infer the need of cultural unity
- Know the Dravidian culture
- Realize the power of Indian educational system called gurukul
- Come to know the concepts of vedic thought

UNIT I INTRODUCTION TO INDIAN THOUGHT AND CULTURE

Plurality of Indian culture - Cultural Diversity and Cultural Unity -Different manifestations of Indian Culture: Indus valley culture -Vedic culture and Dravidian culture.-The Medieval BhaktiCulture

UNIT II TRADITIONAL KNOWLEDGE SYSTEMS OF INDIA

Introduction to the Traditional Indian Education system of Gurukul - Parampara - Understanding Indian Philosophy: Vedic thought and the nine schools of philosophy - Indigenous Knowledge andWomen in India

TEXT BOOKS

1. Chatterjee, Satishchandra and DhirendramohanDatta. (2007) Introduction to Indian Philosophy.Rupa Publications, New Delhi.
2. Husain,S. Abid. (2003). The National Culture of India. National Book Trust, NewDelhi.

SEMESTER-V

24BEMC551 DESIGN THINKING 1H-1C

Instruction Hours/week: L:1 T:0 P:0 Marks: Internal: 100 External:0 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course is for the students to:

- Illustrate design thinking concepts and principles
- Utilize design thinking methods in every stage of the problem
- Identify the different phases of design thinking
- Plan for various product and service communication in design thinking
- Interpret the use of tools for the design process

COURSE OUTCOMES

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

- Explain the design thinking process, tools and theories. K2
- Identify the types of users and the requirements of customers. K3
- Explore the concepts of Prototyping and its testing. K4
- Analyze design thinking strategies in product and service design. K4
- Customize existing products by utilizing design thinking strategies. K4

UNIT I INTRODUCTION 6

Understanding Design thinking and tools - Human-Centric Design Process - Design Thinking Process - DT Activity with case studies.

UNIT II EMPATHISE WITH USERS 6

Five Whys - Needs of user - Types of user research -Customer Journey Mapping - ObservationalResearch

UNIT III PROTOTYPING 6

Ideas to presentable concepts - Scenario-based Prototyping – Testing prototypes - Usability andergonomic testing - Rapid prototyping.

UNIT IV PRODUCT AND SERVICE DESIGN 6

Product Design - Interaction Design - Service Design - Communication Design - TransportationDesign.

UNIT V DESIGN AND INNOVATION 6

DT For strategic innovations - Extreme Competition - Experience design - Standardization - Humanization - Creative Culture.

TOTAL: 30 Hours

TEXT BOOKS

1. Bala Ramadurai, "Karmic Design Thinking", 2020.
2. Christian Mueller-Roterberg, “Handbook of Design thinking”, Amazon Digital Services LLC - KDP Print US, 2018.
3. Tim Brown, “Change by Design”, Harper Business Publisher, 2019
4. Hasso Plattner, Christoph Meinel and Larry Leifer, "Design Thinking: Understand Improve – Apply", Springer, 2011
5. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	-	-	-	-	1	1	1	-	3	-	2
CO2	3	2	1	-	-	-	-	2	1	1	-	3	-	2
CO3	3	2	2	1	-	2	1	2	2	2	-	3	-	2
CO4	3	3	2	1	-	2	1	2	2	2	-	3	-	2
CO5	3	3	2	1	-	2	1	2	2	2	-	3	-	2
Average	**2.8**	**2.2**	**1.6**	**1**	**-**	**2**	**1**	**1.8**	**1.6**	**1.6**	**-**	**3**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

LIST OF PROJECT WORK

SEMESTER-II

24BECS291 APPLICATION DEVELOPMENT I 2H-1C

Instruction Hours/week: L:0 T:0 P:2 Marks: Internal:100 External:0 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students to

- Develop basic programming skills applicable to software development
- Utilize development tools and techniques.
- Validate applications to ensure quality and performance.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Interpret the principles and components of application development. K2
- Apply basic programming techniques to simple applications. K3
- Develop functional applications using appropriate development tools and languages K3
- Analyze user requirements to meet application solutions. K4
- Function applications to ensure security and performance standards. K4

Students have to develop applications in the following domains:

1. Full Stack Web Development
2. Mobile Application Development
3. Cloud Computing
4. Computer vision
5. Internet of Things
6. Game Development
7. Artificial Intelligence
8. Data science
9. Machine learning
10. Deep learning
11. Quantum Computing
12. Web application
13. Image Processing
14. Cyber Security
15. Others

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	1	2	1	1	1	1	2	2	2	2	3
CO2	3	2	1	1	2	1	1	1	1	2	2	2	2	3
CO3	3	2	1	1	2	1	1	1	1	2	2	2	2	3
CO4	3	3	2	1	2	1	1	1	1	2	2	2	2	3
CO5	3	3	2	1	2	1	1	1	1	2	2	2	2	3
Avg	2.8	2.2	1.5	**1**	**2**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24BECS391 APPLICATION DEVELOPMENT II 2H-1C

Instruction Hours/week: L:0 T:0 P:2 Marks: Internal:100 External:0 Total:100
End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students to

- Develop basic programming skills applicable to software development
- Utilize development tools and techniques.
- Validate applications to ensure quality and performance.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Interpret the principles and components of application development. K2
- Apply basic programming techniques to simple applications. K3
- Develop functional applications using appropriate development tools and languages K3
- Analyze user requirements to meet application solutions. K4
- Function applications to ensure security and performance standards. K4

Students have to develop applications in the following domains:

1. Full Stack Web Development
2. Mobile Application Development
3. Cloud Computing
4. Computer vision
5. Internet of Things
6. Game Development
7. Artificial Intelligence
8. Data science
9. Machine learning
10. Deep learning
11. Quantum Computing
12. Web application
13. Image Processing
14. Cyber Security
15. Others

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	1	2	1	1	1	1	2	2	2	2	3
CO2	3	2	1	1	2	1	1	1	1	2	2	2	2	3
CO3	3	2	1	1	2	1	1	1	1	2	2	2	2	3
CO4	3	3	2	1	2	1	1	1	1	2	2	2	2	3
CO5	3	3	2	1	2	1	1	1	1	2	2	2	2	3
Avg	2.8	2.2	1.5	**1**	**2**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

24BECS392 INTERNSHIP I 2H-1C

Instruction Hours/week: L:0 T:0 P:2 **Marks: Internal:100 External:0 Total:100**

End Semester Exam:3 Hours

PRE- REQUISITES: None

COURSE OBJECTIVES:

The goal of this course for the students is to

- Be self-motivated and diligent professional
- Involve new learning, expanded growth or improvement on the job
- Enable the students to develop their engineering skills

COURSE OUTCOMES:

Upon completion, the students will be able to

- Interpret research literature in engineering problem domain. K2
- Identify mathematics, science and engineering concepts and modern engineering tools necessary to communicate the identified Study /internship. K3
- Apply critical thinking and analytical skills in problem solving. K3
- Develop innovative solutions to real world problems. K3
- Analyze the diverse engineering disciplines to dynamic projects environments K4

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	3	2	2	2	2	2	3	3	3	3
CO2	3	2	1	1	3	2	2	2	2	2	3	3	3	3
CO3	3	2	1	1	3	2	2	2	2	2	3	3	3	3
CO4	3	2	1	1	3	2	2	2	2	2	3	3	3	3
CO5	3	3	2	1	3	2	2	2	2	2	3	3	3	3
Avg	**2.8**	**2**	**1.3**	**1**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-IV

24BECS491 APPLICATION DEVELOPMENT III 2H-1C

Instruction Hours/week: L:0 T:0 P:2 Marks: Internal:100 External:0 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students to

- Develop basic programming skills applicable to software development
- Utilize development tools and techniques.
- Validate applications to ensure quality and performance.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Interpret the principles and components of application development. K2
- Apply basic programming techniques to simple applications. K3
- Develop functional applications using appropriate development tools and languages K3
- Analyze user requirements to meet application solutions. K4
- Function applications to ensure security and performance standards. K4

Students have to develop applications in the following domains:

1. Full Stack Web Development
2. Mobile Application Development
3. Cloud Computing
4. Computer vision
5. Internet of Things
6. Game Development
7. Artificial Intelligence
8. Data science
9. Machine learning
10. Deep learning
11. Quantum Computing
12. Web application
13. Image Processing
14. Cyber Security
15. Others

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	1	2	1	1	1	1	2	2	2	2	3
CO2	3	2	1	1	2	1	1	1	1	2	2	2	2	3
CO3	3	2	1	1	2	1	1	1	1	2	2	2	2	3
CO4	3	3	2	1	2	1	1	1	1	2	2	2	2	3
CO5	3	3	2	1	2	1	1	1	1	2	2	2	2	3
Avg	2.8	2.2	1.5	**1**	**2**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-V

24BECS591 INTERNSHIP II 2H-1C

Instruction Hours/week: L:0 T:0 P:2 **Marks: Internal:100 External:0 Total:100**

End Semester Exam:3 Hours

PRE- REQUISITES: None

COURSE OBJECTIVES:

The goal of this course for the students is to

- Be self-motivated and diligent professional
- Involve new learning, expanded growth or improvement on the job
- Enable the students to develop their engineering skills

COURSE OUTCOMES:

Upon completion, the students will be able to

- Interpret research literature in engineering problem domain. K2
- Identify mathematics, science and engineering concepts and modern engineering tools necessary to communicate the identified Study /internship. K3
- Apply critical thinking and analytical skills in problem solving. K3
- Develop innovative solutions to real world problems. K3
- Analyze the diverse engineering disciplines to dynamic projects environments K4

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	3	2	2	2	2	2	3	3	3	3
CO2	3	2	1	1	3	2	2	2	2	2	3	3	3	3
CO3	3	2	1	1	3	2	2	2	2	2	3	3	3	3
CO4	3	2	1	1	3	2	2	2	2	2	3	3	3	3
CO5	3	3	2	1	3	2	2	2	2	2	3	3	3	3
Avg	**2.8**	**2**	**1.3**	**1**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-VI

24BECS691 MINI PROJECT 2H-1C

Instruction Hours/week: L:0 T:0 P:2 **Marks: Internal:100 External:0 Total:100**

End Semester Exam:3 Hours

PRE- REQUISITES: None

COURSE OBJECTIVES:

The goal of this course for the students is to

- Define the problem of the proposed research.
- Apply the concept of computational science in solving research problem.
- Demonstrate and validate the result of the chosen problem.

COURSE OUTCOMES:

Upon completion the students will be able to

- Apply practically acquired knowledge within the chosen area of project domain. K3
- Identify the technical aspects of a project with comprehensive and systematic approach. K3
- Develop effective communication and report writing related to project findings. K3
- Examine the principles of project management and finance during the implementation of the project. K4
- Function as an individual or in a team in development of engineering projects. K4

CO, PO PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	3	2	2	2	2	2	3	3	3	3
CO2	3	2	1	1	3	2	2	2	2	2	3	3	3	3
CO3	3	2	1	1	3	2	2	2	2	2	3	3	3	3
CO4	3	3	2	1	3	2	2	2	2	2	3	3	3	3
CO5	3	3	2	1	3	2	2	2	2	2	3	3	3	3
Avg	**3**	**2.4**	**1.4**	**1**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-VII

24BECS791 PROJECT WORK PHASE I / FIELD PROJECT 8H-4C

Instruction Hours/week: L:0 T:0 P:8 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PRE- REQUISITES: None

COURSE OBJECTIVES:

The goal of this course for the students is to

- Apply engineering knowledge in practical problem solving.
- Foster innovation in design of products, processes or systems.
- Develop creative thinking in finding viable solutions to engineering problems.

COURSE OUTCOMES:

Upon completion, the students will be able to

- Identify theoretical concepts to solve industrial problems with teamwork and multidisciplinary approach K3
- Apply project management skills for planning, scheduling, execution and monitoring. K3
- Utilize the techniques, skills and modern tools necessary for the project. K3
- Examine research gaps and propose creative solutions K4
- Analyze products, processes for sustainable and socially relevant applications K4

CO,PO PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	3	2	2	2	2	2	3	3	2	3
CO2	3	2	1	1	3	2	2	2	2	2	3	3	2	3
CO3	3	2	1	1	3	2	2	2	2	2	3	3	2	3
CO4	3	2	1	1	3	2	2	2	2	2	3	3	2	3
CO5	3	3	2	1	3	2	2	2	2	2	3	3	2	3
Avg	**3**	**2.2**	**1.2**	**1**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-VIII

24BECS891 PROJECT WORK AND VIVA VOCE PHASE II 16H-8C

Instruction Hours/week: L:0 T:0 P:16 **Marks: Internal:80 External:120 Total:200**

End Semester Exam:3 Hours

PRE- REQUISITES: None

COURSE OBJECTIVES:

The goal of this course for the students is to

- Apply engineering knowledge in practical problem solving.
- Foster innovation in design of products, processes or systems.
- Develop creative thinking in finding viable solutions to engineering problems.

COURSE OUTCOMES:

Upon completion, the students will be able to

- Identify theoretical concepts to solve industrial problems with teamwork and multidisciplinary approach K3
- Apply project management skills for planning, scheduling, execution and monitoring. K3
- Utilize the techniques, skills and modern tools necessary for the project. K3
- Examine research gaps and propose creative solutions K4
- Analyze products, processes for sustainable and socially relevant applications K4

CO,PO ,PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	3	2	2	2	2	2	3	3	2	3
CO2	3	2	1	1	3	2	2	2	2	2	3	3	2	3
CO3	3	2	1	1	3	2	2	2	2	2	3	3	2	3
CO4	3	2	1	1	3	2	2	2	2	2	3	3	2	3
CO5	3	3	2	1	3	2	2	2	2	2	3	3	2	3
Avg	**3**	**2.2**	**1.2**	**1**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SKILL DEVELOPMENT COURSES

SEMESTER-III

24BECS311 SKILL DEVELOPMENT I 2H-1C

Instruction Hours/week: L:0 T:0 P:2 Marks: Internal:100 External:0 Total:100

End Semester Exam:3 Hours

Students have to undergo skill-oriented courses offered in latest engineering trends from reputed industries

PRE- REQUISITES: None

COURSE OBJECTIVES:

The goal of this course for the students is to

- Acquire experience with tools and platforms related to new technologies.
- Identify technical skills required for developing, implementing and maintaining applications.
- Develop practical solutions to demonstrate the effective use of new technologies.

COURSE OUTCOMES:

Upon completion, the students will be able to

- Interpret proficiency in implementing industry best practices in job-related tasks. K2
- Build skills to generate and validate new ideas and drive innovation within startups or existing businesses. K3
- Develop the ability to adapt emerging technologies relevant to business and research contexts K3
- Utilize research skills necessary for higher studies and research projects. K3
- Make use of emerging technologies to solve complex problems. K3

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	2	2	2	2	2	2	2	3	3	3
CO2	3	2	1	1	2	2	2	2	2	2	2	3	3	3
CO3	3	2	1	1	2	2	2	2	2	2	2	3	3	3
CO4	3	2	1	1	2	2	2	2	2	2	2	3	3	3
CO5	3	2	1	1	2	2	2	2	2	2	2	3	3	3
Avg	**2.8**	**1.8**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-IV

24BECS411 SKILL DEVELOPMENT II 2H-1C

Instruction Hours/week: L:0 T:0 P:2 Marks: Internal:100 External:0 Total:100

End Semester Exam:3 Hours

Students have to undergo skill-oriented courses offered in latest engineering trends from reputed industries

PRE- REQUISITES: None

COURSE OBJECTIVES:

The goal of this course for the students is to

- Acquire experience with tools and platforms related to new technologies.
- Identify technical skills required for developing, implementing and maintaining applications.
- Develop practical solutions to demonstrate the effective use of new technologies.

COURSE OUTCOMES:

Upon completion, the students will be able to

- Interpret proficiency in implementing industry best practices in job-related tasks. K2
- Build skills to generate and validate new ideas and drive innovation within startups or existing businesses. K3
- Develop the ability to adapt emerging technologies relevant to business and research Contexts K3
- Utilize research skills necessary for higher studies and research projects. K3
- Make use of emerging technologies to solve complex problems. K3

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	2	2	2	2	2	2	2	3	3	3
CO2	3	2	1	1	2	2	2	2	2	2	2	3	3	3
CO3	3	2	1	1	2	2	2	2	2	2	2	3	3	3
CO4	3	2	1	1	2	2	2	2	2	2	2	3	3	3
CO5	3	2	1	1	2	2	2	2	2	2	2	3	3	3
Avg	**2.8**	**1.8**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation