B.Tech. (Artificial Intelligence and Data Science)

2018 Regulations, Curriculum & Syllabi

Academic Year: 2020 - 2021 Onwards

Stay Ahead

BANNARI AMMAN INSTITUTE OF TECHNOLOGY
An Autonomous Institution Affiliated to Anna University - Chennai • Approved by AICTE • Accredited by NAAC with 'A+' Grade
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BANNARI AMMAN INSTITUTE OF TECHNOLOGY, SATHYAMANGALAM

REGULATIONS 2018

(CHOICE BASED CREDIT SYSTEM)

(Common to all B.E./B.Tech. Degree Programmes)

Regulation 2018 has been prepared in accordance with the guidelines given by the University Grants Commission, All India Council for Technical Education and affiliating University incorporating the features of the Choice Based Credit System (CBCS). The Regulation 2018 is applicable to the candidates admitted to the Bachelor of Engineering (B.E.) / Bachelor of Technology (B.Tech.) Degree Programmes of the Institution in the academic year 2018-2019 for Regular admission (Academic year 2019-2020 for Lateral Entry) and subsequently.

The regulations hereunder are subjected to amendments as may be decided by the Academic Council of the Institution from time to time. Any or all such amendments will be effective from such date and to such batches of students (including those already in the middle of the programme) as may be decided by the Academic Council.

1. ADMISSION

Candidate, seeking admission to the B.E./B.Tech. Programme, shall satisfy the conditions of admission prescribed by the Directorate of Technical Education and Anna University, Chennai as given below.

1.1 Regular Admission

Candidates, for admission to the first semester of the eight semesters B.E./B.Tech. Degree Programmes, shall be required to have passed:

- Higher Secondary Examination (10 +2) of curriculum (Regular Academic Stream) prescribed by the Government of Tamil Nadu with Mathematics, Physics, and Chemistry as three of the four subjects of the study prescribed under Part-III or any other examinations of any Board or University or authority accepted by the Syndicate of the University / Directorate of Technical Education (DoTE), Chennai as equivalent thereto.

(or)

- Should have passed Higher Secondary Examination of Vocational Stream (Engineering/Technology), prescribed by the Government of Tamil Nadu.

1.2 Lateral Entry Admission

1.2.1 The candidates who possess Diploma in Engineering / Technology awarded by the State Board of Technical Education and Training, Tamil Nadu or its equivalent are eligible to apply for Lateral Entry admission to the third semester of B.E. / B.Tech. Programmes in the branch of study as per the eligibility criteria prescribed by the Directorate of Technical Education from time to time.

(or)

1.2.2 The candidates who possess the Bachelor Degree in Science (B.Sc.) (10+2+3 stream) with Mathematics as a subject in B.Sc. is eligible to apply for Lateral Entry admission to the third semester of B.E./B.Tech. Programmes, as per the eligibility criteria prescribed by the Directorate of Technical Education from time to time. Such candidates shall undergo two additional Engineering subject(s) one each in third and fourth semesters, as bridge courses.

2. PROGRAMMES OFFERED

A candidate may be offered admission to any one of the programmes offered by the Institution for the candidates specified in Clause 1.1 and as per the eligibility criteria of DoTE for the candidates under Clause 1.2 from the list given below:

B. E. Programmes

i. Aeronautical Engineering
ii. Agricultural Engineering
iii. Automobile Engineering
iv. Civil Engineering
v. Computer Science and Engineering
vi. Electronics and Communication Engineering
vii. Electrical and Electronics Engineering
viii. Electronics and Instrumentation Engineering
ix. Mechanical Engineering
x. Mechatronics

B. Tech. Programmes

i. Biotechnology
ii. Fashion Technology
iii. Food Technology
iv. Information Technology
v. Textile Technology

3. STRUCTURE OF THE PROGRAMME

3.1 Every programme shall have a distinct curriculum with syllabi consisting of theory, laboratory, project, soft-skills and personality development courses, as prescribed by the respective Boards of Studies, broadly categorized under:

(i) **Basic Science** courses including Mathematics, Physics, Chemistry and further specialization in these subjects

(ii) **Basic Engineering** courses including Engineering Graphics, Engineering Practices, Basics of Electrical, Electronics, Civil, Mechanical Engineering, Engineering Mechanics and Computer Programming.

(iii) **Humanities and Social Science** courses including Language Courses, Management Courses, Soft Skills and Professional Ethics.

(iv) **Professional Courses** include Discipline Core Courses, Professional Electives, and Open Electives.

(v) **Employability Enhancement Courses (EEC)** includes Project Work and /or Internship, Seminar, Industrial /Practical Training, Value Added and Certificate Courses.

The medium of instruction is English for all the Courses, Examinations, Seminar Presentation, Projects and any other courses that a student register for.

3.2 Each course is normally assigned a certain number of credits based on the following

Contact period per week	Credits
1 Lecture / 1 Tutorial period	1
2 laboratory Periods (Laboratory / Seminar / Project Work / etc.)	1

3.3 All the B.E. / B.Tech. Students will study Communicative English I during the First Semester. In the Second Semester, they will be divided into two streams based on their English language proficiency assessed in the Continuous Assessment during semester I, in which the upper segment will be provided an option to enroll and study Communicative English II / German / Japanese / French / Chinese / Hindi while the lower segment will study Communicative English II.

3.4 Every student shall be required to opt for **Nine** electives from the list of electives. Students can opt for the electives (Core / Professional) from his / her own discipline courses, during V to VIII Semesters, if he/she satisfies the prerequisite for that particular course.

3.5 However, out of nine electives, every student shall be required to opt for, a minimum of one and subject to a maximum of three courses as open elective from the list of electives of the branch / branches other than his / her branch of specialisation, if he/she satisfies the prerequisite for that particular course.

3.6 Students can also opt for **one-credit courses** of 15 to 20-hour duration, which will be offered by the experts from the industry on specialised topics. Students can opt for such **one-credit courses** during the semesters I to VII as and when these courses are offered. A student will also be permitted to register the **one-credit courses** offered by other Departments, provided the student has fulfilled the necessary pre-requisites or the courses that may not require any pre-requisites. Under no circumstances, the same one credit course shall be repeated in subsequent semesters in any Department / Centre for the same batch of the students and a maximum batch size for a given course shall not exceed 40. In case of disciplines with multiple divisions (intake more than 60) different course(s) shall be offered to other batch(es) of students.

On successful completion of one credit courses, Credits will be indicated in the Grade Sheet, but will not be considered for computing the Cumulative Grade Point Average (CGPA). However, if a student wishes to avail the exemption from any one of the Electives (other than open elective) of the Semester VIII, he / she can do so by exercising his / her option in writing to the respective Head of the Department during the beginning of the VIII Semester, following the equivalence norm, that one **regular elective** (in the **VIII Semester**) is equivalent to **three one-credit courses** completed by the student during the previous semesters, IV to VII. Details of the one credit courses offered by the department shall be forwarded to the Office of the Controller of Examinations. However, one credit courses completed during I to III semesters shall be maintained in the Grade sheet as "Additional credits earned" (not considered for the computation of SGPA/CGPA).

3.7 A student can register for Self-Study Elective(s) over and above the electives from any branch of Engineering / Technology at the rate of one per semester starting from V semester onwards provided he/she maintains a Cumulative Grade Point Average (CGPA) of 8.50 or above till the previous semesters with no current arrears. Credits will be indicated for such courses in the grade sheets (additional credits) but will not be considered for computing the CGPA.

3.8 A Student may be permitted to credit only one online course with the approval of the Departmental Consultative Committee constituted by the Head of the Department, subject to a maximum of three credits. The student needs to obtain certification or credit to become

eligible for writing the End Semester Examination to be conducted by the CoE. A student can get exemption for a maximum of 3 credits during the entire programme (in lieu of Core elective or Open elective). The Head of the Department may identify a faculty member as coordinator for the course, who is responsible for the evaluation process. The course shall be evaluated through the End Semester Examination only. The evaluation methodology may be decided by the course faculty coordinator.

3.9 **Industrial Training / Internship**

The students may undergo Industrial training / Internship optionally for a period as specified in the table during summer / winter vacation and the credits earned will be indicated in the Mark Sheet. If the student earns three credits in Industrial Training / Internship, the student may drop one Professional Elective. In such cases, Industrial Training / Internship need to be undergone continuously from one organization only. However, if the number of credits earned is 1 or 2, these credits shall not be considered for classification of the degree. The students may also undergo Internship at Research organization / University (after due approval from the Department Consultative Committee) during summer / winter vacation, in lieu of Industrial training.

Duration of Training / Internship	Credits
2 Weeks	1
1 Month	2
2 Months	3

3.10 **Socially Relevant Projects**

A Student may be permitted to carry out a socially relevant project during semester II to semester VI in consultation with the Faculty Guide and submit the project report, in the prescribed format, at the end of the Semester for the valuation.

On successful completion of socially relevant project work, one credit will be indicated in the grade sheet (Additional credits), but these credits will not be considered for computing the CGPA.

4. VALUE ADDED COURSES

A Student can opt for the Value-Added Courses offered by the various Department / Centres from Semester II to VII. Head of the Department / Centre shall submit the list of such courses, duly approved / ratified by the Academic Council, to the Controller of Examinations to administer the examination process. A separate Certificate will be issued on successful completion of the course by the Office of the Controller of Examinations.

5. DURATION OF THE PROGRAMME

5.1 A regular student (admitted after 10+2) or equivalent is normally expected to satisfactorily fulfil the requirements for award of the degree B.E. / B.Tech. within four academic years (8 semesters) from the date of admission but in any case not more than 7 years (14 Semesters); lateral entry students shall fulfil such requirements within three academic years (6 semesters) from the date of admission but in any case not more than six years (12 Semesters) leading to the award of Degree of Bachelor of Engineering (B.E.) / Bachelor of Technology (B.Tech.) of Anna University, Chennai.

5.2 The total period for completion of the programme from the commencement of the semester, to which the student was admitted, shall not exceed the maximum period (Clause 5.1), regardless to the break-of-study (vide Clause 15) or period of prevention in order.

5.3 Each semester shall consist of minimum 90 working days. Head of the Department shall ensure that every faculty member teaches the subject / course as prescribed in the approved curriculum and syllabi.

5.4 Special Theory / Practical Sessions may be conducted for students who require additional inputs over and above the number of periods normally specified (Remedial Classes), as decided by the Head of the Department, within the specified duration of the Semester / Programme.

6. COURSE ENROLLMENT AND REGISTRATION

6.1 Each student, on admission shall be assigned to a Faculty Advisor (vide Clause 8) who shall advise / counsel the student about the details of the academic programme and the choice of course(s) considering the student's academic background and career objectives.

6.2 Every student shall enroll for the courses of the succeeding semester, in the current semester. However, the student shall confirm the enrollment by registering for the courses within the first five working days after the commencement of the semester concerned.

6.3 After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the End Semester Examinations.

6.3.1 Each student, on admission to the programme, shall register for **all the courses prescribed in the curriculum** in the **first Semester of study (III Semester** for students admitted under **lateral entry stream).**

6.3.2 The enrollment for all the courses of the Semester II will commence 10 working days prior to the last working day of Semester I. The student shall confirm the enrollment by registering for the courses within the first five working days after the commencement of the Semester II. In case, if a student fails to register in course(s), he/ she may be permitted to register the same, as specified in the Clause 6.5, in the subsequent semesters or when it is offered.

6.3.3 The enrollment for the courses of the Semesters III to VIII will commence 10 working days prior to the last working day of the preceding semester. The student shall enroll for the courses with the guidance of the student's Faculty Advisor. If a student wishes, the student may drop or add courses (vide Clause 6.4) within **five** working days after the commencement of the semester concerned and complete the registration process duly authorized by the Faculty Advisor.

6.4 Flexibility to Add or Drop courses

6.4.1 A student has to earn the total number of credits specified in the Curriculum of the respective Programme of study in order to be eligible to obtain the degree. However, if a student wishes, the student is permitted to earn more than the total number of credits prescribed in the curriculum by opting for one- credit courses, self study electives or additional courses.

6.4.2 From the III to VIII semesters (from IV to VIII Semesters in case of lateral entry students), the student has the option of registering for additional courses or dropping

existing courses. The total number of credits that a student can add or drop is limited to 8, subject to a maximum of 2 courses in a given Semester. In such cases, the attendance requirement as stated in Clause 7 is mandatory.

6.4.3 The student shall register Project work I in semester VII and Project work II in semester VIII only.

6.5 Reappearance Registration

6.5.1 If a student fails in a theory course, the student shall do reappearance registration (Examination) for that course in the subsequent semesters or when it is offered next.

6.5.2 On registration, a student may attend the classes for the reappearance registration courses, if the student wishes, and the attendance requirement (vide Clause 7) is not compulsory for such courses.

6.5.3 However, if a student wishes to improve his/ her continuous assessment, in the second attempt during reappearance, he/she shall satisfy the Clause 6.5.5 and appear for continuous assessment as given for that particular course.

6.5.4 If the theory course, in which the student has failed, is either a professional elective or an open elective, the student may register for the same or any other professional elective or open elective course, respectively in the subsequent semesters. However, the change of elective courses is permitted only once.

6.5.5 In this case (Clause 6.5.4), the student shall attend the classes, satisfy the attendance requirements (vide Clause 7), earn Continuous Assessment marks and appear for the End Semester Examination.

6.5.6 The student who fails in any continuous assessment courses (Laboratory/ Project work / Seminar or any other HSS/EEC courses) shall register for the same in the subsequent semesters or when offered next, and **repeat** the course as per Clause 6.5.5.

6.5.7 If a student is prevented from writing the end semester examination of a course or several courses due to lack of attendance, the student has to register for that / those course(s) again, when offered next, attend the classes and fulfill the requirements as per Clause 6.5.5 & 6.5.6. If the course, in which the student has 'lack of attendance', is a Core Elective or an Open Elective, the student may register for the same or any other Core Elective or Open Elective course(s) respectively in the subsequent semesters and appear in the examination as per Clause 6.5.5.

6.5.8 If a student fails to secure a pass in any theory courses (including elective) he/she is given a maximum of three arrear attempts to complete the courses. If the student still

fails to secure a pass, he/she shall register for the same when offered next and repeat the course.

7. REQUIREMENTS FOR APPEARING FOR THE END SEMESTER EXAMINATION OF A COURSE

A student who has fulfilled the following conditions (vide Clause 7.1 and 7.2) shall be deemed to have satisfied the attendance requirements for appearing for End Semester Examination of a particular course.

7.1 Every student is expected to attend all the periods and earn 100% attendance. However, a student shall secure not less than 80% attendance course wise taking into account the number of periods required for that course as specified in the curriculum.

7.2 If a student, secures attendance between 70% and 79% in any course(s) in the current semester due to medical reasons (prolonged hospitalization / accident / specific illness) or participation in Institution/ University/ State/ National/ International level extra and co-curricular activities, with prior permission from the Head of the Department, shall be permitted to appear for the current semester examinations subject to the condition that the student shall submit the medical certificate / participation certificate attested by the Head of the Department (along with Condonation form). Such certificates along with the condonation forms shall be forwarded to the Controller of Examinations for verification and permission to attend the examinations. However, during the entire programme of study, a student can avail such Condonation in any two semesters only (regardless the number of courses).

7.3 A student shall normally be permitted to appear for End Semester Examination of the course(s) if the student has satisfied the attendance requirements (vide Clause 7.1 – 7.2) and has registered for examination in those courses of that semester by paying the prescribed fee.

7.4 Students who do not satisfy Clause 7.1 and 7.2 and who secure less than 70% attendance in a course will not be permitted to write the End-Semester Examination of that course. The student has to register and repeat this course in the subsequent semesters or when it is offered next (vide Clause 6.5).

7.5 If a student has shortage of attendance in all the registered courses, he/she would not be permitted to move to the higher semester and has to repeat the current semester in the subsequent year.

7.6 In the case of reappearance (Arrear) registration for a course, the attendance requirement as mentioned in Clauses 7.1 - 7.3 is not applicable. However, the student has to register for examination in that course by paying the prescribed fee.

7.7 A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course for improvement of grades.

8. FACULTY 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 Faculty member of the Department who shall function as Faculty Advisor for those students. The Faculty Advisor shall advise and guide the students in registering of courses, reappearance of courses, monitor their attendance and progress and counsel them periodically. The Faculty Advisor also discusses with or informs the parents about the progress / performance of the students concerned.

The responsibilities of the faculty advisor shall be:

- To inform the students about the various facilities and activities available to enhance the student's curricular and co-curricular activities.
- To guide student enrollment and registration of the courses.
- To authorize the final registration of the courses at the beginning of each semester.
- To monitor the academic and general performance of the students including attendance and to counsel them accordingly.

9. COMMITTEES

9.1 Common Course Committee

9.1.1 A theory course handled by more than one faculty including the discipline with multiple divisions (greater than or equal to 2) shall have a "Common Course Committee" comprising of all members of faculty teaching that course with one of the members as the Course Coordinator, nominated by the Head of the Institution (Head of the Department in the case of multiple divisions of a discipline) and student representatives (one per specialization or division) registered for that course in the current semester.

First meeting of the Common Course Committee shall be held within fifteen days from the date of commencement of the semester. Two subsequent meetings in a semester may be held at suitable intervals. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all

the students to improve the effectiveness of the teaching-learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to all the students.

9.1.2 In addition, Common Course Committee (without the student representatives) shall meet to ensure uniform evaluation through the common question papers during Continuous Assessment and End Semester Examinations.

9.2 Class Committee Meeting

For all the courses taught, prescribed in the curriculum, Class Committee meeting shall be convened thrice in a semester (first meeting within 15 days from the commencement of the semester and other two meetings at equal interval after the first meeting) comprising members of the faculty handling all the courses and two student representatives from the class.

One of the members of the faculty (preferably not handling any courses to that class), nominated by the Head of the Department, shall coordinate the activities of the Committee. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching-learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to all other students.

10. SYSTEM OF EXAMINATION

10.1 Performance in each course of study shall be evaluated based on (i) Continuous Assessment throughout the semester and (ii) End Semester examination at the end of the semester for the regular courses or as given in the Clause 16. However, the final examination in the case of certificate / value added courses may be conducted, as and when the course is completed, through the office of the Controller of Examinations.

10.2 Each course, both theory and laboratory including project work, shall be evaluated as per the Scheme of Assessment given in Clause 16.

10.3 The End Semester Examinations shall normally be conducted after satisfying the Clause 5.2.

10.4 For the End Semester examinations, both theory and project work, the internal and external examiners (from Academia or Industry) shall be appointed by the Controller of Examinations as per the guidelines given by the Examination cum Evaluation committee of the Institute.

11. PASSING REQUIREMENTS AND PROVISIONS

11.1 The Passing requirement for a student in a course is determined based on the marks obtained both in Continuous Assessment and End Semester Examinations. If the student gets <50% of marks in End Semester Examination, then the student will be awarded only RA (Reappearance) grade.

11.1.1 If a student fails to secure a pass in a particular course, i.e., failing to obtain minimum marks, as stated above, it is mandatory that he/she shall reappear for the examination in that course in the subsequent semester(s) whenever the examinations are conducted for that course, till he / she secures a 'Pass'.

Continuous Assessment (CA) marks obtained by the student in the first appearance shall be retained and considered valid for one subsequent attempt, except Clause 6.5.4, 6.5.5, 6.5.6 and 6.5.7. However, from the third attempt onwards, the student shall be declared to have passed the course if he/she secures a minimum of 6 Grade Points (B Grade) in the course prescribed during the End Semester Examinations.

11.2 If a candidate fails in the seventh semester examinations of Project work I, he/she has to resubmit the Project Report within 30 days from the date of declaration of the results. If he / she fails in the End semester examination of Project work II, he/she shall resubmit the Project Report within 60 days from the date of declaration of the results. The resubmission of the project report and the subsequent viva-voce examination will be considered as reappearance with payment of exam fee. In case a student fails in the resubmission of a project report and subsequent viva-voce examination, the student shall register for the course again, when offered next.

11.3 The passing requirement for the courses which are assessed only through continuous assessment (Laboratory and EEC courses except project work), shall be fixed as minimum 50% and the remaining grades are decided as per clause 12.4. If a candidate fails in EEC courses (Except Project work), he/she has to register and repeat the course within 30 days from the date of declaration of the results. In case a student fails to register within 30 days, he/she shall register for the course again, when offered next.

11.4 The minimum number of total credits to be earned by a student to qualify for the award of Degree in the various branches of study as prescribed by the respective Boards of Studies is given below:

Branch of Study	Minimum Credits	
	Regular Admission	Lateral Entry
B.E. Programmes		
Aeronautical Engineering	172	135
Agricultural Engineering	172	134
Automobile Engineering	170	133
Civil Engineering	171	133
Computer Science and Engineering	171	133
Electronics and Communication Engineering	172	131
Electrical and Electronics Engineering	170	131
Electronics and Instrumentation Engineering	170	131
Mechanical Engineering	170	131
Mechatronics	170	132
B.Tech. Programmes		
Biotechnology	172	134
Fashion Technology	172	134
Food Technology	170	132
Information Technology	170	132
Textile Technology	171	133

11.5 Student Migration and Credit Transfer: Normalization of the Credits will be carried out in consultation with the Board of Studies of the programme concerned and approved by the Head of Institution, if a student migrates from other Autonomous institutions to Bannari Amman Institution of Technology or rejoins from previous regulation to this regulation.

11.6 A student shall be declared to have qualified for award of B.E/B.Tech. Degree if he/she successfully completes the course requirements (vide Clause 7, 10 and 11) and passed all the prescribed courses of study of the respective programme (listed in Clause 2), within the duration specified in Clause 5.1.

12. ASSESSMENT AND AWARD OF LETTER GRADES

12.1 The assessment shall be based on the performance in the End Semester Examinations and / or Continuous Assessment, carrying marks as specified in Clause 16. Letter Grades (based on Credit Point and Grade Point) are awarded to the students based on the performance in the evaluation process.

12.2 Credit Point is the product of Grade Point and number of credits for a course and Grade Point is a numerical weight allotted to each letter grade on a 10-point scale (as specified in the Clause 12.4), while the Letter Grade is an index of the performance of a student in a said course.

12.3 Condition for Relative Grading

The minimum number of students for applying relative grading system is 30. If the students' strength is less than 30 then absolute grading system will be applied. The relative grading system shall not be applied for laboratory and EEC courses.

12.4 The performance of a student will be reported using Letter Grades in absolute grading, each carrying certain points as detailed below: In relative grading, grades will be decided by the faculty concerned. A student who earns a minimum of 6 grade points in a course is declared to have successfully passed the course.

Range of Total Marks (as specified in Clause 16) / Specific Reason	**Grade Points**	**Letter Grade**
91 to 100	10	O (Outstanding)
81 to 90	9	A + (Excellent)
71 to 80	8	A (Very Good)
61 to 70	7	B + (Good)
50 to 60	6	B (Above average)
0 to 49	0	RA (Reappearance Registration)
Incomplete	0	I
Withdrawal	0	W
Absent	0	AB
Shortage of Attendance	0	SA

'RA' --- Reappearance registration is required for that particular course

'I' --- Continuous evaluation is required for that particular course in the subsequent examinations.

'SA' --- shortage of attendance (Clause 7) and hence prevented from writing end semester examination.

12.5 After completion of the evaluation process, Semester Grade Point Average (SGPA), and the Cumulative Grade Point Average (CGPA) is calculated using the formula:

$$SGPA/CGPA = \frac{\sum_1^n C_i * g_i}{\sum_1^n C_i}$$

Where

C_i : Credit allotted to the course.

g_i : Grade Point secured corresponding to the course.

n : number of courses successfully cleared during the particular semester in the case of SGPA and all the semesters, under consideration, in the case CGPA.

12.6 A student who does not appear for the End Semester Examinations in a course, after registering for the same, shall be deemed to have appeared for that examination for the purpose of classification (Subject to Clause 14 and 15).

12.7 For the non-credit course's grades shall be indicated as given in the Clause 16 and shall not be counted for the computation of SGPA/CGPA.

For the Co-curricular activities such as NCC / NSS / NSO / YRC, a satisfactory / not satisfactory grading will appear in the mark sheet. Every student shall put in a minimum of 75% attendance in the training and attend the camp compulsorily. The training and camp shall be completed during the first year of the programme. However, for valid reasons, the Head of the Institution may permit a student to complete this requirement in the second year. A satisfactory grade in the above co-curricular activities is compulsory for the award of degree.

12.8 **Revaluation:** A student, who seeks the re-valuation of the answer script, is directed to apply through proper application to the Controller of Examinations in the prescribed format through the Head of the Department. The Controller of Examinations shall arrange for the revaluation and declare the results. Revaluation is not permitted to the courses other than theory courses. In the case of theory courses with laboratory component, a student can seek revaluation for the theory component only, following the procedure stated above.

12.9 **Supplementary Examinations**: If a student fails to secure a pass in theory course(s) of VIII semester examination, he/she is eligible to appear for a one-time Supplementary Examination which shall be conducted at the end of VIII semester, for the subjects of VIII semester alone within 30 days from the date of declaration of the results.

12.10 **Eligibility for the Award of Degree**

A student shall be declared to be eligible for the award of the B.E. / B.Tech. Degree provided the student has

i. Successfully gained the required number of total credits as specified in the curriculum corresponding to the student's programme within the stipulated time.
ii. Successfully completed the course requirements, appeared for the End-Semester examinations and passed all the courses prescribed in all the 8 semesters within a maximum period of 7 years reckoned from the commencement of the first semester to which the candidate was admitted.
iii. Successfully completed the NCC / NSS / NSO / YRC / Extra-curricular/ Co-curricular requirements.
iv. No disciplinary action is pending against the student.
v. The award of Degree must have been approved by the Syndicate of the University.

13. CLASSIFICATION OF THE DEGREE AWARDED

For the purpose of the 'Award of Degree', the duration of completion of the programme shall be the total duration taken by a student for completing first time registration of all the required courses and satisfying Clause 11, regardless to the period of Break-of-study as per Clause 15 and satisfy any one of the conditions required as given below.

13.1 **First Class with Distinction**: A student who satisfies the following conditions shall be declared to have passed the examination in **First class with Distinction**:

- Should have passed the examination in all the courses of all the eight semesters (six semesters for lateral entry students) in the student's First Appearance within five years, which includes authorized break of study of one year. Withdrawal from examination (vide Clause 15) will not be considered as an appearance.
- Should have secured a CGPA of **not less than 8.50**
- Should **NOT** have been prevented from writing end semester examination due to lack of attendance in any of the courses.

13.2 **First Class**: A student who satisfies the following conditions shall be declared to have passed the examination in **First class**:

- Should have passed the examination in all the courses of all eight semesters (six semesters for lateral entry students) within five years, which includes one year of authorized break of study (if availed) or prevention from writing the End Semester Examination due to lack of attendance (if applicable).
- Should have secured a CGPA of **not less than 7.00**

13.3 **Second Class**: All other students (not covered in clauses 13.1 and 13.2) who qualify for the award of the degree shall be declared to have passed the examination in **Second Class.**

14. WITHDRAWAL FROM THE EXAMINATION

14.1 A student may, for valid reasons, be granted permission by the Head of the Department to withdraw from appearing in the examination in any course(s) only once during the entire duration of the degree programme.

14.2 Withdrawal application shall be valid only, if the student is eligible to write the examination as per Clause 7 and, if it is made within TEN working days before the commencement of the end semester examination in that course or courses and also recommended by the Head of the Department.

14.3 Notwithstanding the requirement of mandatory TEN working days' notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.

14.4 If a student withdraws a course or courses from writing end semester examinations, he/she shall register the same in the subsequent semester and write the end semester examination(s).

14.5 Withdrawal shall not be considered as an appearance in the examination for the eligibility of a student for First Class with Distinction or First Class.

14.6 Withdrawal is permitted for the end semester examinations in the final semester, only if the period of study of the student concerned does not exceed 5 years as per clause 13.1 & 13.2.

15. AUTHORIZED BREAK OF STUDY FROM A PROGRAMME

15.1 A student is permitted to go on break of study for a fixed period of one year as a single break in the entire course of study.

15.2 A student is normally not permitted to break the period of study temporarily. However, if a student happens to discontinue the programme temporarily during the middle of programme of study, for reasons such as personal accident or hospitalization due to ill health or in need of health care, he/she shall apply to the Head of the Institution in advance, in any case, not later than the last date for registering for the semester examination, through the Head of the Department stating the reasons for the break-of-study (for one academic semester or 6 months, whichever is earlier). However, a student detained for want of minimum attendance requirement as per Clause 7 shall not be considered as permitted 'Break of Study' and Clause 15.3 is not applicable for such case.

15.3 The student is permitted to rejoin the programme after the break / prevention due to lack of attendance, shall be governed by the Curriculum and Regulations in force at the time of rejoining. The students rejoining in new Regulations shall apply to the Dean Academics in the prescribed format through the Head of the Department at the beginning of the readmitted semester itself for prescribing additional/equivalent courses, if any, from any semester of the regulations in-force, so as to bridge the curriculum in-force and the old curriculum.

15.4 Authorized break of study will be counted towards the duration specified for passing all the courses (vide Clause 5.1 and 5.2) and for the purpose of classification of Degree (vide Clause 13).

15.5 The total period for completion of the programme reckoned from the commencement of the first semester to which the student is admitted shall not exceed the maximum period specified in Clause 5.1, irrespective of the period of break of study in order that he / she may be eligible, for the award of the degree (vide Clause 13).

15.6 In case of valid reasons (as stated in Clause 15.2) extended break-of-study may be granted by the Head of the Institution for a period not more than one year in addition to the earlier authorized break of study.

15.7 If a student does not report back to the Institute, even after the extended Break of Study, the name of the student shall be deleted permanently from the college enrollment. Such students are not entitled to seek readmission under any circumstances.

16. SCHEME OF ASSESSMENT

Courses offered under B.E. / B.Tech. Programmes are assessed as given below:

I	**THEORY COURSES**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Periodical Test I (10)	
	Periodical Test II (10)	
	Innovative Practices (30)	
	End Semester Examination	**50**
	Total Marks	**100**

II	**THEORY COURSES WITH LAB COMPONENT**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Periodical Test I (10)	
	Periodical Test II (10)	
	Innovative Practices (30)	
	(Laboratory Assessment & Report)	
	End Semester Examination (QP pattern as per (I))	**50**
	Total Marks	**100**

III	**LABORATORY COURSES**	**Marks**
	Continuous Assessment	**100**
	Distribution of marks for Continuous Assessment:	
	Conduct of Experiment	
	i. Preparation (20)	
	ii. Experiment and Analysis of Results (20)	
	iii. Record (10)	
	Test – Cycle I (25)	
	Test – Cycle II (25)	
	Total Marks	**100**

IV	**PROJECT WORK I**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	<u>Review I</u>	
	Literature Survey (5)	
	Identification of topic and Justification (5)	
	Work plan (10)	
	<u>Review II</u>	
	Approach & Results (15)	
	Conclusion (15)	

	End Semester Examination	**50**
	Report[#] (20)	
	Presentation (20)	
	Viva voce (10)	
	Total Marks	**100**

V	**PROJECT WORK II**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Review I	
	Progress (10)	
	Review II	
	Approach & Results (10)	
	Review III	
	Conclusion & Final Presentation (10)	
	Report (15)	
	Publication of Paper in Conferences / Journals (5)	
	End Semester Examination	
	Presentation (30)	**50**
	Viva voce (20)	
	Total Marks	**100**

VI	**LANGUAGE ELECTIVE**	**Marks**
	(CONTINUOUS ASSESSMENT ONLY)	
	Test 1	
	Listening (5)	
	Speaking (10)	**25**
	Reading (5)	
	Writing (5)	
	Test 2	
	Listening (5)	
	Speaking (10)	**25**
	Reading (5)	
	Writing (5)	
	Oral Exam	**50**
	Total Marks	**100**

VII	**ONE-CREDIT COURSE**	**Marks**
	(CONTINUOUS ASSESSMENT ONLY)	
	Test I	**50**
	Quiz/ Assignment	**50**
	Total Marks	**100**

[#] *Reports / Record Note / Integrated Lab Manual to be retained for 1 year for Academic Audit, by respective Department*

VIII	**INDUSTRIAL TRAINING/ INTERNSHIP (CONTINUOUS ASSESSMENT ONLY)**	**Marks**
	Assessment by Industry	**30**
	Viva-voce	**20**
	Presentation	**30**
	Case Study / Report	**20**
	Total Marks	**100**
IX	**SOFT SKILLS (CONTINUOUS ASSESSMENT ONLY)**	**Marks**
	Test I	**25**
	Test II	**25**
	Final Examination	**50**
	Total Marks	**100**
	Grades (Excellent / Good / Satisfactory)	
X	**VALUE ADDED / CERTIFICATE COURSES (CONTINUOUS ASSESSMENT ONLY)**	**Marks**
	Test I	**25**
	Test II	**25**
	Final Evaluation / Test	**50**
	Total Marks	**100**
	Grades (Excellent / Good / Satisfactory)	
XI	**ENGINEERING GRAPHICS**	**Marks**
	Continuous Assessment	**100**
	Distribution of marks for Continuous Assessment:	
	Exercise (Minimum 10 Exercises/Modelling)	**60**
	Model Examination	**40**
	Total Marks	**100**

Optional Test: *A student becomes eligible to appear for an optional test conducted after the Periodical Test II, only under the following circumstances: (i) absent for Test I or Test II or both on account of medical reasons (hospitalization / accident / specific illness), or (ii) participation in the College / University / State / National / International level Sports events with prior permission from the Head of the Institution and (iii) on satisfying the conditions (i) or (ii), the student should have registered for the Optional Test, through the concerned member of faculty who handles the course or through the respective Head of the Department, submitted to the Controller of Examinations. Such Optional Tests are not conducted for the courses under the categories III, IV, V, VI, VII, VIII, IX, X and XI listed above.*

17. FIELD / INDUSTRIAL VISIT / INTERNSHIP

In order to provide the experiential learning to the students, Head of the Department shall take efforts to arrange at least two industrial visits / field visits. The students may also undergo in-plant training / internship during summer / winter vacation between III and VII semesters.

18. PERSONALITY AND CHARACTER DEVELOPMENT

Every student shall be required to undergo a minimum of 40 hours of Personality Development Programmes viz, NSS / NCC / YRC / YOGA / Sports and Games / Technical and Non-technical Club activities during the first year. The attendance of the personality and character development courses / events shall be maintained on the regular basis by the concerned First Year Co-ordinators and made available in the Office of the Controller of Examinations before the commencement of Semester examinations of Semester I or Semester II.

19. DISCIPLINE

A student is expected to follow the rules and regulations laid down by the Institute and the affiliating University, as published from time to time. Any violations, if any, shall be treated as per the procedures stated thereof.

If a student indulges in malpractice in any of the End Semester / Continuous Assessments, he / she shall be liable for punitive action as prescribed by the Institution / University from time to time.

20. REVISION OF REGULATIONS, CURRICULUM AND SYLLABI

The Institution reserves the right to revise/amend/change the Regulations, Curriculum, Syllabi, Scheme of Examinations and date of implementation and to introduce Additional Electives, Open Electives, One Credit Courses and Value-Added Courses through the Academic Council.

VISION

To build a conducive academic and research environment to produce competent Professionals to the dynamic needs of the emerging trends in the field of Artificial Intelligence and Data Science.

MISSION

i. To establish a unique learning environment and to enable the students to face the challenges in Artificial Intelligence and Data Science.

ii. To critique the role of information and analytics for a professional career, research activities and consultancy.

iii. To produce competent engineers with professional ethics and life skills.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Competent engineering professionals to use Artificial Intelligence and Data Science to solve engineering problems.

PEO2: Capable of pursuing higher studies and research, with wider opportunities in teaching and innovation.

PEO3: Improve communication skills, follow professional ethics and involve in team work in their profession.

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

a) **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b) **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c) **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.

d) **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.

e) **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

f) **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.

g) **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.

h) **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i) **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j) **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.

k) **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.

l) **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.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

MAPPING OF PEOs AND POs

POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2
PEO 1	X	X	X		X		X				X		X	X
PEO 2			X	X		X						X	X	X
PEO 3								X	X	X			X	X

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE **Minimum Credits to be Earned : 172**										
I SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ESE**	**Total**	
20AI101	ENGINEERING MATHEMATICS I	3	1	0	4	4	50	50	100	BS
20AI102	ENGINEERING PHYSICS I	2	0	2	3	4	50	50	100	BS
20AI103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
20AI104	PROGRAMMING FOR PROBLEM SOLVING	2	0	2	3	4	50	50	100	ES
20AI105	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	2	0	2	3	4	50	50	100	ES
18HS101	COMMUNICATIVE ENGLISH I	1	0	2	2	3	100	0	100	HSS
Total					18	23				
II SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ESE**	**Total**	
20AI201	ENGINEERING MATHEMATICS II	3	1	0	4	4	50	50	100	BS
20AI202	ENGINEERING PHYSICS II	2	0	2	3	4	50	50	100	BS
20AI203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
20AI204	APPLICATION BASED PROGRAMMING IN PYTHON	3	0	2	4	4	50	50	100	ES
20AI205	DIGITAL SYSTEM DESIGN	3	0	2	4	4	50	50	100	ES
	LANGUAGE ELECTIVE	1	0	2	2	3	100	0	100	HSS
Total					20	23				

III SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ESE**	**Total**	
20AI301	PROBABILITY AND STATISTICS	3	1	0	4	4	50	50	100	BS
20AI302	DATA STRUCTURES USING CPP	3	0	0	3	4	50	50	100	PC
20AI303	PRINCIPLES OF OPERATING SYSTEM	3	0	0	3	3	50	50	100	PC
20AI304	COMPUTER ORGANIZATION AND ARCHITECTURE	3	0	0	3	3	50	50	100	PC
20AI305	DATABASE MANAGEMENT SYSTEMS	3	0	0	3	3	50	50	100	PC
20AI306	JAVA PROGRAMMING	2	0	2	3	3	50	50	100	PC
20AI307	DATA STRUCTURES LABORATORY	0	0	4	2	2	100	0	100	PC
20AI308	DATABASE MANAGEMENT SYSTEMS LABORATORY	0	0	4	2	2	100	0	100	PC
18GE301	SOFT SKILLS - VERBAL ABILITY	0	0	2	0	2	100	0	100	EEC
Total					23	26				
IV SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ESE**	**Total**	
20AI401	APPLIED LINEAR ALGEBRA	3	1	0	4	4	50	50	100	BS
20AI402	DESIGN AND ANALYSIS OF ALGORITHMS	3	0	0	3	4	50	50	100	PC
20AI403	DATA WAREHOUSING AND DATA MINING	2	0	2	3	4	50	50	100	PC
20AI404	COMPUTER NETWORKS	3	0	0	3	3	50	50	100	PC
20AI405	ARTIFICIAL INTELLIGENCE	3	0	0	3	3	50	50	100	ES
20AI406	STATISTICAL MACHINE LEARNING	3	0	0	3	3	50	50	100	PC
20AI407	ARTIFICIAL INTELLIGENCE LABORATORY	0	0	4	2	4	100	0	100	PC
20AI408	STATISTICAL MACHINE LEARNING LABORATORY	0	0	4	2	4	100	0	100	ES
18HS001	ENVIRONMENTAL SCIENCE	2	0	0	-	2	100	0	100	BS
18GE401	SOFT SKILLS - BUSINESS ENGLISH	0	0	2	0	2	100	0	100	EEC
Total					23	33				

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ESE**	**Total**	
20AI501	SOFTWARE ENGINEERING AND TESTING METHODOLOGIES	3	0	0	3	3	50	50	100	PC
20AI502	DEEP LEARNING	3	1	0	4	4	50	50	100	PC
20AI503	ANALYTICS IN CLOUD COMPUTING	3	0	0	3	3	50	50	100	PC
20AI504	PROGRAMMING FOR DATA SCIENCE	3	0	0	3	3	50	50	100	PC
	PROFESSIONAL ELECTIVE I	-	-	-	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE II	-	-	-	3	3	50	50	100	PE
20AI507	PROGRAMMING FOR DATA SCIENCE LABORATORY	0	0	4	2	4	100	0	100	PC
20AI508	ANALYTICS IN CLOUD COMPUTING LABORATORY	0	0	4	2	4	100	0	100	PC
18GE501	SOFT SKILLS - APTITUDE I	0	0	2	0	2	100	0	100	EEC
Total					23	29				
VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ESE**	**Total**	
20AI601	DATA SECURITY	3	1	0	4	3	50	50	100	PC
20AI602	COMPUTER VISION	3	0	0	3	3	50	50	100	PC
20AI603	DATA VISUALIZATION	3	0	2	4	3	50	50	100	PC
20AI604	NATURAL LANGUAGE PROCESSING	3	0	0	3	3	50	50	100	EEC
	PROFESSIONAL ELECTIVE III	-	-	-	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE IV	-	-	-	3	3	50	50	100	PE
20AI607	NATURAL LANGUAGE PROCESSING LABORATORY	0	0	4	2	4	100	0	100	EEC
20AI608	COMPUTER VISION LABORATORY	0	0	4	2	4	100	0	100	PC
18GE601	SOFT SKILLS-APTITUDE II	0	0	2	0	2	100	0	100	EEC
Total					24	28				

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ESE**	**Total**	
18HS002	PROFESSIONAL ETHICS IN ENGINEERING	2	0	0	2	2	50	50	100	HSS
20AI702	IOT ANALYTICS	3	0	0	3	3	50	50	100	PC
20AI703	SOCIAL MEDIA ANALYSIS	3	0	0	3	3	50	50	100	EEC
20AI704	AI FOR ROBOTICS	3	1	0	4	3	50	50	100	PC
	PROFESSIONAL ELECTIVE V	-	-	-	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE VI	-	-	-	3	3	50	50	100	PE
20AI707	IOT ANALYTICS LABORATORY	0	0	4	2	4	100	0	100	EEC
20AI708	PROJECT WORK I	0	0	6	3	6	50	50	100	EEC
Total					23	27				
VIII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ESE**	**Total**	
	PROFESSIONAL ELECTIVE VII	-	-	-	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE VIII	-	-	-	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE IX	-	-	-	3	3	50	50	100	PE
20AI804	PROJECT WORK II	0	0	18	9	18	50	50	100	EEC
Total					18	27				

ELECTIVES										
LANGUAGE ELECTIVES										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18HSH01	HINDI	1	0	2	2	3	100	0	100	HSS
18HSG01	GERMAN	1	0	2	2	3	100	0	100	HSS
18HSJ01	JAPANESE	1	0	2	2	3	100	0	100	HSS
18HSC01	CHINESE	1	0	2	2	3	100	0	100	HSS
18HSF01	FRENCH	1	0	2	2	3	100	0	100	HSS
18HS201	COMMUNICATIVE ENGLISH II	1	0	2	2	3	100	0	100	HSS
DISCIPLINE ELECTIVES (AI in Health Care and Autonomous Systems)										
20AI001	ARTIFICIAL INTELLIGENCE FOR MEDICAL IMAGE ANALYSIS	3	0	0	3	3	50	50	100	PE
20AI002	AUTONOMOUS SYSTEMS AND DRONES	3	0	0	3	3	50	50	100	PE
20AI003	INTELLIGENT TRANSPORTATION SYSTEMS	3	0	0	3	3	50	50	100	PE
20AI019	ROBOTIC PROCESS AUTOMATION	3	0	0	3	3	50	50	100	PE
DISCIPLINE ELECTIVES (AI in Cyber Security and Gaming)										
20AI004	ARTIFICIAL INTELLIGENCE IN CYBER SECURITY	3	0	0	3	3	50	50	100	PE
20AI005	BLOCKCHAIN TECHNOLOGY	3	0	0	3	3	50	50	100	PE
20AI006	GAME THEORY FOR AI	3	0	0	3	3	50	50	100	PE
20AI007	VIRTUAL REALITY AND AUGMENTED REALITY	3	0	0	3	3	50	50	100	PE
20AI020	CYBER THREAT INTELLIGENCE	3	0	0	3	3	50	50	100	PE
DISCIPLINE ELECTIVES (Generic AI)										
20AI008	COGNITIVE COMPUTING	3	0	0	3	3	50	50	100	PE
20AI009	EXPERT SYSTEMS	3	0	0	3	3	50	50	100	PE
20AI010	GPU ARCHITECTURE AND PROGRAMMING	3	0	0	3	3	50	50	100	PE
20AI011	HUMAN COMPUTER INTERACTION	3	0	0	3	3	50	50	100	PE
20AI012	KNOWLEDGE REPRESENTATION AND REASONING	3	0	0	3	3	50	50	100	PE

20AI013	REINFORCEMENT LEARNING	3	0	0	3	3	50	50	100	PE
20AI021	PATTERN RECOGNITION	3	0	0	3	3	50	50	100	PE
20AI022	RECOMMENDATION SYSTEMS	3	0	0	3	3	50	50	100	PE
DISCIPLINE ELECTIVES (Analytics)										
20AI014	BIG DATA ANALYTICS	3	0	0	3	3	50	50	100	PE
20AI015	GEOSPATIAL DATA ANALYSIS	3	0	0	3	3	50	50	100	PE
20AI016	PREDICTIVE ANALYTICS	3	0	0	3	3	50	50	100	PE
20AI017	TIME SERIES ANALYSIS AND FORECASTING	3	0	0	3	3	50	50	100	PE
20AI018	VISUAL ANALYTICS	3	0	0	3	3	50	50	100	PE
20AI023	BUSINESS ANALYTICS	3	0	0	3	3	50	50	100	PE
20AI024	HEALTHCARE ANALYTICS	3	0	0	3	3	50	50	100	PE
20AI025	VIDEO ANALYTICS	3	0	0	3	3	50	50	100	PE
DISCIPLINE ELECTIVES (General)										
20AI026	DIGITAL MARKETING	3	0	0	3	3	50	50	100	PE
20AI027	OPEN STACK ESSENTIALS	3	0	0	3	3	50	50	100	PE
OPEN ELECTIVE										
20AI0YA	FUNDAMENTALS OF DATA SCIENCE	3	0	0	3	3	50	50	100	OE
ONE CREDIT COURSES										
20AI0XA	TENSORFLOW	0	0	0	1		100	0	100	EEC
20AI0XB	TABLEAU	0	0	0	1		100	0	100	EEC
20AI0XC	TYPESCRIPT WITH JEST TESTING FRAMEWORK	0	0	0	1		100	0	100	EEC
20AI0XD	REACT JS	0	0	0	1		100	0	100	EEC

SUMMARY OF CREDIT DISTRIBUTION

S.No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDIT	CREDITS in %	Range of Total Credits	
		I	II	III	IV	V	VI	VII	VIII			Min	Max
1	BS	10	10	4	4					28	16.27	15%	20%
2	ES	6	8		5					19	11.04	15%	20%
3	HSS	2	2					2		6	3.48	5%	10%
4	PC			19	14	17	13	7		70	40.69	30%	40%
5	PE					6	6	6	9	27	15.69	10%	15%
6	EEC						5	8	9	22	12.79	10%	15%
Total		18	20	23	23	23	24	23	18	172	100	-	-

BS - Basic Sciences
ES - Engineering Sciences
HSS - Humanities and Social Sciences
PC - Professional Core
PE - Professional Elective
EEC - Employability Enhancement Course
CA - Continuous Assessment
ES - End Semester Examination

20AI101 ENGINEERING MATHEMATICS I 3 1 0 4

Course Objectives

- Understand the concepts of vectors and Eigenvectors for different matrices to describe the stability of the linear systems in engineering fields.
- Exemplify the concepts of differentiation and integration to identify the area of 2D and 3D surfaces in engineering problems.
- Explain the concepts of analytic functions in complex domain to predict the nature of different engineering systems.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.

Course Outcomes (COs)

1. Represent the different forms of coordinate system in complex plane and characteristics of linear systems by Eigenvalues and Eigenvectors.
2. Analyse various types of functions and their differentiation techniques involved in engineering fields.
3. Implement different methods of integration used in engineering problems.
4. Execute the suitable integration technique to calculate the area and volume of different surfaces.
5. Apply the concept of analytic function to estimate the integral in complex plane.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3												
2	3	1												
3	1													
4	2													
5		3												

UNIT I **9 Hours**

COMPLEX NUMBERS, VECTORS AND MATRICES

Complex plane, polar coordinates and polar form of complex numbers, powers and roots, fundamental theorem of algebra. Vector algebra in 2-D and 3-D space, dot product and cross product. Matrices: Eigen values and Eigen vectors, Properties of eigen values and eigen vectors.

UNIT II **9 Hours**

CALCULUS

Limits and Continuity of Functions: Limits of functions, types of limits, evaluation of limits, continuity of functions, properties of continuous functions. Derivatives: Derivatives, differentiability, rules and properties, differentiation of transcendental functions, higher order derivatives, implicit differentiation, and

differentiation of hyperbolic functions. Integration: Anti-derivatives, Riemann Sum, indefinite and definite integration, Mean Value Theorem for definite integral, Fundamental Theorem of Calculus.

UNIT III **9 Hours**

INTEGRATION METHODS

Basic integration formulae for algebraic and transcendental functions. Integration by special devices: integration by parts, rationalizing substitution or trigonometric substitution, partial fractions, reduction formulas, improper integrals, convergence tests.

UNIT IV **9 Hours**

APPLICATIONS OF DERIVATIVES AND INTEGRATIONS

Extreme values, points of inflection and curve sketching, Rolles Theorem, Mean Value Theorem, optimization, indeterminate forms, L Hopitals Rule. Area between curves, volume of a general solid by slicing and cylindrical shell methods, volume of a solid of revolution, length of plane curves, area of a surface of revolution.

UNIT V **9 Hours**

COMPLEX ANALYSIS

Analytic Functions- Properties of Analytic function - Determination of Analytic Function using Milne Thompson method. Cauchys Integral Formula - Classification of Singularities - Cauchys Residue Theorem.

FOR FURTHER READING

Applications of mass spring system in ordinary differential equations of higher order.

Total: 60 Hours

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley, 2001
2. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.
3. Kreysgiz E, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 1999.
4. Anton H, Calculus with Analytic Geometry, 5th edition, John Wiley & Sons, 1995.
5. Ayres F Jr and Mendelson E, Schaum s Outline of Theory and Problems of Calculus, 4th edition, McGraw Hill, 1999.
6. S.C. Gupta, Fundamentals of Statistics, 7th Edition, Himalaya Publishing House Pvt. Ltd. 2018.

20AI102 ENGINEERING PHYSICS I 2 0 2 3

Course Objectives

- Illustrate the Newtons laws of motion and wave motion with applications
- Understand the basic properties of electricity, magnetism and optics
- Differentiate the special theory of relativity and quantum physics from classical physics

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

Course Outcomes (COs)

1. Illustrate the Newtons three laws of motion and apply the same to solve the real world problems involving elevator, atwood machine and acceleration of objects
2. Exemplify the physical characteristics of simple harmonic motion, wave motion and find the solutions for wave equations
3. Infer the fundamental laws, properties of electricity and magnetism and apply the same to electric and magnetic elements
4. Apply the principles of physical and geometrical optics in the mirrors, lenses, microscopes and diffraction gratings
5. Outline the importance of special theory of relativity, quantum physics and analyse the wave and particle nature of matter

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1							2					
2	2								2					
3	2	2												
4	2	2							2					
5	2	1							2					

UNIT I **6 Hours**

MECHANICS

Newtons laws of motion: Concept of force and its nature-Newtons first law and inertial frames- definition of mass -Newtons second law-gravitational force and weight -Newtons third law. Applications of Newtons laws: particle in equilibrium, particle under net force-weighing a mass in an elevator, the atwood machine and acceleration of two objects connected by a cord

UNIT II **6 Hours**

OSCILLATIONS AND WAVES

Fundamentals of simple harmonic motion -energy of simple harmonic oscillator -spring mass system -time period of simple pendulum, compound pendulum and torsional pendulum - Damped oscillations. Travelling wave motion -sinusoidal waves on strings -speed of a wave -reflection and transmission -rate of energy transfer in wave motion

UNIT III **6 Hours**

ELECTRICITY AND MAGNETISM

Point charges-electric fields -Gauss law and its applications -electric potential -capacitance -energy stored in a capacitor. Concept and source of magnetic fields -Amperes theorem -determination of magnetic field due to different current distributions -Faradays law -self-induction and mutual induction -energy stored in an inductor

UNIT IV **6 Hours**

LIGHT AND OPTICS

Nature of light -laws of reflection and refraction -refractive index and Snells law -dispersion of light -total internal reflection -image formation: concave mirrors -convex mirrors -thin lenses -compound microscope -human eye. Conditions of interference -Youngs double slit experiment - intensity distribution of interference -phase change due to reflection -diffraction-narrow slit diffraction -single slit and two slit -intensity distribution -diffraction grating -applications

UNIT V **6 Hours**

MODERN PHYSICS

Special theory of relativity -simultaneity and time dilation -twin paradox -length contraction -relativistic mass variation -space time graph.Black body radiation and Planck hypothesis -allowed energy levels -thermal radiation from different objects -photoelectric and Compton Effect. Matter waves -de-Broglie hypothesis -wave nature of particles -Davission-Germer experiment

1 **5 Hours**

EXPERIMENT 1

Determination of resultant of system of concurrent coplanar forces-Parallelogram law of forces

2 **5 Hours**

EXPERIMENT 2

Determination of moment of inertia-Torsional pendulum

3 **5 Hours**

EXPERIMENT 3

Determination of wavelength of mercury spectral lines-spectrometer

4 **4 Hours**

EXPERIMENT 4

Determination of refractive index of solid and liquid-travelling microscope

5 **3 Hours**

EXPERIMENT 5

Determination of wavelength of laser-diffraction grating

6 **4 Hours**

EXPERIMENT 6

Determination of frequency of a tuning fork-Meldes apparatus

7 **4 Hours**

EXPERIMENT 7

Thickness of a thin wire using interference of light-Air wedge method

Total: 60 Hours

Reference(s)

1. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2011
2. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011
3. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017
4. H D Young and R A Freedman, Sears and Zemanskys University Physics with Modern Physics, Pearson education, 2016
5. R K Gaur and S L Gupta, Engineering Physics, DhanpatRai Publications, 2012

20AI103 ENGINEERING CHEMISTRY I 2 0 2 3

Course Objectives

- Identify the properties and applications of optical materials for smart screen
- Summarize the conducting materials and explain its applications to smart screens
- Classify the materials for data storage in electronic devices
- Outline the applications of organic materials in data storage
- Choose the suitable materials for the fabrications of microprocessors in electronic devices

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
g. 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.

Course Outcomes (COs)

1. Compare the inorganic and organic materials used for smart screen fabrication
2. Demonstrate the fabrication of smart screen using conducting material
3. Analyse the type of materials for data storage in electronic devices
4. Identify various organic nanoscale materials in data storage
5. Select suitable materials for fabrication of microprocessor

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2					1							
2	2	3												
3	2	2					1							
4	2	2												
5	2	2												

UNIT I **6 Hours**

OPTICAL MATERIAL FOR SMART SCREEN

Types: Inorganic: Rare earth metals [yttrium, lanthanum, cerium, praseodymium, neodymium, europium, terbium and dysprosium] - organic: Organic dielectric material [Polystyrene, PMMA] - organic light emitting diodes [polythiopene]

UNIT II **6 Hours**

CONDUCTING MATERIALS FOR SMART SCREEN

Conductive components: Indium tin oxide [properties and applications] - touch screen [resistive and capacitive]. Chemical components in glass - alumino silicate - gorilla glass

UNIT III **5 Hours**

MATERIALS FOR DATA STORAGE

Classification - magnetic storage [Iron oxide, cobalt alloy, chromium oxide and barium ferrite] - optical storage [photochromic materials] - solid storage

UNIT IV **5 Hours**

ORGANIC NANOSCALE MATERIAL FOR DATA STORAGE

Data Storage - classification [media, access, information and volatility] - flexible data storage [transistor Structure] - flexible floating gate - flexible charge trap- flexible ferroelectric- flexible resistive memory with organic material

UNIT V **7 Hours**

MATERIALS FOR MICROPROCESSOR FABRICATION

Micro electrical components: Fabrication (CVD method) and use of metal oxide materials. Integrated circuit manufacturing - preparation of silicon wafer - masking - photo-resistant materials - classification. Doping: Atomic diffusion, ion implantation, making successive layers. Microcapacitors: Types - electrochemical capacitors, electrolytic capacitors and supercapacitors. Soldering materials: copper, tin and silver

FURTHER READING

Applications of advanced data storage materials in electronic devices, conducting materials for smart screen Applications of smart material for microprocessor fabrication.

1 **5 Hours**

EXPERIMENT 1

Estimation of copper content in a sample solution prepared from copper doped optical light emitting diodes

2 **5 Hours**

EXPERIMENT 2

Determination of conductivity of aluminium chloride, aluminium silicate and tin oxide compounds using conductivity meter

3 **5 Hours**

EXPERIMENT 3

Estimation of barium content in a sample solution prepared from iron alloy used in magnetic storage material

4 **4 Hours**

EXPERIMENT 4

Estimation of iron content in sample solution prepared from ferro electric materials using spectrophotometer

5 **6 Hours**

EXPERIMENT 5

Electroless plating of copper on polymeric material used in IC fabrication

6 **6 Hours**

EXPERIMENT 6

Electroless plating of nickel on polymeric material used in IC fabrication

Total: 60 Hours

Reference(s)

1. Padma L Nayak, Polymer Science, 1st Edition, Kalyani Publishers, New Delhi, 2005.
2. Smart Materials Taxonomy, Victor Goldade, Serge Shilko, Aleksander Neverov, CRC publication, 2015.
3. Advanced Magnetic and Optical Materials, edited by Ashutosh Tiwari, Parameswar K. Iyer, Vijay Kumar, Hendrik Swart, wiley publication, 2016.
4. Recent Advances of Flexible Data Storage Devices Based on Organic Nanoscaled Materials- Li Zhou, Jingyu Mao, Yi Ren, Su-Ting Han, V A. L. Roy and Ye Zhou, Small 1703126, 2018.
5. G.M. Crean, R. Stuck, J.A. Woollam. Semiconductor Materials Analysis and Fabrication Process Control Elsevier publication, 2012.

20AI104 PROGRAMMING FOR PROBLEM SOLVING 2 0 2 3

Course Objectives

- Understand the basics of C primitives, operators and expressions.
- Gain knowledge about the different primitive and user defined data types.
- Impart knowledge about the structural programming concepts.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.

Course Outcomes (COs)

1. Explain the basic C programming concepts
2. Implement C programs using control statements
3. Implement the concepts of Arrays and strings in C
4. Implement the concepts of functions and pointers in C
5. Analyze the concepts of structures, unions and files in C

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2											
2	2	3	2											
3	2	3	2											
4	2	3	2											
5	2	3	2											

UNIT I **6 Hours**

INTRODUCTORY CONCEPTS

C Primitives: Introduction to C, planning and writing a C program, Character Set, Keywords and Identifiers, Data Types, Variables and Constants, Compiling and executing the C program, Operators and Expressions: Arithmetic, Relational, Logical, Increment and decrement, Conditional, Bitwise, Comma, Size of (), Assignment, Shift operator, Precedence and order of evaluation Type Conversion, Input and Output Operations: Formatted I/O functions, getchar and putchar function, gets and puts functions

UNIT II **6 Hours**

CONTROL STATEMENTS

Decision Making and Branching: simple if statement, if else statement, nesting of if else Statement, Switch Statement. Decision Making and Looping: while statement, do while statement, for statement, Nested for statement Jump Statement: goto, break, continue, return statement

UNIT III **6 Hours**

ARRAYS AND STRINGS

Arrays: Introduction, one dimensional array, declaration, Initialization of one dimensional array, two dimensional arrays, initializing two dimensional arrays, multi-dimensional arrays. Strings: Declaring and initializing string variables, Reading strings from terminal, writing string to screen, String handling functions.

UNIT IV **6 Hours**

FUNCTIONS AND POINTERS

User Defined Functions: Elements of user defined functions , Definition of functions, return values and their types, function calls, function declaration, categories of function, call by value and call by reference, recursion, Preprocessor directives and macros. Pointers: Understanding Pointers, accessing the address of the variable, declaring pointer variables, Initialization of pointer variables, accessing a variable through its pointer.

UNIT V **6 Hours**

STRUCTURES AND FILES

Storage Class Specifiers: Auto, registers, static, extern, typedef Structures and Unions: Introduction, defining a structure, declaring structure variables, accessing structure members, structure initialization, Unions, Enumerated data type File Management in C: Defining and opening a file, closing a file, Input/output operations on files, Command line arguments

1 **4 Hours**

EXPERIMENT 1

Write a C program to perform arithmetic operations on integers and floating point numbers.

2 **4 Hours**

EXPERIMENT 2

Write a C program to implement ternary operator and relational operators.

3 **2 Hours**

EXPERIMENT 3

Write a C program to read the values of A, B, C through the keyboard. Add them and after addition check if it is in the range of 100 to 200 or not. Print separate message for each.

4 **2 Hours**

EXPERIMENT 4

Write a C program to display the roots of a quadratic equation with their types using switch case.

5 **2 Hours**

EXPERIMENT 5

Write a C program to generate the following triangle.

1
1 2 3
1 2 3 4 5
1 2 3 4 5 6 7

6 **4 Hours**

EXPERIMENT 6

Write a C program to get a matrix of order 3x3 and display a matrix of order of 4x4, with the fourth row and column as the sum of rows and columns respectively.

7 **2 Hours**

EXPERIMENT 7

Write a c program to remove the occurrence of "the" word from entered string.

8 **2 Hours**

EXPERIMENT 8

Write a C program to find the factorial of given number.

9 **4 Hours**

EXPERIMENT 9

Design a structure to hold the following details of a student. Read the details of a student and display them in the following format Student details: roll no, name, branch, year, section, cgpa.

****

NAME:
ROLLNO:
BRANCH:
YEAR:
SECTION:
CGPA:

10 **4 Hours**

EXPERIMENT 10

Create two files test1.txt and test2.txt and write a C program to read the file text1.txt character by character on the screen and paste it at the end of test2.txt

Total: 60 Hours

Reference(s)

1. Herbert Schildt, C -The complete Reference, Tata McGraw-Hill, 2013
2. Byron Gottfried, Programming with C, Schaum""s Outlines, Tata Mcgraw-Hill, 2013
3. E.Balagurusamy, Programming in ANSI C, Tata McGraw-Hill, 2012
4. Kernighan B W and Ritchie O M, The C programming Language. Prentice-Hall of India, 2009
5. Kelley A and I. Pohl, A Book on C: Programming in C, Pearson Education, 1998
6. Ashok.N.Kamthane, Programming in C, Pearson education,2013

20AI105 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

2 0 2 3

Course Objectives

- To understand the basic concepts of electric circuits and magnetic circuits.
- To illustrate the construction and operation of various electrical machines and semiconductor devices.
- To learn the fundamentals of communication systems.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
l. 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.

Course Outcomes (COs)

1. Understand the basic concepts of electric and magnetic circuits
2. Summarize the types of DC machines.
3. Classify the static and dynamic AC machines and explain their operation.
4. Interpret the operation of AC and DC drives
5. Illustrate the characteristics of semiconductor devices and communication systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3											1		
2	3			3										
3	3			3										
4	3	2	3											
5	3			3								3		

UNIT I **7 Hours**

ELECTRIC CIRCUITS

Definition of Voltage, Current, Electromotive force, Resistance, Power & Energy, Ohms law and Kirchoffs Law & its applications - Series and Parallel circuits - Voltage division and Current division techniques - Generation of alternating emf - RMS value, average value, peak factor and form factor- Definition of real, reactive and apparent power.

UNIT II **5 Hours**

DC MACHINES

Introduction of magnetic circuits - Law of Electromagnetic induction, Flemings Right & Left hand rule- Types of induced emf - Definition of Self and Mutual Inductance - DC Motor- Construction - Working Principle- Applications.

UNIT III **6 Hours**

AC MACHINES

Single Phase Transformer - Alternator - Three phase induction motor - Single phase induction motor - Construction - Working Principle - Applications.

UNIT IV **5 Hours**

ELECTRICAL DRIVES

Speed control of dc shunt motor and series motor - Armature voltage control - Flux control - Construction and operation of DC servo motor - Construction and operation of DC servo motor stepper motor.

UNIT V **7 Hours**

ELECTRON DEVICES AND COMMUNICATION

Characteristics of PN Junction diode and Zener diode - Half wave and Full wave Rectifiers - Bipolar Junction Transistor - Operation of NPN and PNP transistors - Logic gates - Introduction to communication systems.

FOR FURTHER READING

Voltage Regulator - Stepper motor - Energy meter - SMPS, Satellite and Optical communication.

1 **4 Hours**

EXPERIMENT 1

Analyze the VI characteristics of a fixed resistor and a lamp by varying its temperature.

2 **4 Hours**

EXPERIMENT 2

Apply the voltage division and current division techniques for series and parallel connections of lamp loads.

3 **4 Hours**

EXPERIMENT 3

Understand the concept of electromagnetic induction using copper coil.

4 **4 Hours**

EXPERIMENT 4

Understand the construction and working principle of DC machines.

5 **6 Hours**

EXPERIMENT 5

Determine the VI Characteristics of PN Junction diode and plot the input and output wave shapes of a half wave rectifier.

6 **4 Hours**

EXPERIMENT 6

Realize the working of transistor as an electronic switch through experiments.

7 **4 Hours**

EXPERIMENT 7

Lighting applications using logic gates principle.

Total: 60 Hours

Reference(s)

1. T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011.
2. Smarjith Ghosh, Fundamentals of Electrical and Electronics Engineering, Prentice Hall (India) Pvt. Ltd., 2010.
3. A. Sudhakar, Shyammohan S Palli, Circuits and Networks Analysis and Synthesis, Tata McGraw Hill, 2010
4. R. S. Sedha, A Textbook of Applied Electronics, S.Chand & Company Ltd, 2013

18HS101 COMMUNICATIVE ENGLISH I 1 0 2 2

Course Objectives

- Read and understand the main points on familiar matters regularly encountered in work, school or leisure.
- Listen and respond in most common situations where English is spoken.
- Write simple connected texts on topics which are familiar or of personal interest.
- Describe experiences and events, hopes and ambitions and briefly give reasons and explanations for opinions and plans.

Programme Outcomes (POs)

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

j. 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.

Course Outcomes (COs)

1. Use appropriate grammar & vocabulary that is expected at the BEC Preliminary exam level.
2. Understand the general meaning of non-routine letters within own work area, and short reports of a predictable nature.
3. Write straightforward, routine letters of a factual nature, and make notes on routine matters, such as taking/placing orders.
4. Follow simple presentations/demonstrations.
5. Deal with predictable requests from a visitor, state routine requirements, and offer advice within own job area on simple matters.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2									2					
3									2					
4										1				
5										2				

UNIT I **9 Hours**

GRAMMAR

Tenses Future continuous, Past continuous, Past perfect, Past simple, Past tense responses, Present perfect continuous, Present perfect/past simple Reported speech Adverbs intensifiers Comparatives and superlatives Conditionals 2nd and 3rd Connecting words expressing cause and effect, contrast Phrasal verbs Prepositions of place Simple passive - Wh-questions in the past Question tags Will and going to, for prediction-Gender Sensitive Vocabulary

UNIT II **9 Hours**

READING

Understanding short real-world notices, messages Detailed comprehension of factual material; skimming and scanning skills - Interpreting visual information Reading for detailed factual information Reading for gist and specific information - Grammatical accuracy and understanding of text structure - Reading and information transfer.

UNIT III **9 Hours**

WRITING

Internal communication including note, message, memo or email - arranging / rearranging appointments, asking for permission, giving instructions - Business correspondence including letter, fax, email apologizing and offering compensation, making or altering reservations, dealing with requests, giving information about a product-Hierarchy in Business Correspondence

UNIT IV **9 Hours**

LISTENING

Listening for specific information Listening for numbers and letters Note completion Listening for gist listening to monologues (presentations, lectures, announcements and briefings) listening to interacting speakers (telephone conversations, face-to-face conversations, interviews and discussions).

UNIT V **9 Hours**

SPEAKING

Exchanging personal and factual information expressing and finding out about attitudes and opinions organize a larger unit of discourse Turn-taking, negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing and/or disagreeing, suggesting, speculating, comparing and contrasting, and decision-making.

Total: 45 Hours

Reference(s)

1. Alexander Garrett, Cambridge BEC Preliminary Students Book with Answers, Cambridge University Press, 2016.
2. Lan Wood, Anne Williams and Anna Cowper. Pass Cambridge BEC Preliminary, Second Edition, New Delhi, 2014.
3. Norman Whitby. Cambridge Business Benchmark. Pre-Intermediate to Intermediate, Students Book. South Asian Edition, 2018.

20AI201 ENGINEERING MATHEMATICS II 3 1 0 4

Course Objectives

- Understand the concepts of partial derivatives and multiple integrals to define the area, volume and extreme values of various surfaces in engineering fields.
- Classify the sequences and series in linear systems is convergent or divergent.
- Formulate the real time engineering problem into mathematical model using ordinary differential equation and solve it by appropriate method.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.

Course Outcomes (COs)

1. Illustrate the various parameters in partial differentiation and characterize the maxima and minima functions for signals and systems.
2. Apply multiple integral concepts to calculate the area and volume by appropriate vector integral theorems.
3. Analyse the convergence and divergence of sequences and series by various tests.
4. Construct first order differential equations from real time phenomena and solve it by suitable method.
5. Execute the appropriate method to solve the second order differential equations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3												
2	3	1												
3	1													
4	2													
5		3												

UNIT I **9 Hours**

PARTIAL DIFFERENTIATION

Functions of several variables, plotting of 2-variable functions, introduction to cylindrical and spherical coordinates, chain rule, total differential, gradient, directional derivatives, normal lines and tangent planes, extreme of functions of two variables, applications.

UNIT II **9 Hours**

MULTIPLE INTEGRALS

Double integrals, regions of integrations, triple integrals, applications (Cartesian coordinates only- Greens theorem and Gauss Divergence theorem).

UNIT III **9 Hours**

SEQUENCES AND SERIES

Sequences and series, convergence and divergence of series, absolute convergence, conditional convergence, test for convergence and divergence. Power series for functions, interval of convergence, Taylor and Maclaurin series, Taylors Theorem with remainder.

UNIT IV **9 Hours**

FIRST ORDER DIFFERENTIAL EQUATIONS

Separable differential equations, homogeneous differential equations, exact differential equations, integrating factor, Bernoulli"s equation, applications.

UNIT V **9 Hours**

SECOND ORDER DIFFERENTIAL EQUATIONS

Second order homogeneous and non-homogeneous equations with constant coefficients, variation of parameters, method of undetermined coefficients, series solutions of differential equations, applications.

FOR FURTHER READING

Applications of mass spring system in ordinary differential equations of higher order.

Total: 60 Hours

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley, 2001.
2. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.Kreysgiz E, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 1999.
3. Ray Wylie and C Louis Barrett, Advanced Engineering Mathematics, Sixth Edition, Tata McGraw-Hill Publishing Company Ltd, 2003.
4. Peter V. O Neil, Advanced Engineering Mathematics, Seventh Edition, Cengage Learning India Private Limited, 2012.
5. Glyn James, Advanced Engineering Mathematics, Third Edition, Wiley India, 2014.

20AI202 ENGINEERING PHYSICS II 2 0 2 3

Course Objectives

- Understand the applications of laser and fibre optics in the field of engineering
- Impart knowledge in crystallography and semiconductors
- Differentiate the different types of magnetic materials and their applications

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

Course Outcomes (COs)

1. Understand the principle, characteristics, different types of lasers and apply the same for optical data storage and retrieval techniques
2. Illustrate the propagation of light through different optical fibres, applications of optical fibres in communication and sensors
3. Identify the seven crystal systems, crystal planes and the stacking sequences in metallic crystal structures
4. Analyse the characteristics of semiconducting materials in terms of crystal lattice, charge carriers and energy band diagrams
5. Outline the properties of magnetic materials, domain theory of ferromagnetism and the applications for recording and readout process

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1							2					
2	2	1							2					
3	2	1												
4	2	1							2					
5	2	1							2					

UNIT I **7 Hours**

LASER

Principle - interaction of radiation with matter - characteristics of laser radiation - pumping mechanisms - types: CO2 laser -homo junction GaAs laser -applications: optical data storage and retrieval techniques - holography: principle -types - comparison of holography with photography - construction - reconstruction of hologram –applications

UNIT II **7 Hours**

FIBER OPTICS

Principle- conditions to achieve total internal reflection- structure- acceptance angle and numerical aperture (qualitative treatment only)- types- modes of propagation- refractive index profile- block diagram of fiber optic communication system- fiber optic sensors- intensity modulated sensor-endoscopy - merits of fiber cables over conventional communication systems

UNIT III **5 Hours**

CRYSTAL PHYSICS

Crystalline and amorphous materials - lattice -lattice point -basis - unit cell - crystal systems - Bravais lattices -planes in crystals- Miller indices -procedure for finding Miller indices- important features of Miller indices-unit cell characteristics of SC, BCC, FCC and HCP structures

UNIT IV **6 Hours**

SEMICONDUCTING MATERIALS

Characteristics -elemental and compound semiconductors- energy band description and current conduction in intrinsic semiconductors- energy band description of n-type and p-type semiconductors- conductivity of extrinsic semiconductors - variation of Fermi level with temperature and impurity concentration- temperature dependence on carrier concentration - Hall effect-applications - solar cells - photodiodes

UNIT V **5 Hours**

MAGNETIC MATERIALS

Fundamental definitions -Bohr magneton- classification of dia, para and ferromagnetic materials - domain theory - hysteresis curve - soft and hard magnetic materials -energy product and its importance - anti-ferromagnetic materials - ferrites -giant magneto resistance (GMR) effect -application: Principles of Magnetic Recording- Magnetic Digital Recording- Magneto-Optic Recording

1 **2 Hours**

EXPERIMENT 1

Exposure to Engineering Physics Laboratory and precautionary measures

2 **4 Hours**

EXPERIMENT 2

Determine the wavelength of given laser source by applying the principle of diffraction

3 **4 Hours**

EXPERIMENT 3

Determination of acceptance angle and numerical aperture of a given fibre

4 **4 Hours**

EXPERIMENT 4

Evaluation of band gap of given material using band gap kit.

5 **4 Hours**

EXPERIMENT 5

Determine the V-I characteristics of a solar cell

6 **4 Hours**

EXPERIMENT 6

Using Hall Effect, determine the nature of given material

7 **4 Hours**

EXPERIMENT 7

Find the refractive index of a transparent solid with the aid of travelling microscope

8 **4 Hours**

EXPERIMENT 8

Determination of energy loss per cycle of a ferromagnetic material using hysteresis curve

Total: 60 Hours

Reference(s)

1. Balasubramaniam, R. Callisters Materials Science and Engineering Wiley India Pvt.Ltd, 2014
2. Kasap, S.O. Principles of Electronic Materials and Devices McGraw-Hill Education,2017
3. Wahab, M.A. Solid State Physics: Structure and Properties of Materials Alpha Science International Ltd., 2017
4. Donald A. Neamen. Semiconductor Physics and Devices, McGraw-Hill, 2011
5. K. Thiyagarajan and A. K. Ghatak, LASERS: Fundamentals and Applications, Springer, USA, 2015
6. B.D. Cullity, Introduction to Magnetic Materials, Addison-Wesley

20AI203 ENGINEERING CHEMISTRY II 2 0 2 3

Course Objectives

- Classify the traditional and materials used to manage heat developed in electronic devices
- Classify the traditional and advanced materials used to manage heat developed in electronic devices
- Summarize the terminologies of electrochemistry and explain the applications of energy storage devices for computers
- Indicate the types, properties and applications of nanochips and carbon nanotubes used in electronic devices
- Outline sources of e-wastes and its effects on environment and its management

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
g. 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.

Course Outcomes (COs)

1. Compare the metals and alloys used as thermal management materials in electronic devices
2. Interpret the advanced thermal management materials for microelectronics and optoelectronics
3. Analyze the importance of primary, secondary batteries and fuel cells used in energy storage devices in computers
4. Identify various organic nanoscale materials in data storage
5. Select a suitable technology to manage e-wastes from various electronic devices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2					1							
2	2	3												
3	2	2					1							
4	2	2												
5	2	2												

UNIT I **6 Hours**

THERMAL MANAGEMENT MATERIALS

Heat generation - purpose - classification of electronic packaging - types of thermal management materials - traditional thermal management materials: Metals [Cu, Al, W and Mo] - compounds [Al2O3, BeO, AlN, SiC and Kovar alloy]

UNIT II **7 Hours**

ADVANCED THERMAL MANAGEMENT MATERIALS

Alloys: W-Cu, Mo-Cu, Cu/MoCu/Cu, AlSiC, Cu/SiC and W85-Cu. Fiber-reinforced material - sandwich structure of composite - thermal management materials for microelectronics and optoelectronics: Carbon nanotubes and aluminium/diamond composites

UNIT III **7 Hours**

ENERGY STORAGE DEVICES FOR COMPUTERS

Cell - cell potential - determination of potential. Batteries - types: Primary battery [Zinc-carbon]. Secondary battery: lead-sulphur. Modern battery: lithium polymer battery and fuel cells

UNIT IV **5 Hours**

NANOMATERIALS

Nano chips - types of material - properties - applications. Carbon nanotubes - fullerene, graphene : Types and applications

UNIT V **5 Hours**

E- WASTE MANAGEMENTS

Sources - toxicity due hazardous substances - impact to environment. E-waste management- Hazardous materials recycling (Gallium and Arsenic)

1 **8 Hours**

EXPERIMENT 1

General introduction and Determination of thermal stability of aluminium oxide using thermo gravimetric analysis

2 **4 Hours**

EXPERIMENT 2

Determination of thermal stability of copper alloys using thermo gravimetric analysis

3 **6 Hours**

EXPERIMENT 3

Determination of single electrode potential of zinc and copper electrodes

4 **6 Hours**

EXPERIMENT 4

Preparation of cadmium nanoparticles and its characterization

5 **6 Hours**

EXPERIMENT 5

Estimation of chromium and lead content in sample solution prepared from e-waste [PCB] using spectrophotometer

Total: 60 Hours

Reference(s)

1. Ravi Kandasamy, Arun S. Mujumdar. Thermal Management of Electronic Components. Lap Lambert Academic Publishing GmbH KG, 2010.
2. Guosheng Jiang, Liyong Diao, Ken Kuang. Advanced Thermal Management Materials. Springer Science & Business Media, 2012.
3. Nihal Kularatna. Energy Storage Devices for Electronic Systems: Rechargeable Batteries and Supercapacitors. Academic Press, 2014.
4. Odne Stokke Burheim. Engineering Energy Storage. Academic Press, 2017.
5. M. S. Dresselhaus, G. Dresselhaus, P. C. Eklund. Science of Fullerenes and Carbon Nanotubes: Their Properties and Applications. Elsevier, 1996.
6. Kazuyoshi Tanaka, S. Iijima. Carbon Nanotubes and Graphene. Edition 2, Newnes, 2014.

20AI204 APPLICATION BASED PROGRAMMING IN PYTHON 3 0 2 4

Course Objectives

- Develop a basic understanding Python programming language
- Solve problems requiring the writing of well-documented programs in the Python language, including use of the logical constructs of that language
- Demonstrate significant experience in data structures with the Python program

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.
n. Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Explain the basic concepts of Python programming
2. Implement Python programs using control statement and functions
3. Develop Python programs for the data structures String, List and Set
4. Implement Python programs for tuples and dictionaries data structures
5. Develop Python programs for files, modules and packages

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2		2								3	3
2	2	3	3		2								3	3
3	3	3	3	2	2								3	3
4	3	3	3	2	2								3	3
5	3	3	3	1	2								3	3

UNIT I **9 Hours**

THEORY COMPONENT CONTENTS BASICS OF PYTHON PROGRAMMING

Introduction-Python - Object Oriented Programming - Classes , Object and Instances- Constructor, class attributes and destructors - decorator pattern - real time uses of class in live projects - inheritance, overlapping and overloading operators- adding and retrieving dynamic attributes of classes - programming using Oops Support.

UNIT II **9 Hours**

CONTROL STATEMENTS AND FUNCTIONS IN PYTHON

Conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, Break, continue, pass; Functions: Introduction, inbuilt functions, user defined functions, passing parameters, return values, recursion

UNIT III **9 Hours**

DATA STRUCTURES: STRINGS, LISTS, SET

Strings: string slices, immutability, string methods and operations; Lists: creating lists, list operations, list methods, mutability, aliasing, cloning lists, list and strings, list and functions ; list processing : list comprehension, searching and sorting, Sets: creating sets, set operations.

UNIT IV **8 Hours**

DATA STRUCTURES: TUPLES, DICTIONARIES, ARRAYS

Tuples: Tuple assignment, Operations on Tuples, lists and tuples, Tuple as return value; Dictionaries: operations and methods, Nested Dictionaries, Arrays: operations and methods

UNIT V **10 Hours**

FILES, MODULES, PACKAGES

Files and exception: text files, reading and writing files, format operator, exception handling, modules, packages

1 **2 Hours**

EXPERIMENT 1

Programs using expressions and input and output statements.

2 **2 Hours**

EXPERIMENT 2

Programs using operators and built in functions.

3 **2 Hours**

EXPERIMENT 3

Programs using conditional statements.

4 **2 Hours**

EXPERIMENT 4

Programs performing all string operations.

5 **2 Hours**

EXPERIMENT 5

Programs using functions

6 **2 Hours**

EXPERIMENT 6

Programs to find square root, GCD, exponentiation, sum an array of numbers

7 **2 Hours**

EXPERIMENT 7

Programs to perform linear search, binary search

8 **2 Hours**

EXPERIMENT 8

Programs to perform operations on list

9 **2 Hours**

EXPERIMENT 9

Programs using dictionary and set

10 **2 Hours**

EXPERIMENT 10

Programs to work with Tuples.

11 **2 Hours**

EXPERIMENT 11

Programs to sort elements (Selection, Insertion, Merge, Quick)

12 **2 Hours**

EXPERIMENT 12

Program to perform word count in file.

13 **2 Hours**

EXPERIMENT 13

Program to perform file operations

14 **2 Hours**

EXPERIMENT 14

Program to count the number of characters, words and lines in a text file

15 **2 Hours**

EXPERIMENT 15

Programs using modules and packages

Total: 75 Hours

Reference(s)

1. Ashok Namdev Kamthane,Amit Ashok Kamthane, Programming and Problem Solving with Python , Mc-Graw Hill Education,2018.
2. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, Second edition, Updated for Python 3, Shroff Reilly Publishers, 2016
3. John V Guttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press, 2013.
4. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
5. Timothy A. Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd., 2015.
6. Kenneth A. Lambert, Fundamentals of Python: First Programs, CENGAGE Learning, 2012.

20AI205 DIGITAL SYSTEM DESIGN 3 0 2 4

Course Objectives

- Understand the fundamentals of digital logic
- Understand the implementation of logic circuits
- Analyse and design various combinational and sequential circuits

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.

Course Outcomes (COs)

1. Understand the boolean algebra and logic gates
2. Design and analyze combinational circuits
3. Implement synchronous sequential logic
4. Understand the procedures in Asynchronous sequential logic
5. Implement the design with MSI devices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2												
2	3	2	2											
3	3	3	3											
4	3	3	3											
5	3	3	3											

UNIT I **9 Hours**

BOOLEAN ALGEBRA AND LOGIC GATES

Number systems and conversions - Boolean algebra - Minterm - Maxterm - SOP and POS forms - NAND and NOR implementation - Simplification of Boolean functions: K Map - Don"t care conditions - Five variable K map - Quine Maccluskey method - Logic gates.

UNIT II **9 Hours**

COMBINATIONAL LOGIC

Combinational circuits - Analysis procedures - Design procedures - Adders - Subtractors - Binary adder - Carry Look Ahead Adder - BCD Adder - Magnitude comparator - Code Converters - Multiplexers and Demultiplexers- Function realization using multiplexers - Decoders and encoders.

UNIT III **10 Hours**

SYNCHRONOUS SEQUENTIAL LOGIC

Sequential circuits - Flip flops - Flip Flop Conversion - Analysis procedures - Design procedures - Moore and Mealy models - State reduction and state assignment - Shift Registers - Counters.

UNIT IV **10 Hours**

ASYNCHRONOUS SEQUENTIAL LOGIC

Design of Asynchronous sequential circuits - Analysis procedure: Transition Table - Flow Table - Race Condition- stability, Design Procedure: Primitive Flow Table- Reduction- Transition Table- Race Free State Assignment- Hazards.

UNIT V **7 Hours**

DESIGN WITH MSI DEVICES

Programmable Logic Devices (PLD) - Programmable Logic Array (PLA) - Programmable Array Logic (PAL) - Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using ROM, PLA, PAL.

FOR FURTHER READING

Design of a simple CPU - ASM charts - Hardware Description Language - RTL Design

1 **2 Hours**

EXPERIMENT 1

Implement Boolean Laws using Logic Gates

2 **4 Hours**

EXPERIMENT 2

Implement arithmetic circuits (Adder, Subtractor)

3 **2 Hours**

EXPERIMENT 3

Construct Code convertors (BCD, Gray, Excess -3)

4 **4 Hours**

EXPERIMENT 4

Construct Parity generator and parity checker

5 **2 Hours**

EXPERIMENT 5

Construct Magnitude comparator

6 **4 Hours**

EXPERIMENT 6

Demonstrate Multiplexer and Demultiplexers

7 **2 Hours**

EXPERIMENT 7
Function realization using multiplexers

8 **4 Hours**

EXPERIMENT 8
Demonstrate Encoder and Decoder

9 **2 Hours**

EXPERIMENT 9
Construct synchronous and Ripple counter

10 **4 Hours**

EXPERIMENT 10
Implement shift register (SISO, SIPO, PISO, PIPO)

Total: 75 Hours

Reference(s)

1. M.Morris Mano and Michael D Ciletti, Digital Design with an introduction to the VHDL, Pearson Education, 5th Edition, 2013
2. A Anand Kumar, Fundamentals of Digital Circuits, 3rd Edition,2014
3. Charles H.Roth, Jr., Fundamentals of Logic Design, 4th Edition, Jaico Publishing House, 2000
4. Mandal, Digital Electronics Principles & Application, McGraw Hill Edu, 2013.
5. Donald D.Givone, Digital Principles and Design, Tata McGraw-Hill, 2003.
6. John M.Yarbrough, Digital Logic, Application & Design, Thomson, 2002.

20AI301 PROBABILITY AND STATISTICS 3 1 0 4

Course Objectives

- Understand the basic concepts of probability and the distributions with characteristics and also two-dimensional random variables.
- Apply the basic rules and theorems of probability theory to determine probabilities that help to solve engineering problems.
- Determine the expectation and variance of a random variable from its distribution.
- Learn how to formulate and test hypotheses about means, variances and proportions and to draw conclusions based on the results of statistical tests.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.
n. Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Demonstrate and apply the basic probability axioms and concepts in their core areas of random phenomena in their core areas.
2. Calculate the relationship of two-dimensional random variables using Correlation techniques and to study the properties of two-dimensional random variables.
3. Formulate the testing of hypothesis based on different types of hypothesis.
4. Implement one-way and two-way classifications.
5. Summarize the measurements for statistical quality control.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	1										3	3
2	2	3											3	3
3	3	2		1									3	3
4	2	1	1	3									3	3
5	2	2	1	1									3	3

UNIT I **9 Hours**

PROBABILITY AND RANDOM VARIABLES

Introduction to probability concepts, Types of Events, axioms, theorems, Conditional probability, Multiplication theorem, Applications. Characteristics of random variables - Discrete case, Probability Mass function, Cumulative distribution function, Applications ,Characteristics of random variables - Continuous case, , Probability density function, Cumulative distribution function, Applications, Central and Raw Moments, Expectation, variance, Applications, Moment generating function of discrete and continuous random variable.

UNIT II **9 Hours**

TWO - DIMENSIONAL RANDOM VARIABLES

Joint Distributions - Marginal and Conditional Distributions - Covariance - Correlation and Linear Regression - Transformation of Random Variables - Central Limit Theorem (For Independent And Identically Distributed Random Variables).

UNIT III **9 Hours**

TESTING OF HYPOTHESIS

Sampling Distributions - Estimation Of Parameters - Statistical Hypothesis - Large Sample Test Based On Normal Distribution For Single Mean And Difference Of Means -Tests Based On T, Chi-square And F Distributions For Mean, Variance And Proportion - Contingency Table (Test For Independent) - Goodness Of Fit.

UNIT IV **9 Hours**

DESIGN OF EXPERIMENTS

One Way And Two Way Classifications - Completely Randomized Design - Randomized Block Design - Latin Square Design - 22 Factorial Design.

UNIT V **9 Hours**

STATISTICAL QUALITY CONTROL

Control Charts for Measurements (X and R Charts) - Control Charts For Attributes (P, C and NP Charts) - Tolerance Limits - Acceptance Sampling.

Total: 60 Hours

Reference(s)

1. Devore. J.L., Probability and Statistics for Engineering and the Sciences, Cengage Learning, New Delhi, 8th Edition, 2012.
2. Walpole. R.E., Myers. R.H., Myers. S.L.,Probability and Statistics For Engineers And Scientists, Pearson Education, Asia , 8th Edition, 2007.
3. Ross, S.M., Introduction to Probability and Statistics for Engineers and Scientists, 3rd Edition, Elsevier, 2004.
4. Spiegel. M.R., Schiller. J. And Srinivasan. R.A., Schaum S Outline of Theory and Problems of Probability And Statistics, Tata McGraw Hill Edition, 2004.

20AI302 DATA STRUCTURES USING CPP 3 0 0 3

Course Objectives

- Understand the concepts of Object Oriented Programming.
- Implement ADTs such as arrays, lists, stacks, queues, trees, graphs, search trees in C++ to solve real world problems.
- Analyze various searching and sorting techniques.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Identify the features of object oriented concepts in C++
2. Implement the operations and applications of Stack ADT, Queue ADT and List ADT
3. Classify the types of tree data structures and explain the tree traversal methods
4. Outline the features and applications of graph data structure
5. Design algorithms for searching and sorting techniques

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2											
2	2	3	3										2	
3	2	3	3										2	
4	2	3	3										2	
5	2	3	3										2	

UNIT I **9 Hours**

INTRODUCTION

Need for Object Oriented Programming-Characteristics of Object Oriented Programming-Classes and Objects-Member Functions- Constructors and Destructors - Operator Overloading-Inheritance -Function Overloading.

UNIT II **9 Hours**

STACKS AND QUEUES

Classification of Data Structures-Abstract Data Types(ADTs)- Array Implementation-Linked List Implementation-Types of Linked List-Applications of List-Stack ADT- Operations- Applications of Stack-Queue ADT - Operations - Circular Queue- Priority Queue-Dequeue-Applications of Queue.

UNIT III **9 Hours**

TREES

Tree ADT - Tree Traversals-Binary Tree ADT - Expression Trees- Applications of Trees-Binary Search Tree ADT - AVL Trees-Heap Tree-B-Tree-B+ Tree-Heap-Applications of Heap.

UNIT IV **9 Hours**

GRAPHS

Definition - Representation of Graph - Types of Graph - Breadth-First Traversal - Depth-First Traversal - Topological Sort - Shortest Path Algorithms: Unweighted Shortest Paths - Dijkstra"s Algorithm - Minimum Spanning Tree: Prim"s Algorithm - Kruskal"s Algorithm

UNIT V **9 Hours**

SEARCHING, SORTING AND HASHING TECHNIQUES

Searching: Linear Search-Binary Search-Sorting: Bubble Sort- Selection Sort-Insertion Sort-Shell Sort - Radix Sort-Merge Sort -Hashing: Hash Functions-Separate Chaining-Open Addressing -Rehashing-Extendible Hashing.

FURTHER READING

Set-Extensible Arrays-Associative Arrays-Reactive Data Structures-Distributed Data Structures-Custom Data Structures

Total: 45 Hours

Reference(s)

1. E.Balagurusamy, "Object Oriented Programming with C++", Seventh Edition, McGraw Hill Education, 2017.
2. Robert Lafore, "Object Oriented Programming in C++", Galgotia Publication, 2010.
3. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, Fourth Edition, Pearson Education, 2014.
4. Michael T. Goodrich, Roberto Tamassia and David M. Mount, Data structures and Algorithms in C++, Second Edition, Wiley India, 2011.
5. Sartaj Sahni, ata Structures, Algorithms, And Applications in C++, Second Edition, Silicon Press, 2004.
6. John Hubbard, Data Structures with C++, First Edition, McGraw Hill Education, 2017.

20AI303 PRINCIPLES OF OPERATING SYSTEM 3 0 0 3

Course Objectives

- To understand the concepts of the basic functionalities of an Operating Systems
- To analyze and evaluate the process of Operating Systems
- To provide knowledge on the structure and operations of memory management

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.

Course Outcomes (COs)

1. Classify operating system components and system calls based on functionality
2. Analyze and evaluate CPU scheduling algorithms
3. Interpret the solutions for critical section problems and deadlock prevention
4. Analyze the memory management techniques in terms of fragmentation
5. Identify the various file organization and access methods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2											
2	3	3	3											
3	3	3	3											
4	3	3	3											
5	3	3	3											

UNIT I **9 Hours**

OVERVIEW OF OPERATING SYSTEM

Introduction - operating system structure - Operating System Operations- Process Management - Memory Management - Storage Management- I/O systems-Protection and Security- Operating System Services-System Calls - Types of System Calls- System Programs - Operating system services and kernel Features.

UNIT II **9 Hours**

PROCESS MANAGEMENT

Processes-Process Concept-Process Scheduling-Operations on Processes-Inter-process Communication.Threads: Overview- Multithreading Models-Threading Issues.CPU Scheduling-Basic Concepts-Scheduling Criteria-Scheduling Algorithms-Overview of Multiprocessor Scheduling and Real time scheduling.

UNIT III **9 Hours**

SYNCHRONIZATION AND DEADLOCK

Process Synchronization: Introduction - The Critical Section Problem - Synchronization Hardware - Semaphores -Deadlocks: System Model - Deadlock Characterization - Methods for Handling Deadlock - Deadlock Prevention - Deadlock Avoidance - Deadlock Detection - Recovery from Deadlock.

UNIT IV **8 Hours**

MEMORY MANAGEMENT

Main Memory: Background- Swapping- Contiguous Memory Allocation- Segmentation- Paging- Structure of the Page Table. Virtual Memory: Background- Demand Paging- Page Replacement - Resident set management, cleaning policy, fetch policy - Allocation of Frames- Thrashing.

UNIT V **10 Hours**

STORAGE MANAGEMENT

Overview of Mass Storage Structure-Disk Structure and attachment-Disk Scheduling-Disk Management-Swap-Space Management.File-System Interface:File Concept-Access Methods- File System Implementation:File-System Structure-Directory Implementation-Allocation Methods-Free-Space Management.

Total: 45 Hours

Reference(s)

1. William Stallings, "Operating Systems Internals and Design Principles", Pearson Education, Eighth Edition, 2015.
2. John J Donovan, "System Programming", McGraw Hill Publication, Reprint, 2014.
3. William Stallings, "Operating System", Pearson Education, Sixth Edition, 2012
4. Andrew S. Tanenbaum, "Modern Operating Systems", Third Edition Prentice Hall of India Pvt. Ltd, 2010

20AI304 COMPUTER ORGANIZATION AND ARCHITECTURE

3 0 0 3

Course Objectives

- Understand the basic structure and operation of a digital computer
- Familiarize with the implementation of fixed point and floating-point arithmetic operations
- Explore the processing of instruction and control unit design
- Acquire the knowledge of Parallel processing and memory hierarchy system

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.

Course Outcomes (COs)

1. Apply the knowledge of performance metrics to find the performance of systems
2. Determine the technique to execute multiple instruction in single core and multi-core processor
3. Analyze how parallel processing and memory system can have significant impact on performance of a digital computer
4. Identify the different types of parallelism that can be exploited in a computer architecture
5. Understand the process of controlling and coordinating computer memory

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2											
2	2	3	2											
3	2	2	2											
4	2	3	2											
5	2	2	2											

UNIT I **9 Hours**

COMPUTER STRUCTURE

Evolution of Computers - Functional units and its operational concepts-Performance and Metrics for Performance Measurement - Memory operations, locations and addresses - Instruction and instruction sequencing - Addressing modes - Assembly language.

UNIT II **10 Hours**

ARITHMETIC OPERATIONS

Hardware for Addition and Subtraction -Addition and subtraction of signed numbers - Design of fast adders - Multiplication of positive numbers - Signed operand multiplication and fast multiplication-Integer division - Floating point numbers and operations.

UNIT III **9 Hours**

BASIC PROCESSING AND CONTROL UNIT

ALU Operation-Execution of a complete instruction Control Unit-Hardwired Control - Microprogrammed Control - Data path and control consideration -Pipelining and its Hazards.

UNIT IV **9 Hours**

PARALLELISM

Instruction level parallelism - Concepts and Challenges, Basic Compiler Techniques for Exposing ILP, Reducing Branch Costs with Advanced Branch Prediction, Dynamic Scheduling- Thread Level Parallelism - Introduction, Shared-Memory Multicore Systems, Performance Metrics for Shared-Memory Multicore Systems-Flynn"s classification multithreading- Data Level Parallelism- Introduction, Vector Architecture, SIMD Instruction Set Extensions for Multimedia, Graphics Processing Units, GPU Memory Hierarchy.

UNIT V **8 Hours**

MEMORY MANGEMENT AND I/O SYSTEMS

Introduction- Advanced Optimizations of Cache Performance- Memory Technology and Optimizations- Virtual Memory and Virtual Machines - The Design of Memory Hierarchy - Introduction to Pin Instrumentation and Cache grind.

FOR FURTHER READING

Case Study: Memory Hierarchies in Intel Core i7 and ARM Cortex-A8, Dynamic Scheduling in Intel Core i7 and ARM Cortex-A8, Intel Skylake and IBM Power8 and Nvidia Maxwell.

Total: 45 Hours

Reference(s)

1. David A Patterson and John L Hennessey, Computer organization and design, fifth edition, Morgan Kauffman, 2014.
2. J.L. Hennessy and D.A. Patterson. Computer Architecture: A Quantitative Approach. 5th Edition, Morgan Kauffmann Publishers, 2012.
3. Carl Hamacher, Zvonko G Varanesic and Safat G Zaky, Computer Organisation, sixth edition, Mc Graw-Hill Inc, 2012.
4. William Stallings, Computer Organization and Architecture, seventh Edition, Pearson Education, 2006.
5. John P Hayes, Computer architecture and Organisation, third edition, Tata McGraw-Hill, 1998.
6. Morris Mano, Computer System Architecture, third edition, Prentice-Hall of India, 2000.

20AI305 DATABASE MANAGEMENT SYSTEMS 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Differentiate database systems from file system by understanding the features of database system and design an ER model for a database system.
2. Develop solutions to a broad range of query and data update problems using relational algebra, relational calculus and SQL.
3. Apply the normalization theory in relational databases for removing anomalies.
4. Compare database storage and access techniques for file organization, indexing methods and Query Processing.
5. Analyze the basic issues of transaction processing, concurrency control, deadlock and its recovery schemes

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2											
2	3	3	3		3								3	
3	3	3	2		2								3	
4	3	2	3										3	
5	3	2	2										2	

UNIT I **8 Hours**

INTRODUCTION

Introduction: Database system application, purpose of database system View of Data -Database Languages-Data Storage and Querying-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. Case Studies on Designing Database Models

UNIT II **9 Hours**

RELATIONAL MODEL AND DATABASE DESIGN

Introduction to Relational Model - Formal Relational Query Languages - Introduction to SQL: Data definition-Basic structure of SQL Queries-Additional Basic operations -Set operations-Aggregate functions Nested sub queries-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. Case Study Implementation on Handling Data

UNIT III **8 Hours**

DATA STORAGE AND QUERY PROCESSING

Overview of Physical Storage Media - Magnetic disk Flash storage -RAID-File and Record Organization - Indexing and Hashing :Ordered Indices - B+Tree Index File-Static Hashing -Dynamic Hashing-Query Processing: Overview-measures of Query Cost. Importing / Exporting Large Amount of Data into a database.

UNIT IV **9 Hours**

TRANSACTION MANAGEMENT

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-Time stamp based protocols-Recovery system: Failure classification -Storage-Recovery and atomicity.

UNIT V **11 Hours**

ADVANCED TOPICS

Distributed Databases: Architecture, Data Storage, Transaction Processing-Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL-XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery- Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems.

FOR FURTHER READING

Introduction to Parallel, Distributed and Object Oriented Databases- Introduction to MySQL and PHP

Total: 45 Hours

Reference(s)

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts , McGraw - Hill, 2015
2. Ramez Elmasri and Shamkant B. Navathe, Fundamental Database Systems, Pearson Education, 2008
3. Raghu Ramakrishnan, Database Management System, Tata McGraw-Hill Publishing Company, 2003
4. C.J.Date, An Introduction to Database system, Pearson Education, 2006
5. Peter Rob and Corlos Coronel, Database System, Design, Implementation and Management , Thompson Learning Course Technology, 2003

20AI306 JAVA PROGRAMMING 2 0 2 3

Course Objectives

- Impart the basics of Java primitives, operators, classes and objects.
- Implement the object oriented thinking in Java
- Develop knowledge of standalone desktop and database applications using Java

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. To understand the elementary programming and object oriented thinking of Java.
2. To develop a java application using three pillars of object oriented programming concepts.
3. To define exceptions and use I/O streams and files in various roles.
4. To develop a java application with generics classes and multithreading concepts.
5. To design desktop based java applications using Java Applet, AWT, Swing and its components.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2		3									
2	3	3	3		3									
3	3	3	3		3									
4	3	3	3		3									
5	3	3	3		3									

UNIT I **6 Hours**

BASICS OF JAVA

The Evolution of Java- Characteristics of Java-Java Environment-Compilation and Execution-Overview of Object Oriented Programming - -Elementary Programming structures in Java- Datatypes, Variables, Arrays, Operators, Control Statements-Classes-Methods-Objects-this-Constructors and Destructors.

UNIT II **6 Hours**

OBJECT ORIENTED PROGRAMMING

Inheritance: Basics - Using Super - Types of Inheritances-Polymorphism- Method overloading and Method overriding-Abstraction- Using Abstract Classes and abstract Methods-Interfaces- Definitions and Implementation-Packages - Access Protection - Importing Packages.

UNIT III **6 Hours**

EXCEPTION AND I/O PROGRAMMING

Exception-Exception Hierarchy-Checked and Unchecked Exception- Exception Handling-Try and Catch-Throw and Throws-custom exceptions-Input/Output Basics-Streams-Byte streams and Character streams-Reading and Writing Files-Serialization-String Handling:Special String operations and Methods-String Buffer and String Builder

UNIT IV **6 Hours**

GENERIC AND CONCURRENT PROGRAMMING

Generics Types - Generic Classes and Methods - Wild Cards and Type Erasure -Restrictions on Generics-Collection Interfaces -Collection Classes-Multithreaded Programming-Thread Model-Creating Threads-Inter Thread Communication. Lambda Expression and Annotations

UNIT V **6 Hours**

EVENT PROGRAMMING

Applet Basics - Applet Architecture - Applet Display Methods - Event Handling Mechanisms - Event Classes - Event Listener - Working with Windows, Graphics, Colours and Fonts - AWT Controls - Introduction to Swing - Swing Components-Layout Managers- JDBC Concepts

FOR FURTHER READING

Java FX vs Swing and AWT, Java FX controls-Java Networking -Java Server faces

1 **3 Hours**

EXPERIMENT 1

Program on Classes and Method

2 **2 Hours**

EXPERIMENT 2

Implementation of Inheritance

3 **3 Hours**

EXPERIMENT 3

Implementation of Interfaces and Packages

4 **3 Hours**

EXPERIMENT 4

Implementation of Exception handling mechanisms

5 **2 Hours**

EXPERIMENT 5

Develop a program to implement String Handling Methods

6 **3 Hours**

EXPERIMENT 6
Implementation of I/O Streams

7 **3 Hours**

EXPERIMENT 7
Implementation of Collections Interfaces and Classes

8 **3 Hours**

EXPERIMENT 8
Implementation of Multithreaded Programming

9 **2 Hours**

EXPERIMENT 9
Implementation of Applet Programs

10 **2 Hours**

EXPERIMENT 10
Write a program to implement Event classes

11 **2 Hours**

EXPERIMENT 11
Implementation of Swing programs and layout managers

12 **2 Hours**

EXPERIMENT 12
Implementation of JDBC concepts

Total: 60 Hours

Reference(s)

1. Herbert Schildt, Java: The Complete Reference, 11th Edition, McGraw Hill Education, 2018.
2. Y Daniel Liang, Introduction to Java Programming, 11thEdition, Pearson Publication, 2018.
3. Deitel and Deitel, Java How to Program,11th edition, Prentice Hall of India, 2020
4. Cay S Horstmann, Gary Cornell, Core Java Volume - I Fundamentals, 11th Edition, Prentice Hall, 2018.
5. Cay S Horstmann, Gary Cornell, Core Java Volume - II Advanced Features, 11th Edition, Prentice Hall, 2018.

20AI307 DATA STRUCTURES LABORATORY 0 0 4 2

Course Objectives

- Implement the operations of linear and non-linear data structures
- Build solutions for real world applications using searching, sorting and hashing techniques

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Implement C++ programs to illustrate linear data structures
2. Implement C++ programs to illustrate non-linear data structures
3. Develop C++ programs to illustrate recursion, searching, sorting and hashing
4. Execute C++ programs using machine learning libraries

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2										2	
2	2	3	3										2	
3	2	3	3										3	
4	2	3	3										3	

1 **2 Hours**

EXPERIMENT 1

Implement Towers of Hanoi puzzle using recursion

2 **4 Hours**

EXPERIMENT 2

Design a singly linked list data structure that performs the following operations efficiently:
i. Create a list
ii. Insert an element to the list
iii. Delete the maximum element from the list
iv. Arrange the list as sorted order
v. Display the elements of the list

3 **6 Hours**

EXPERIMENT 3

Design a doubly linked list data structure that performs the following operations efficiently:
i. Create a list
ii. Insert an element to the list
iii. Delete the maximum element from the list
iv. Arrange the list as sorted order
v. Display the elements of the list

4 **8 Hours**

EXPERIMENT 4

i. Design a web browser application using Stack that performs that following operations:
a. 'Create history' function that stores the URLs of web pages visited
b. 'Go back' function removes the recently visited web page from the Stack
ii. Design a music player using Queue with the following functions:
a. 'Play-Next' function should display the next song in the songs list
b. 'Play-Previous' function should display the previously played songs in the list
c. 'Display' function display all the songs added to the queue in order

5 **4 Hours**

EXPERIMENT 5

Create a binary search tree of characters and perform preorder, inorder and post order Traversals.

6 **6 Hours**

EXPERIMENT 6

Create an expression tree and traverse the expression tree to generate infix, prefix and post expressions.

7 **7 Hours**

EXPERIMENT 7

Implement Prim's algorithm and Kruskal's algorithm to find the Minimum Spanning Tree of a Graph.

8 **4 Hours**

EXPERIMENT 8

Create function templates to search for a key element in a list of elements using Linear search and Binary search.

9 **15 Hours**

EXPERIMENT 9

Write a C program that arranges a list of ATM transactions done by a particular user based on date of transaction using:
a. Insertion sort
b. Selection sort
c. Bubble sort
d. Quick sort
e. Heap sort
f. Merge sort
Analyze the time complexities of each of the above algorithms and identify the best one.

10 **4 Hours**

EXPERIMENT 10

Implement the functions of a Dictionary ADT using hashing techniques

Total: 60 Hours

Reference(s)

1. E.Balagurusamy, "Object Oriented Programming with C++", Seventh Edition, McGraw Hill Education, 2017.
2. Robert Lafore, "Object Oriented Programming in C++", Galgotia Publication, 2010.
3. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, Fourth Edition, Pearson Education, 2014.
4. Michael T. Goodrich, Roberto Tamassia and David M. Mount, Data structures and Algorithms in C++, Second Edition, Wiley India, 2011.
5. Sartaj Sahni, ata Structures, Algorithms, And Applications in C++, Second Edition, Silicon Press, 2004.
6. John Hubbard, Data Structures with C++, First Edition, McGraw Hill Education, 2017.

20AI308 DATABASE MANAGEMENT SYSTEMS LABORATORY

0 0 4 2

Course Objectives

- Understand the DDL, DML, TCL and DCL commands in SQL.
- Understand the design principles of a relational database system and SQL.
- Implement programs using SQL and PL/SQL.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Implement SQL commands like DDL, DML, TCL, and DCL
2. Implement stored procedures, functions, triggers and cursors.
3. Implement database connectivity with front end tools

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3		3								3	
2	2	2	3		3								3	
3	2	2	3		3								3	

1 **4 Hours**

EXPERIMENT 1

Working with SQL commands like DDL, DML, TCL, and DCL

2 **8 Hours**

EXPERIMENT 2

Performing Single- row functions and group functions in SQL.

3 **4 Hours**

EXPERIMENT 3

Execute simple queries using joins and Integrity constraints.

4 **8 Hours**

EXPERIMENT 4

Creation and manipulation of database objects.

5 **4 Hours**

EXPERIMENT 5

Implementation of cursor in PL/SQL block.

6 **8 Hours**

EXPERIMENT 6

Generate trigger in PL/SQL block.

7 **8 Hours**

EXPERIMENT 7

Write PL/SQL block Programs using exception handling.

8 **8 Hours**

EXPERIMENT 8

Design a PL/SQL blocks using subprograms namely functions and procedures

9 **8 Hours**

EXPERIMENT 9

Database Connectivity with Front End Tools

Total: 60 Hours

Reference(s)

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts , McGraw - Hill, 2015
2. Ramez Elmasri and Shamkant B. Navathe, Fundamental Database Systems,Pearson Education, 2008
3. Raghu Ramakrishnan, Database Management System, Tata McGraw-Hill Publishing Company, 2003
4. C.J.Date,An Introduction to Database system, Pearson Education, 2006
5. Peter Rob and Corlos Coronel, Database System, Design, Implementation and Management , Thompson Learning Course Technology, 2003

18GE301 SOFT SKILLS - VERBAL ABILITY 0 0 2 0

Course Objectives

- To help students gain adequate proficiency in vocabulary
- To help students become proficient in basic writing skills related to workplace communication
- To read and understand unabridged text

Programme Outcomes (POs)

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

j. 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.

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

Course Outcomes (COs)

1. Take up verbal ability part of the placement tests with confidence
2. Write with confidence in professional and workplace communication
3. Distinguish fact from opinion by reading passages from a text

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										1				
2											2			
3									2					
4														
5														

UNIT I **15 Hours**

INTRODUCTION

Synonyms - Antonyms - Word Groups - Verbal Analogies - Etymology - Critical Reasoning - Cloze Test - One Word Substitution - Idioms and Phrases - Text & Paragraph Completion.

UNIT II **15 Hours**

BASICS OF VERBAL APTITUDE

Sentence Formation - Paragraph Formation - Change of Voice - Change of Speech - Reading Comprehension - Sentence Equivalence - Jumbled Sentences - Spotting Errors -Homophones Homonyms - Commonly Mispronounced/Misspelt Words.

Total: 30 Hours

Reference(s)

1. Murphy, Raymond. English Grammar in Use a Self-Study Reference and Practice Book for Intermediate Learners of English. IV Edition. United Kingdom: Cambridge University Press. 2012.
2. Lewis, Norman. Word Power Made Easy. New York: Pocket Books. 1991.
3. Baron"s The Official Guide for New GMAT Review, New Jersey: John Wiley & Sons, Inc. 2015.

20AI401 APPLIED LINEAR ALGEBRA 3 1 0 4

Course Objectives

- Understand the basic concepts of Matrices, Eigenvalues, Eigenvectors and their Decomposition techniques to solve the given system.
- Analyze the system of vectors by different vector space and Inner product space techniques.
- Apply the concepts of linear algebra in the field of Artificial Intelligence and Data Science.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.
n. Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Represent characteristics of matrices and determinants with their properties.
2. Analyze the characteristics of a linear system with Eigenvalues and Eigenvectors.
3. Implement the various matrix decomposition techniques to solve the given system.
4. Analyze the linear dependence and compute the basis and dimension of vector spaces.
5. Analyze the systems by Inner product space techniques.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2											3	3
2	1	3											3	3
3		2											3	3
4	1	2											3	3
5	1	2											3	3

UNIT I **9 Hours**

MATRICES

Types of matrices- Matrix operations -Determinants-Orthogonal Matrices-Block Matrices-Rank of a matrix-Solution of Linear system: Matrix inversion method-Rank method-Consistency of system.

UNIT II **9 Hours**

DIAGONALIZATION

Characteristics equation (including Block matrices)-Cayley- Hamilton theorem-Diagonalization-Algebraic and Geometric Multiplicity-Minimal polynomial (including Block matrices)-Characteristic and minimal polynomial of Block Matrices-Iterative method: Eigenvalues and Eigen vectors by power method.

UNIT III **9 Hours**

MATRIX DECOMPOSITIONS

Nature of Matrices-Echelon matrices-Row canonical form-Gauss elimination method-Gauss Jordan method-Single value decomposition -LU decomposition.

UNIT IV **9 Hours**

VECTOR SPACES

Vector spaces-subspaces-Linear combinations-Spanning sets-Linear dependence and independence -Basis and Dimensions -Rank and nullity.

UNIT V **9 Hours**

INNER PRODUCT SPACES

Inner product spaces-Vector norms -Cauchy -Schwarz inequality -Orthogonality-Gram -Schmidt orthogonalization -QR decomposition.

FOR FURTHER READING

Eigenvalues, Eigenvectors, Matrix Operation using MATLAB/Any Programming language of your choice.

Total: 60 Hours

Reference(s)

1. Kreyszig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley, 1993.
2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publication, 2017.
3. Lloyd N. Trefethen, David Bau III, Numerical Linear Algebra,Society for Industrial and Applied Mathematics, 1997.
4. James W. Demmel, Applied Numerical Linear Algebra, The Orient Blackswan, 1st Edition, 2017.
5. Gilbert Strang, Introduction to linear algebra, Fifth Edition, ANE Books, 2016.

20AI402 DESIGN AND ANALYSIS OF ALGORITHMS 3 0 0 3

Course Objectives

- Identify the various algorithm design techniques.
- Impart knowledge on runtime analysis of algorithms.
- Empathize the limits of computation.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.

Course Outcomes (COs)

1. Analyze the algorithm efficiency by means of mathematical notations.
2. Analyze the different sorting algorithms using algorithm design techniques.
3. Analyze the different techniques in the design of Graph algorithms.
4. Analyze the various backtracking and branch and bound algorithms.
5. Differentiate algorithms design techniques of NP complete with NP hard problem.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2											
2	3	3	3											
3	3	3	3											
4	3	3	2											
5	3	3	3											

UNIT I **9 Hours**

FUNDAMENTALS OF THE ANALYSIS OF ALGORITHM EFFICIENCY

Analysis Framework - Asymptotic notations - Basic Efficiency classes - Mathematical Analysis of Non-recursive Algorithm - Mathematical Analysis of Recursive Algorithm - Example: Fibonacci Numbers - Empirical Analysis of Algorithms

UNIT II **8 Hours**

BRUTE FORCE AND DIVIDE AND CONQUER STRATEGIES

Brute Force Strategy: Selection Sort and Bubble Sort, Sequential Search and Brute-force string matching - Divide and conquer: Presorting, Balanced Search trees AVL Trees, Heaps and Heap sort.

UNIT III **10 Hours**

GREEDY STRATEGIES AND DYNAMIC PROGRAMMING

Greedy Technique: Prims Algorithm, Kruskals Algorithm, Dijkstra Algorithm, Huffman trees-The simplex method, The stable marriage problem- Dynamic Programming: All pairs shortest path, optimal binary Search tree, Warshalls and Floyd Algorithm, multistage graphs, Knapsack problem.

UNIT IV **9 Hours**

BACKTRACKING AND BRANCH AND BOUND

Backtracking: Solution space and tree organization, N - queens problem, Sum of subset problem, Graph coloring, Knapsack problem-Branch and Bound: 0/1 Knapsack problem, Traveling salesman problem, Assignment problem, Least Cost branch and bound.

UNIT V **9 Hours**

ALGORITHM DESIGN TECHNIQUES TO NP COMPLETE AND NP HARD PROBLEMS

NP Complete problems backtracking: n-Queens Problem, Hamiltonian Circuit problem, Subset-Sum problem, Branch and bound: Assignment problem, Knapsack problem, Traveling salesman problem- Approximation algorithms for NP hard problems: Travelling salesman and knapsack problem

FOR FURTHER READING

Sets and Dictionaries- Algorithm visualization- Exhaustive search- Knapsack problem and memory functions- Decision trees

Total: 45 Hours

Reference(s)

1. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education Asia, 2011
2. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, Introduction to Algorithms, PHI Pvt. Ltd., 2009
3. Sara Baase and Allen Van Gelder, Computer Algorithms Introduction to Design and Analysis, Pearson Education Asia, 2010
4. A.V.Aho, J.E. Hopcroft and J.D.Ullman, The Design and Analysis of Computer Algorithms, Pearson Education Asia, 2003

20AI403 DATA WAREHOUSING AND DATA MINING 2 0 2 3

Course Objectives

- Gather and analyze large sets of data to gain useful business understanding
- Understand the data mining functionalities, technologies and steps in preprocessing the data
- Learn data mining algorithms, methods and tools

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Design data warehouse by applying principles of dimensional modelling and ETL concepts
2. Analyze various data pre-processing techniques for efficient data mining.
3. Apply association rule mining for finding hidden and interesting patterns in data.
4. Apply statistical procedure, machine learning and neural network based classification algorithms for data prediction
5. Apply clustering algorithms for the application and generalizations for real time problems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2											2	
2	3	3	2	2	1								3	
3	3	3	2										3	
4	3	3	3	2	1								3	
5	3	3	3	2	1								3	

UNIT I **9 Hours**

DATA WAREHOUSE FUNDAMENTALS

Introduction, OLTP Systems, Characteristics & Functions of Data Warehouses, Advantages and Applications of Data Warehouse, Top- Down and Bottom-Up Development Methodology, Tools for Data warehouse development, Multidimensional Data Model, Data Warehouse architecture, ETL Overview, ETL Requirements and Steps, ETL Tools.

UNIT II **9 Hours**

DATA MINING AND DATA PREPROCESSING

Types of Data , Data Mining Functionalities , Interestingness of Patterns, Classification of Data Mining Systems , Data Mining Task Primitives , Integration of a Data Mining System with a Data Warehouse,Descriptive Data Summarization,Data Preprocessing Overview, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation.

UNIT III **9 Hours**

ASSOCIATION RULE MINING

Frequent Itemsets, Closed Itemsets, and Association Rules, Frequent Pattern Mining, The Apriori Algorithm, Generating Association Rules from Frequent Itemsets, Mining Frequent Itemsets without Candidate Generation, Mining Frequent Itemsets Using Vertical Data Format, Mining Closed Frequent Itemsets.

UNIT IV **9 Hours**

CLASSIFICATION

Classification: Basic Concepts, General approach to solve classification problem, Decision Trees Induction, Rule Based Classifiers, Nearest Neighbor Classifiers, Bayesian Classifiers, Estimating Predictive accuracy of classification methods, improving accuracy of classification methods, Evaluation criteria for classification methods.

UNIT V **9 Hours**

CLUSTER ANALYSIS

Overview, Features of cluster analysis, Data similarity and dissimilarity measures, Types of cluster analysis methods, Partitioning Methods: K-Means and K-Medoids, Hierarchical Methods: Agglomerative and Divisive Hierarchical Clustering, Outlier Analysis: Statistical Distribution-Based Outlier Detection, Distance-Based Outlier Detection.

1 **3 Hours**

EXPERIMENT 1

An member club data warehouse application online has most member clubs, members earn points through activities such as purchases, subscriptions, and consumptions of services. Members can use points in lieu of money towards these activities. Assume that there are 1 million members and 100,000 unique web pages. Draw the star and snowflake schema for the member club data warehouse.

2 **2 Hours**

EXPERIMENT 2

For example, let’s say there are following numbers 99, 19, 2, 44, 51, 44, 56, 78, 44, 99, 86.
Perform statistical operations such as mean, median, mode and variance on the numbers.

3 **1 Hour**

EXPERIMENT 3

Perform data cleaning operations on the text Welcome To Artificial Intelligence written in four different ways (with different spacing between the words).

4 **3 Hours**

EXPERIMENT 4

A Decision Tree can operate on both categorical and numerical data. For a dataset with Outlook, Temperature, Humidity and Windy Predictor variables and Play Golf as the class variable, compute the frequency table for the above decision tree.

5 **3 Hours**

EXPERIMENT 5

Generate a candidate set of 1 , 2 and 3-itemsets with minimum support count on AllElectronics transaction database, D. Assume there are nine transactions in the database, that is, |D|=9.

6 **3 Hours**

EXPERIMENT 6

Cluster the following eight points (with (x, y) representing locations) :
A1(2, 10), A2(2, 5), A3(8, 4), A4(5, 8), A5(7, 5), A6(6, 4), A7(1, 2), A8(4, 9)
Initial cluster centers are: A1(2, 10), A4(5, 8) and A7(1, 2).
The distance function between two points a = (x1, y1) and b = (x2, y2) is defined as P(a, b)=|x2-x1|plus|y2-y1|
Compute the distance table which shows the Point belongs to Cluster for the given points :
A1(2, 10), A2(2, 5), A3(8, 4), A4(5, 8), A5(7, 5), A6(6, 4), A7(1, 2), A8(4, 9) with Clusters (2, 10), (5, 8) and (1,2).

Total: 60 Hours

Reference(s)

1. Jiawei Han, Micheline Kamber and Jian Pei, Data Mining Concepts and Techniques,Third Edition, Elsevier, 2012.
2. Paulraj Ponniah, Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals, Wiley, 2010.
3. Alex Berson, Stephen J Smith, Data warehousing, Data mining, and OLAP, Tata McGraw Hill edition, 2007.
4. Pang-Ning Tan, Michael Steinbach and Vipin Kumar,Introduction to Data Mining, Pearson Education, 2007.
5. G. K. Gupta ,Introduction to Data Mining with Case Studies, Easter Economy Edition, Prentice Hall of India, 2006.

20AI404 COMPUTER NETWORKS 3 0 0 3

Course Objectives

- Understand the principles and standards of networking and communication
- Cognize the different layer of networks and interpret the functionalities and protocols used in each layer of TCP/IP protocol suite
- Gain knowledge in the trends and application of networks.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.

Course Outcomes (COs)

1. Examines the data communications and defines their components, the types of data exchanged, their standards.
2. Summarize the services provided by the data-link layer, its addressing mechanisms and help the delivery of data frame in the network layer.
3. Identify the network services, the routing protocols and apply the suitable addressing for their network.
4. Apply the necessary transport protocol based on the flow and error control services needed for their network.
5. Demonstrate how application programs use the services of all the layers in their network.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	3	2	2	2										
3	3	2	2	2										
4	3	2	2	2										
5	3	2	2											

UNIT I **9 Hours**

DATA COMMUNICATIONS

Introduction: Data Communications, Networks, Network Types, Protocol Layering, TCP/IP Protocol Suite, OSI Model - Physical Layer: Data and Signals-Digital and Analog Signals-Multiplexing-Spread Spectrum-Transmission Media-Guided and unguided media-Switching

UNIT II **9 Hours**

DATA LINK LAYER

Introduction to Data Link Layer: Link Layer Addressing - Error Detection and Correction: Block Coding, Cyclic Codes, Checksum, Forward Error Correction - Data Link Control: DLC services, Data-Link Layer Protocols, HDLC, Point-to-Point Protocol - Media Access Control: Random Access and Controlled Access - Ethernet: IEEE 802.3 - IEEE 802.11.

UNIT III **9 Hours**

NETWORK LAYER

Network Layer Services - Packet Switching - IPV4 Addresses - Forwarding of IP Packets - Network Layer Protocols: IP, ICMPv4, Mobile IP - Routing Algorithms- Unicast Routing Protocols-Multicast Routing protocols - Next Generation IP: IPv6 Addressing, IPv6 Protocol.

UNIT IV **9 Hours**

TRANSPORT LAYER

Introduction to Transport Layer: Simple Protocol, Stop-and-Wait Protocol, Go-Back-N Protocol, Selective-Repeat Protocol, Bidirectional Protocols: Piggybacking - User Datagram Protocol - Transmission Control Protocol - Congestion Control.

UNIT V **9 Hours**

APPLICATION LAYER

Client Server Programming - WWW - FTP - Electronic Mail - Telnet - SSH - DNS - SNMP - DHCP - MQTT - IMAP - TLS/SSL-IP Security.

FOR FURTHER READING

WiMAX-Peer to Peer Networking-Internet Security

Total: 45 Hours

Reference(s)

1. Behrouz A. Forouzan, Data Communication and Networking, Fifth Edition, McGraw Hill Education (India) Private Limited, 2013.
2. William Stallings, Data and Computer Communications, Tenth Edition, Prentice Hall, 2014.
3. Andrew S Tanenbaum and David J Wetherall, Computer Networks, Fifth Edition, Pearson Education, 2011.
4. Larry L Peterson and Bruce S Davie, Computer Networks: A Systems Approach, Fifth Edition, Elsevier, 2011.
5. James F Kurose and Keith W Ross, Computer Networking: A Top-Down Approach Featuring the Internet, Sixth Edition, Addison-Wesley, 2013.

20AI405 ARTIFICIAL INTELLIGENCE 3 0 0 3

Course Objectives

- To impart knowledge about Artificial Intelligence.
- To give understanding of the main abstractions and reasoning for intelligent systems.
- To enable the students to understand the basic principles of Artificial Intelligence in various applications

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Compare AI with human intelligence and traditional information processing, and discuss its strengths and limitations and its application to complex and human-centered problems
2. Analyze the structures and algorithms selection in Artificial Intelligence techniques related to knowledge representation and reasoning.
3. Analyze the search strategies and its types
4. Apply and evaluate intelligent agents to given real time dataset
5. Understand the structures of Learning concepts and use of PROLOG in AI.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2											3	
2	3	2	2										3	
3	3	3	3	2									3	
4	3	3	2	1									3	
5	3	3	3	2									3	

UNIT I **9 Hours**

INTRODUCTION TO AI

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 **9 Hours**

INTELLIGENT AGENTS

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 **9 Hours**

PROBLEM-SOLVING

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 **9 Hours**

KNOWLEDGE AND REASONING

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 **9 Hours**

ADVERSARIAL SEARCH AND GAMES

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.

FOR FURTHER READING

Text Classification - Information Retrieval, Natural Language Processing

Total: 45 Hours

Reference(s)

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
3. David L. Poole and Alan K. Mackworth, Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010.
4. Deepak Khemani, Artificial Intelligence, Tata McGraw Hill Education 2013
5. Mishra R B, Artificial Intelligence, PHI Learning Pvt. Ltd., New Delhi, 2013.

20AI406 STATISTICAL MACHINE LEARNING 3 0 0 3

Course Objectives

- To understand the concepts of Machine Learning.
- To appreciate supervised learning and their applications.
- To appreciate the concepts and algorithms of unsupervised learning.
- To understand the basic concept of reinforcement learning algorithm and its applications.
- To study about modelling, aggregation and knowledge representation using graphical models.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.
n. Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Identify applications suitable for different types of Machine Learning with suitable justification.
2. Implement supervised Learning algorithms for real time data sets for intelligent decision making.
3. Apply Machine Learning techniques to classification and clustering to unstructured data.
4. Apply reinforcement learning techniques for real life problems
5. Implement probabilistic discriminate and generative algorithms for an applications of your choice and analyze the results.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2										3	
2	3	3	3	3	2								3	2
3	3	3	3	3	2								3	
4	3	3	3	3	2								3	
5	3	3	3	3	2								3	2

UNIT I **9 Hours**

INTRODUCTION TO MACHINE LEARNING

Machine Learning - Machine Learning Foundations - Overview - applications - Types of machine learning - basic concepts in machine learning Examples of Machine Learning -Applications - Linear Models for Regression - Linear Basis Function Models - The Bias-Variance Decomposition - Bayesian Linear Regression - Bayesian Model Comparison

UNIT II **9 Hours**

SUPERVISED LEARNING

Linear Models for Classification - Discriminant Functions -Probabilistic Generative Models - Probabilistic Discriminative Models - Bayesian Logistic Regression. Decision Trees - Classification Trees- Regression Trees - Pruning. Ensemble methods- Bagging- Boosting.

UNIT III **9 Hours**

UNSUPERVISED LEARNING

Clustering- K-means - EM - Mixtures of Gaussians - The EM Algorithm in General -Model selection for latent variable models - high-dimensional spaces - The Curse of Dimensionality -Dimensionality Reduction - Factor analysis - Principal Component Analysis - Probabilistic PCA- Independent components analysis

UNIT IV **9 Hours**

REINFORCEMENT LEARNING

Passive reinforcement learning- direct utility estimation- adaptive dynamic programming- temporal difference learning- active reinforcement learning- exploration- learning an action-utility function- Generalization in reinforcement learning- policy search- applications in game playing- applications in robot control

UNIT V **9 Hours**

PROBABILISTIC GRAPHICAL MODELS

Graphical Models-Undirected Graphical Models-Markov Random Fields-Directed Graphical Models-Bayesian Networks-Conditional Independence properties-Markov Random Fields-Hidden Markov Models-Conditional Random Fields (CRFs).

FOR FURTHER READING

Dimensionality Reduction - Linear Discriminant Analysis - Principal Component Analysis - Factor Analysis - Independent Component Analysis - Locally Linear Embedding - Isomap - Least Squares Optimization - Evolutionary Learning - Genetic algorithms - Genetic Offspring

Total: 45 Hours

Reference(s)

1. Kevin P. Murphy, Machine Learning : A Probabilistic Perspective, MIT Press, 2012
2. Stephen Marsland, Machine Learning- An Algorithmic Perspective, Chapman and Hall, CRC Press, Second Edition, 2014.
3. EthemAlpaydin, Introduction to Machine Learning, MIT Press, Third Edition, 2014.
4. Christopher Bishop, Pattern Recognition and Machine Learning Springer, 2007.
5. P. Flach, Machine Learning: The art and science of algorithms that make sense of data, Cambridge University Press, 2012.

20AI407 ARTIFICIAL INTELLIGENCE LABORATORY

0 0 4 2

Course Objectives

- To provide skills for designing and analyzing AI based algorithms.
- To enable students to work on various AI tools.
- To provide skills to work towards solution of real life problems.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Analyze and specify software requirements.
2. Apply search techniques and knowledge representation schemes.
3. Apply AI techniques to solve real world problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	2	2								3	
2	3	3	3	2									3	
3	3	3	3	2	2								3	

1 **6 Hours**

EXPERIMENT 1

Installation and working on various AI tools viz Scikit Learn, Tensorflow, Keras, CNTK

2 **6 Hours**

EXPERIMENT 2

Data pre-processing and annotation and creation of datasets.

3 **4 Hours**

EXPERIMENT 3

Implementation of Breadth First searching techniques.

4 **4 Hours**

EXPERIMENT 4

Implementation of Depth First searching techniques.

5 **4 Hours**

EXPERIMENT 5

Implementation of Hill climbing algorithm

6 **4 Hours**

EXPERIMENT 6

Implementation of A* Algorithm

7 **8 Hours**

EXPERIMENT 7

Designing a Chat bot application.

8 **4 Hours**

EXPERIMENT 8

Implementation of Knowledge base system

9 **4 Hours**

EXPERIMENT 9

Implementation of Inference system.

10 **4 Hours**

EXPERIMENT 10

Write a program to solve 4-Queen problem.

11 **4 Hours**

EXPERIMENT 11

Write a program to solve traveling salesman problem.

12 **4 Hours**

EXPERIMENT 12

Implementation of Tic-Tac-Toe game

13 **4 Hours**

EXPERIMENT 13

Implementation of snake game in python

Total: 60 Hours

Reference(s)

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
3. EthemAlpaydin, Introduction to Machine Learning, MIT Press, Third Edition, 2014.
4. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
5. P. Flach, Machine Learning the art and science of algorithms that make sense of dat, Cambridge University Press, 2012.
6. Stephen Marsland, Artificial Intelligence, Chapman and Hall, CRC Press, Second Edition, 2014.

20AI408 STATISTICAL MACHINE LEARNING LABORATORY

0 0 4 2

Course Objectives

- To understand the concepts of Machine Learning.
- To implement supervised learning and their applications.
- To implement the concepts and algorithms of unsupervised learning.
- To practice modelling, aggregation and knowledge representation using graphical models.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Implement supervised Learning algorithms for real time data sets for intelligent decision making.
2. Apply Machine Learning techniques to classification and clustering to unstructured data.
3. Apply reinforcement learning techniques for real life problems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	2	2								3	
2	3	3	3	2	2								3	
3	3	3	3	2	2								3	

1 **6 Hours**

EXPERIMENT 1

Load Real Time data Set and Python Libraries, Installing Libraries through Anaconda Prompt, Perform data pre-processing through Pandas Library.

2 **6 Hours**

EXPERIMENT 2

Implement the Naive Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets

3 **6 Hours**

EXPERIMENT 3

Implement decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

4 **6 Hours**

EXPERIMENT 4

Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

5 **6 Hours**

EXPERIMENT 5

Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering

6 **6 Hours**

EXPERIMENT 6

Implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem

7 **6 Hours**

EXPERIMENT 7

Assuming a set of documents that need to be classified, use the Semi Supervised Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

8 **6 Hours**

EXPERIMENT 8

Implement Q Learning with Linear Function Approximation.

9 **6 Hours**

EXPERIMENT 9

Implement the Policy Gradient concept in Reinforcement learning. Compare the Reinforce with Baseline with Actor Critic with Baseline.

10 **6 Hours**

EXPERIMENT 10

Consider a time series data set. Plot the data, identify the components of the Time Series data, Calculate the seasonality and stationarity and identify the trend patter present in the time series data. Remove the white noise if available in the time series data.

Total: 60 Hours

Reference(s)

1. Kevin P. Murphy, Machine Learning : A Probabilistic Perspective, MIT Press, 2012
2. Stephen Marsland, Machine Learning - An Algorithmic Perspective, Chapman and Hall, CRC Press, Second Edition, 2014.
3. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, Third Edition, 2014.
4. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
5. P. Flach, Machine Learning: The art and science of algorithms that make sense of data, Cambridge University Press, 2012.

18HS001 ENVIRONMENTAL SCIENCE 2 0 0 0

Course Objectives

- Understand the interdisciplinary and holistic nature of the environment
- Identify the significance of natural resources and environment on the quality of life and stimulate the quest for sustainable development
- Assess the socio-economic, political and ethical issues in environmental science

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
g. 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.

Course Outcomes (COs)

1. Explain the importance of interdisciplinary nature of environment studies, uses and exploitation of natural resources
2. Analyze the different types of ecosystems and biodiversity, its values and also role of professionals in protecting the environment from degradation
3. Identify the existing environmental challenges related to pollution and its management
4. Select suitable strategies for sustainable management of components of environmental science
5. Correlate the impacts of population and human activities on environment

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2					3							
2	1	1					3							
3	2	2					3							
4	1						3							
5	2						3							

UNIT I **6 Hours**

NATURAL RESOURCES

Forest resources: Use - over exploitation - deforestation - case studies. Water resources: Use - over utilization of surface and ground water - conflicts over water. Mineral resources: Use - exploitation - environmental effects of extracting and using mineral resources - case studies. Food resources: Effects of modern agriculture - fertilizer-pesticide problems (eutrophication, blue baby syndrome, biomagnification). Energy resources: renewable (solar, wind, and hydro).

UNIT II **6 Hours**

ECOSYSTEMS AND BIODIVERSITY

Concept of an ecosystem: Structure and function of an ecosystem - producers - consumers - decomposers - food chains - food webs and ecological pyramids - Types of ecosystem: Introduction - characteristic features: desert ecosystem. Biodiversity - value of biodiversity - threats to biodiversity - endangered and endemic species - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT III **6 Hours**

ENVIRONMENTAL POLLUTION

Pollution: Definition - causes - effects - control measures of air pollution - water pollution: (Sewage water treatment by activated sludge and trickling filter process) - noise pollution- thermal pollution. Disaster management: causes - effects - control measures of floods and earthquake

UNIT IV **7 Hours**

SOCIAL ISSUES AND ENVIRONMENT

Sustainable development: Definition - Unsustainable to sustainable development - solid waste management - causes - effects - 5R Principles (landfills, incineration, composting). Water conservation - rain water harvesting - watershed management. Climate change - global warming - acid rain - ozone layer depletion. E-waste.

UNIT V **5 Hours**

HUMAN POPULATION AND ENVIRONMENT

Human population: Population growth - characteristics - variation among nations - population explosion - value education - HIV / AIDS. Role of information technology in environment and human health - occupational safety and health administration (OSHA)

FOR FURTHER READING

Human rights: Biomedical waste -Identification of adulterants in food materials

Total: 30 Hours

Reference(s)

1. Anubha Kaushik, C.P. Kaushik, Environmental Science and Engineering , 4th Multi Colour Edtion, New Age International Publishers, New Delhi, 2014
2. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons
3. T. G. Jr. Miller, S. Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi, 2014
4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press
5. A. K. De, Environmental Chemistry, 7th Edition , New age international publishers, New Delhi, 2014

18GE401 SOFT SKILLS - BUSINESS ENGLISH 0 0 2 0

Course Objectives

- To acquire command of both the receptive skills (Listening, Reading) and the productive skills (Writing and Speaking) of English language
- To understand and make effective use of English language in business contexts

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. 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.
l. 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.

Course Outcomes (COs)

1. Listen, Read, Speak, and Write Business English at the level of independent users
2. Appear for the Business English Certificate (BEC) Vantage level examination conducted by the Cambridge Assessment English

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1				2			2		2		2		
2	1				1					2		2		

UNIT I **15 Hours**

LISTENING AND READING

Listening for writing short answers - filling gaps in sentences - identifying topic, context and function - identify different functions of language in business situations - identify prompts -identify paraphrases of required information Scanning - reading for gist - understanding sentence structure - error identification - identify paraphrases - cohesive words and phrases - understand the importance of analysing the distractors - identify grammatical and semantic relationships

UNIT II **15 Hours**

WRITING AND SPEAKING

Business emails - notes - memos to colleagues or friends - giving instructions - explaining a development - asking for comments - requesting information - agreeing to requests - explaining - apologising reassuring - complaining - describing - summarising - recommending – persuading turn - taking - sustaining interaction - initiating - responding - giving personal information - talking about present circumstances, past experiences and future plans - expressing opinion - speculating - organising a larger unit of discourse - giving information - expressing and justifying opinions - speculating - comparing and contrasting - agreeing and disagreeing

1 **15 Hours**

LISTENING AND READING

Listening for writing short answers - filling gaps in sentences - identifying topic, context and function - identify different functions of language in business situations - identify prompts -identify paraphrases of required information - Scanning - reading for gist - understanding sentence structure - error identification - identify paraphrases - cohesive words and phrases - understand the importance of analysing the distractors - identify grammatical and semantic relationships

2 **15 Hours**

WRITING AND SPEAKING

Business emails - notes - memos to colleagues or friends - giving instructions - explaining a development - asking for comments - requesting information - agreeing to requests - explaining - apologising - reassuring - complaining - describing - summarising - recommending - persuading turn - taking - sustaining interaction - initiating - responding - giving personal information - talking about present circumstances, past experiences and future plans - expressing opinion - speculating - organising a larger unit of discourse - giving information - expressing and justifying opinions - speculating - comparing and contrasting - agreeing and disagreeing

Total: 60 Hours

Reference(s)

1. Whitehead, Russell and Michael Black. Pass Cambridge BEC Vantage Self - study Practice Tests with Key, Heinle - a part of Cengage Learning, Delhi, 2003.

20AI501 SOFTWARE ENGINEERING AND TESTING METHODOLOGIES 3 0 0 3

Course Objectives

- Understand the phases in a software project.
- Analyze and design software systems for any given specification.
- Apply basic software quality assurance practices to ensure the software design and development meets or exceeds applicable standards.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Modern tool usage**:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
i. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
k. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Analyze and identify a suitable software development life cycle model for an application.
2. Develop software requirements specification and cost estimation for an application.
3. Analyze the software design concepts and principles to develop high quality software.
4. Characterize various software testing methodologies and analyze the given software requirements to determine appropriate testing techniques in commercial software environments.
5. Obtain adequate knowledge about software process models, software effort estimation techniques and risk management principles.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2											
2	2	2	2						2					
3	3	2	3		2				2					
4	3	2	3		2				2					
5	3	2	3		2				2		3			

UNIT I **9 Hours**

SOFTWARE PROCESS MODELS

Software Engineering Paradigm - Verification - Validation - Software Process Models: Waterfall model, Incremental model, Spiral model, WIN WIN Spiral model, Evolutionary Process Models, Prototyping model, Concurrent model, unified model - Agile process models

UNIT II **10 Hours**

REQUIREMENTS ANALYSIS AND SPECIFICATION

Requirements Analysis- Software Requirements: Functional and Non-Functional, User requirements, System requirements - Requirements Elicitation - Validation and management - Software prototyping - Rapid prototyping techniques - Analysis and modeling - Data, functional and behavioral models - Metrics in the Process and Project Domains - Software Measurements - Metrics for Software Quality - Software Project Estimation - Decomposition Techniques

UNIT III **8 Hours**

SOFTWARE DESIGN

Design Concepts - Modular design - Design heuristic - Design model and document - Architectural design - Software architecture - Data design - Transform and transaction mapping - User interface design - Component level Design: Designing Class based components, traditional Components-Introduction to Design Patterns

UNIT IV **9 Hours**

SOFTWARE TESTING METHODOLOGIES & AUTOMATION

Software testing fundamentals - Internal and external views of Testing - White box testing - Basis path testing - Control structure testing - Black box testing - Regression Testing - Unit Testing - Static testing vs Structural testing – Code functional testing - Integration Testing - Validation Testing - Acceptance testing – Performance testing – Regression Testing – Ad-hoc testing – Alpha, Beta Tests – Usability and Accessibility testing - Software Test Automation

UNIT V **9 Hours**

PROJECT MANAGEMENT

Software Project Management: Estimation - LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model - Project Scheduling, Earned Value Analysis Planning - Project Plan, Planning Process - Risk Management-Risk Identification- Fundamentals of Agile: Agile Manifesto and Principles, Overview of Scrum, Extreme programming, Introduction to Kanban, Introduction to Agile Ceremonies and Sizing Techniques

Total: 45 Hours

Reference(s)

1. Sommerville, Software Engineering, 10th edition, Addison Wesley, 2016
2. Roger S Pressman, Software Engineering: A Practitioner Approach, Tata McGraw Hill, Eighth Edition, 2015.
3. James S Peters, Witold Pedrycz, Software Engineering an Engineering Approach, Wiley India Edition, 2011
4. Richard Fairley, Software Engineering Concepts, Tata McGraw Hill, 2008
5. Aditya P. Mathur, ―Foundations of Software Testing - Fundamental Algorithms and Techniques, Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008.

20AI502 DEEP LEARNING 3 1 0 4

Course Objectives

- Understand the fundamental concepts of deep learning mechanisms to various learning problems.
- To present the mathematical, statistical and computational challenges of building neural networks.
- Enable the students to know deep learning techniques to support real time applications.

Program Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Modern tool usage**:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Understand the fundamental techniques and principles of Neural Networks.
2. Understand the Feed Forward and Back Forward Propagation algorithms
3. Implement the Convolutional Neural Network to recognize and classify the image.
4. Understand the deep learning architecture to model the data.
5. Apply the deep learning techniques for solving real-life problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	2	2								3	
2	3	2	3	2	3								3	
3	3	3	3	3	3								3	
4	3	3	3	3	3								3	
5	3	3	3	2	3								3	

UNIT I **9 Hours**

NEURAL NETWORKS

Basic concept of Neurons - Perceptron neural networks - Feed Forward and Back Propagation Networks- Activation Function (Sigmoid, Tanh, ReLu, Leaky ReLu)

UNIT II **9 Hours**

INTRODUCTION TO DEEP LEARNING

Feed Forward Neural Networks – Gradient Descent – Back Propagation Algorithm – Vanishing Gradient problem – Mitigation – RelU Heuristics for Avoiding Bad Local Minima – Heuristics for Faster Training – Nestors Accelerated Gradient Descent – Regularization – Dropout.

UNIT III **9 Hours**

CONVOLUTIONAL NEURAL NETWORKS (CNN)

CNN Architecture - CNN Layers: Convolution – ReLu – Pooling – Fully Connected – Filters – Convolution Functions – Efficient convolution algorithms – Unsupervised features - Image Classification using Transfer Learning.

UNIT IV **9 Hours**

MORE DEEP LEARNING ARCHITECTURES

Long Short-Term Memory (LSTM), Gated Recurrent Units (GRU), Encoder/Decoder Architectures – Autoencoders – Standard- Sparse – Denoising – Contractive- Variational Autoencoders – Generative adversarial networks. – Autoencoder and DBM.

UNIT V **9 Hours**

APPLICATIONS OF DEEP LEARNING

Image Segmentation – Object Detection – Automatic Image Captioning – Image generation with Generative Adversarial Networks – Video to Text with LSTM Models – Attention Models for Computer Vision – Case Study: Named Entity Recognition

Total: 60 Hours

Reference(s)

1. Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.
2. Josh Patterson and Adam Gibson, “Deep learning: A practitioner's approach”, O'Reilly Media, First Edition, 2017
3. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018.
4. Simon Haykin, “Neural Networks and Learning Machines”, 3rd Edition, Pearson Prentice Hall.
5. Phil Kim, “Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence”, Apress, 2017.
6. Ragav Venkatesan, Baoxin Li, “Convolutional Neural Networks in Visual Computing”, CRC Press, 2018.
7. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018.
8. Chao Pan, “Deep Learning Fundamentals: An Introduction for Beginners”, AI Sciences LLC, 2018.

20AI503 ANALYTICS IN CLOUD COMPUTING 3 0 0 3

Course Objectives

- Understand the protocols and mechanisms necessary to support cloud computing.
- Understand the architecture and features of different cloud models.
- Analyze the basic concepts of virtualization technology to derive the best practice model for deploying cloud-based applications.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

e. Modern tool usage**:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

n. Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information

Course Outcomes (COs)

1. Understand the different types of cloud models and services for building an efficient cloud computing environment.
2. Design and develop highly scalable cloud-based applications by creating and configuring virtual machines on the cloud.
3. Analyze the key concepts of cloud storage for load balancing in cloud architecture.
4. Understand the concept web services in cloud applications.
5. Explore the cloud security concerns and examine the risks involved in cloud security.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1											
2	3	2	2	2	2								2	
3	3	2	2	2	3								2	
4	3	2	2	2	3								3	3
5	3	2	2	2	3								2	3

UNIT I **9 Hours**

INTRODUCTION TO CLOUD COMPUTING

Defining Cloud Computing-Cloud Types: The NIST Model-The Cloud Cube Model -Deployment Models-Service Models-Essential Characteristics of Cloud Computing-Benefits of Cloud Computing-Measuring the Cloud's Value: Measuring Cloud Computing Costs

UNIT II **9 Hours**

CLOUD ENABLING TECHNOLOGIES

Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices – Virtualization Support and Disaster Recovery.

UNIT III **9 Hours**

CLOUD ARCHITECTURE, SERVICES AND STORAGE

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers

UNIT IV **9 Hours**

ANALYTICS IN CLOUD APPLICATIONS AND WEB SERVICES

Introduction to Cloud Simulator, understanding CloudSim simulator, CloudSim Architecture (User code, CloudSim, GridSim, SimJava) Understanding Working platform for CloudSim, Introduction to GreenCloud -Cloud APIs-Working with Cloud- Cloud Computing Web Services: Google Web service - Surveying the Google application portfolio -Google toolkit -Amazon web services - Components and services - Microsoft cloud services –Windows azure platform - Microsoft Azure Fundamentals: Introduction to Azure-Different segments SaaS, PaaS, and IaaS

UNIT V **9 Hours**

ANALYTICS IN CLOUD SECURITY

Cloud Information Security Objectives-Cloud Security Services-Cloud Security Design Principles-Secure Cloud Software Requirements: Secure Development Practices-Approaches to Cloud Secure Software Requirements Engineering-Cloud Computing and Business Continuity Planning/Disaster Recovery – Cloud Analytics tool and its benefits - Case study with cloud analytics tools using IBM Cognos Analytics or Microsoft Power BI or Zoho Analytics.

FOR FURTHER READING

Cloud evolution- Data center requirements- vmware virtualization- Google Infrastructure- Google Cloud Security, Case study on Amazon, Google and IBM cloud services

Total: 45 Hours

Reference(s)

1. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009., CRC Press, 2017
2. Rittinghouse, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security, CRC Press, 2017.
3. Barrie Sosinsky, Cloud Computing Bible, Wiley-India, 2014.
4. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, ―Mastering Cloud Computing, Tata Mcgraw Hill, 2013.

20AI504 PROGRAMMING FOR DATA SCIENCE 3 0 0 3

Course Objectives

- Understand the R Programming Language.
- Exposure on Solving Data science problems.
- Understand the statistical functions in R.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
l. 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.
n. Ability to identify and use analytic skills for massive datasets to extract insights by applying suitable Data analytic tools and techniques.

Course Outcomes (COs)

1. Install and use R for simple programming tasks.
2. Extend the functionality of R by using add-on packages.
3. Conduct exploratory data analysis using R.
4. Create insightful visualizations to identify patterns from data.
5. Apply statistical estimates to make meaningful predictions from data. Code statistical functions in R.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3		3									3
2	3	3	2		3									3
3	2	3	3		3									3
4	3	3	3	2	3							2		3
5	3	3	3	2	3							3		3

UNIT I **9 Hours**

INTRODUCTION TO R

Installing R and RStudio, RStudio Overview, setting up working directory, working in the Console, Arithmetic Operators, Logical Operations, control structures, Loops, Functions, R Objects, Numbers and Attributes.

UNITII **9 Hours**

R DATA STRUCTURES

Creating Variables, Numeric, Character and Logical Data, Vectors, Lists, Matrices, Arrays, Factors, Data Frames, Special Values, Loop functions, Strings, Operations on Dates and Times

UNIT III **9 Hours**

DATA MANAGEMENT

Installing and loading packages, Intro to tidy verse, fundamentals of data, Downloading and importing data, Tidy data, data wrangling, and simple data cleaning, Numerical and Categorical variables, aggregate functions in R with dplyr , Recoding, data transformation and joins, sampling data for modeling-test and training splits, creating sample groups, Data reduction

UNIT IV **9 Hours**

DATA VISUALIZATION

Visualization Packages, Pie Charts, Bar Charts, Histograms, Line Graphs, Boxplots, Box-and-Whisker Plots Together, Scatterplots, Area Chart, Heat Map, Using the ggplot2package to visualize data, applying themes from ggthemes to refine and customize charts and graphs, Building data graphics for dynamic reporting.

UNIT V **9 Hours**

R-STATISTICS

Measures of central tendency, Measures of variability, Linear Regression, Multiple Regression, Logistic Regression, Probability Distributions: Normal Distribution, Binomial Distribution, Poisson Regression, Analysis of Covariance, Goodness of Fit, Time series analysis.

FOR FURTHER READING

Data querying: SQL and R, RMarkdown

Total: 45 Hours

Reference(s)

1. R for Data Science‖, Hadley Wickham and Garett Goleman, , O'Reilly, 2017
2. R Programming for Data Science, Roger D. Peng, Lean publishing, 2015
3. Practical Data Science with R, Nina Zumel and John Mount, Dreamtech/Manning, 2014
4. Maria Dolores Ugarte, Ana F. Militino, Alan T. Arnholt "Probability and Statistics with R" 2nd Edition on, CRC Press, 2016.
5. Michael Akritas, " Probability & Statistics with R for Engineers and Scientists", 2nd Edition on, CRC Press, 2016

20AI507 PROGRAMMING FOR DATA SCIENCE LABORATORY 0 0 4 2

Course Objectives

- Understand the R Programming Language.
- Exposure on solving data science problems.
- Understand the statistical functions in R.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
l. 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.
n. Ability to identify and use analytic skills for massive datasets to extract insights by applying suitable Data analytic tools and techniques.

Course Outcomes (COs)

1. Install and use R for simple programming tasks.
2. Extend the functionality of R by using add-on packages.
3. Conduct exploratory data analysis using R.
4. Create insightful visualizations to identify patterns from data.
5. Apply statistical estimates to make meaningful predictions from data. Code statistical functions in R.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3		3									3
2	3	3	2		3									3
3	2	3	3		3							1		3
4	3	3	3		3							2		3
5	3	3	3		3							2		3

EXPERIMENT 1 **2 Hours**

R AS CALCULATOR APPLICATION

a. Using with and without R objects on console
b. Using mathematical functions on console
c. Write an R script, to create R objects for calculator application and save in a specified location in disk.

EXPERIMENT 2 **4 Hours**

DESCRIPTIVE STATISTICS IN R

a. Write an R script to find basic descriptive statistics using summary, str, quartile function on mtcars & cars datasets.
b. Write an R script to find subset of dataset by using subset (), aggregate () functions on iris dataset.

READING AND WRITING DIFFERENT TYPES OF DATASETS

a. Reading different types of data sets (.txt, .csv) from Web and disk and writing in file in specific disk location.
b. Reading Excel data sheet in R.
c. Reading XML dataset in R.

EXPERIMENT 3 **4 Hours**

WORKING WITH MESSY DATA

a. Messy Data
b. Renaming Columns (Variable Names)
c. Attaching / Detaching
d. Tabulating Data: Constructing Simple Frequency Tables
e. Ordering Factor Variables

EXPERIMENT 4 **6 Hours**

VISUALIZATIONS

a. Find the data distributions using box and scatter plot.
b. Visualizing Measures of Central Tendency, Variation, and Shape.
c. Show the outliers using plot.
d. Plot the histogram, bar chart and pie chart on sample data.
e. Find the mean, media, standard deviation and quantiles of a set of observations.
f. Generate and Visualize Discrete and continuous distributions using the statistical environment.
g. Demonstration of CDF and PDF uniform and normal, binomial Poisson distributions.

EXPERIMENT 5 **4 Hours**

CORRELATION AND COVARIANCE

a. Find the correlation matrix.
b. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data.
c. Analysis of covariance: variance (ANOVA), if data have categorical variables on iris data

EXPERIMENT 6 **4 Hours**

Estimating a Linear Relationship

A Statistical Model for a Linear Relationship
Least Squares Estimates
The R Function lm
Scrutinizing the Residuals

EXPERIMENT 7 **2 Hours**

STATISTICAL FUNCTIONS IN R

Statistical inference, contingency tables, chi-square goodness of fit, regression, generalized linear models.

EXPERIMENT 7 **4 Hours**

REGRESSION MODEL

Import a data from web storage. Name the dataset and now do Logistic Regression to find out relation between variables that are affecting the admission of a student in an institute based on his or her GRE score, GPA obtained and rank of the student.
Also check the model is fit or not. Require (foreign), require (MASS).
Apply multiple regressions, if data have a continuous Independent variable. Apply on the above dataset.
Apply regression Model techniques to predict the data on the above dataset.

EXPERIMENT 8 **6 Hours**

CLASSIFICATION MODEL

a. Install relevant package for classification.
b. Choose classifier for classification problem.
c. Evaluate the performance of classifier.

CLUSTERING MODEL

a. Clustering algorithms for unsupervised classification.
b. Plot the cluster data using R visualizations.

EXPERIMENT 9 **6 Hours**

Develop a Data Science project using R code to build a recommendation system that recommends movies to the users.

EXPERIMENT 10 **6 Hours**

Develop a Data Science project using R to determine whether the consumer's attitude towards a particular product or topic is positive, negative, or neutral.

EXPERIMENT 11 **6 Hours**

Develop a Data Science project using R for Classifying Loan Applications using German Credit Dataset.

EXPERIMENT 12 **6 Hours**

Every Departmental store chain like Walmart wants to predict the store sales in the nearby future so that inventory planning can be done. Along with that, sales prediction helps to increase/decrease store staff based on the rush (More sales can mean more customers are coming to the stores). Also, it is always a good idea to do sales and revenue forecasting to better understand the company cash-flows and overall growth. In this problem, consider the sales data of more than 15 stores based on store, department and week.

Total: 60 Hours

Reference(s)

1. R for Data Science‖, Hadley Wickham and Garett Grolemund, , O'Reilly, 2017
2. R Programming for Data Science, Roger D. Peng, Lean publishing, 2015
3. Practical Data Science with R, Nina Zumel and John Mount, Dreamtech/Manning, 2014
4. Maria Dolores Ugarte, Ana F. Militino, Alan T. Arnholt "Probability and Statistics with R" 2nd Edition on, CRC Press, 2016.
5. Michael Akritas, " Probability & Statistics with R for Engineers and Scientists", 2nd Edition on, CRC Press, 2016

Web References:

1. http://www.r-bloggers.com/how-to-perform-a-logistic-regression-in-r/
2. http://www.ats.ucla.edu/stat/r/dae/rreg.htm
3. http://www.coastal.edu/kingw/statistics/R-tutorials/logistic.html
4. http://www.ats.ucla.edu/stat/r/data/binary.csv

20AI508 ANALYTICS IN CLOUD COMPUTING LABORATORY 0 0 4 2

Course Objectives

- Understand the basic networking fundamentals to use different devices to build network.
- To install, use, and manage virtual machines in Oracle VirtualBox.
- To develop web applications in cloud, design and development process involved in creating a cloud-based application.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

e. Modern tool usage**:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

n. Ability to identify and use analytic skills for massive datasets to extract insights by applying suitable Data analytic tools and techniques.

Course Outcomes (COs)

1. Understand the fundamental concepts of cloud computing and analyze the networking components for communication.
2. Configure various virtualization tools such as Virtual Box, VMware workstation.
3. Learn how to simulate a cloud environment to implement new schedulers.
4. Analyze and visualize the big query dataset with Google cloud.
5. Use commercial cloud to deploy web applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1		3									
2	3	2	2		3								2	
3	2	2	2		3								2	3
4	3	2	2		3								3	3
5	3	2	2		3								3	3

EXPERIMENT 1 **4 Hours**
OS INSTALLATION

a. Install Ubuntu/Fedora/Redhat/Windows Operating System.
b. Create a directory while installing the Operating System.

EXPERIMENT 2 **4 Hours**
NETWORK SETUP

a. Design and configure a simple network setup for 10 computers using Packet Tracer
b. Restrict the IP address in the above designed network (CIDR calculation-subnet masking)

EXPERIMENT 3 **4 Hours**
VIRTUAL MACHINE SETUP

a. Install VirtualBox/VMware Workstation with different flavors of Linux or windows OS on top of windows7 or 8.
b. Create 2 machines which communicate with each other internally in the virtual environment.

EXPERIMENT 4 **4 Hours**
TIME SYNCHRONIZATION

a. Install and configure network time protocol for time synchronization in Ubuntu environment.

EXPERIMENT 5 **4 Hours**
DATABASE CREATION

a. Install and configure MySQL Server/MariaDB in the virtual machine
b. Access/Connect the database through SQLYOG

EXPERIMENT 6 **4 Hours**
ANALYZE AND VISUALIZE BIGQUERY DATASET WITH GOOGLE CLOUD DATALAB

a. Setting up Google Cloud and Big Query Environment
b. Creating a project on Google Cloud Platform's one of the Analytics services named as Big Query
c. Accessing publicly available sample datasets in Big Query

EXPERIMENT 7 **4 Hours**
WEBHOSTING

a. Install Google App Engine. Create hello world app and other simple web applications using python/java

EXPERIMENT 8 **4 Hours**
VIRTUAL MACHINE OF DIFFERENT CONFIGURATION

Find procedure to run the virtual machine of different configuration. Check how many virtual machines can be utilized at particular time.

EXPERIMENT 9 **4 Hours**
VIRTUAL BLOCK

Find procedure to attach virtual block to the virtual machine and check whether it holds the data even after the release of the virtual machine.

EXPERIMENT 10 **4 Hours**
EXECUTING PROGRAMS IN VIRTUAL MACHINE
Install a C compiler in the virtual machine and execute a sample program.
Show the virtual machine migration based on the certain condition from one node to the other.

EXPERIMENT 11 **4 Hours**
STORAGE CONTROLLER AND HADOOP
Find procedure to install storage controller and interact with it.
Find procedure to set up the one node Hadoop cluster.

EXPERIMENT 12 **4 Hours**
HADOOP AND FUSE
Mount the one node Hadoop cluster using FUSE.

EXPERIMENT 13 **4 Hours**
INTERACTION USING HADOOP API
Write a program to use the API of Hadoop to interact with it.

EXPERIMENT 14 **4 Hours**
MAP AND REDUCE TASKS
Write a word count program to demonstrate the use of Map and Reduce tasks.

EXPERIMENT 15 **4 Hours**
CLOUD SIM SIMULATION
Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm that is not present in Cloud Sim.

Total: 60 Hours

Reference(s)

1. Rittinghouse, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security, CRC Press, 2017.
2. Barrie Sosinsky, Cloud Computing Bible, Wiley-India, 2014.
3. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, ―Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
4. Ronald L.Krutz and Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Wiley-India, 2013.

Web References

1. https://www.edureka.co/blog/hadoop-tutorial/
2. https://www.simplilearn.com/tutorials/hadoop-tutorial
3. https://www.pragimtech.com/blog/cloud/cloud-tutorial-for-beginners/

18GE501 SOFT SKILLS - APTITUDE I **0 0 2 0**

Course Objectives

- Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values. It will provide a lot of activities and examples for a student to learn and develop these life skills.

Course Outcomes (COs)

1. Explain various concepts of number systems and their techniques in solving the percentage, average and age problems.
2. Analyse the profit and loss of real time situations and the relation between ratio, proportion and variation.
3. Apply different techniques to find the distance, speed and time of various moving objects.
4. Understand the concepts of coding, sequences and series, data interpretation and critical reasoning to solve real time logical reasoning problems.

1 **2 Hours**

NUMBER SYSTEMS

Introduction - Definition - Classification on Numbers- Power cycles and remainders - Short cut process-Concept of Highest Common Factor-Concept of Least Common Multiple- Divisibility- Number of zeros in an expression.

2 **2 Hours**

PERCENTAGE

Introduction - Definition and Utility of Percentage - Importance of base/denominator for percentage calculations-Concept of percentage values through additions-Fraction to percentage conversion table.

3 **3 Hours**

AVERAGES AND AGES

Introduction-Average of different groups-Addition or removal of items and change in average-Replacement of some of the items.

4 **3 Hours**

RATIO, PROPORTIONS AND VARIATION

Introduction- Ratio- Properties-Dividing a given number in the given ratio-Comparison of ratios-Proportions-Useful results on proportion- Continued proportion-Relation among the quantities more than two-Variation.

5 **2 Hours**

PROFIT AND LOSS

Gain/Loss and percentage gain or percentage loss-Multiplying equivalents to find sale price-Relation among cost price, sale price, gain/loss and percentage gain or percentage loss-An article sold at two different selling price-Two different articles sold at same selling price-Percentage gain or percentage loss on selling price-Percentage gain or percentage loss on whole property.

6 **2 Hours**

TIME AND WORK

Introduction-Basic concepts-Concepts on working with different efficiencies-Pipes and Cisterns-Work Equivalence (Man Days) -Alternative approach.

7 **2 Hours**

TIME, SPEED AND DISTANCE

Definition-Basics of Time, Speed and Distance - Relative speed-Problems based on Trains-Problems based on Boats and Streams-Problems based on Races-Time taken with two difference modes of transport-Time and distance between two moving bodies.

8 **3 Hours**

CODING AND DECODING

Introduction-Description of Coding method-Coding patterns - Concepts of Coding and Decoding-Problems involving Coding and Decoding methods.

9 **2 Hours**

SEQUENCE AND SERIES

Introduction-Sequences of real numbers - Number and Alphabet series-Description of Number and Alphabet series-Analogy-Odd man out-Power series.

10 **3 Hours**

DATA SUFFICIENCY

Introduction to Data Sufficiency - Overview of the wide variety of Data Sufficiency problems - Basic introduction on how to determine what information is sufficient to solve a given problem - Common pitfalls to avoid.

11 **3 Hours**

DIRECTION

Introduction to Direction - sense test - Overview of the wide variety of Direction problems-Direction-Plotting diagrams.

12 **3 Hours**

CRITICAL REASONING

Introduction-Basic concept of critical reasoning- Weaken the argument-Strengthen the argument-Flaw in the argument-Evaluate the conclusion.

Total: 30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc Graw Hill Publications.
2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd, India.
3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.
4. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.
5. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.
6. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

20AI601 DATA SECURITY 3 1 0 4

Course Objectives

- Understanding the importance of data security in infrastructure management.
- Evaluate the level of threats possessing for the security.
- Analyze the various security intelligence techniques.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.
n. Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Understand the fundamentals of security required to protect data
2. Analyze the security models for enhancing web development
3. Explore the various security techniques available for data transmission
4. Develop the security model to handle the serious security threat
5. Apply the security functionalities on real world problems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1												2
2	2	2	1		1									2
3	2	2	2		1									2
4	2	2	2	2	2									2
5	3	2	3	2	2								3	

UNIT I **9 Hours**

INTRODUCTION TO DATA SECURITY

Learning the security data analysis - Performing exploratory security data analysis – Dissecting the IP address, augmenting the IP address, Mapping outside the continents. Visualizing security data – Understanding the components of visual communications – Learning from security breaches – Working with VCDB data- Breaking up with relational database

UNIT II **9 Hours**

DATA SECURITY FOR WEB DEVELOPMENT

Problems with current security models – Understanding entropy in password security – Good and bad security algorithms, what data should be protected – Password attack vectors – Salting – Peppering – Hash functions for password – Understanding various identity types – Trust zones- Hardening web applications – CSRF attacks – Handling XSS

UNIT III **9 Hours**

SECURITY IN DATA TRANSMISSION

SSL/TSL - Certificate Validation Types and Authorities, Creating Your Own Self-Signed Certificate for Testing- Asynchronous Cryptography- Use Case- Implementation Example- Synchronous Cryptography- Padding- Block Cipher Modes of Operation - Using AES with CTR Encryption Mode - Using AES with GCM Authenticated Encryption Mode

UNIT IV **9 Hours**

SECURITY THREAT MODELLING

Learning to threat model – Strategies – Brainstorming threats, approach, models – STRIDE – Spoofing threats, tampering, repudiation, information disclosure – DOS threats – STRIDE variants- Attack trees – Attack libraries – CAPEC- Privacy tools – Security matrix creation and maintenance

UNIT V **9 Hours**

INTELLIGENCE IN SECURITY – CASE STUDY

Introduction – Information Technology and National Security, Problems and Challenges- Case study on Intelligence and warning: Detecting deceptive criminal identities, The Dark web portal, analyzing the Al-Qaeda network. - Case study on Border and Transportation: Enhancing border safe information sharing, Topological analysis of cross – jurisdictional criminal networks

Total: 60 Hours

Reference(s)

1. Jay Jacobs, Bob Rudis, “Data-Driven Security: Analysis, Visualization and Dashboards", Wiley, 2014
2. Jonathan LeBlanc, Tim Messerschmidt, “Identity and Data Security for Web Development”, June 2016
3. Adam Shostack, “Threat Modeling: Designing for Security”, Wiley, April 2014
4. Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short “Cyber Security Essentials, Wiley, 2018.
5. Chen, Hsinchun," Intelligence and Security Informatics for International Security”, Springer, 2006

20AI602 COMPUTER VISION 3 0 0 3

Course Objectives

- Introduce the computer vision algorithms and concepts to students, which will enable them to implement computer vision systems with emphasis on applications and problem solving.
- Aims to replace natural human vision recognition by training the computers through specific data processing algorithms.
- Explore and contribute to research and developments in the field of computer vision. Applications range from Biometrics, Medical Diagnosis, Document Processing, Mining of Visual Content etc.

Program Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Modern tool usage**:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.
n. Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes

1. Understand the detailed models of image formation and processing.
2. Apply the computer vision techniques for image feature extraction and segmentation.
3. Analyze the computer vision algorithms for recognizing and classifying the pattern.
4. Analyze the computer vision techniques for motion detection.
5. Implement the computer vision techniques in real time problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1										2	
2	2	3	2		3								3	
3	2	2	2		2								3	3
4	2	3	3		3								3	3
5	2	3	3	2	3								3	

UNIT I **9 Hours**

DIGITAL IMAGE FORMATION AND LOW LEVEL PROCESSING

Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing. Depth estimation and Multi camera views: Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3D reconstruction framework; Auto calibration-Introduction on computer vision using Neural network.

UNIT II **9 Hours**

FEATURE EXTRACTION

Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT. Image Segmentation: Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.

UNIT III **9 Hours**

PATTERN ANALYSIS

Clustering: Mean-Shift**,** Density based Spatial, EM using Gaussians Mixture model, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

UNIT IV **9 Hours**

MOTION ANALYSIS

Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo, Motion parameter estimation. Shape from X: Light at Surfaces, Phong Model, Reflectance Map, Albedo estimation, Photometric Stereo, Use of Surface Smoothness Constraint, and Shape from Texture, color, motion and edges.

UNIT V **9 Hours**

APPLICATIONS

Emotion Recognition – Real Time Object Detection – Gesture Recognition – Face Detection- Biometrics-Augmented Reality- Stitching and document processing

Total: 45 Hours

Reference(s)

1. Forsyth, D. A. and Ponce, J., "Computer Vision: A Modern Approach", Prentice Hall, 2nd Ed.
2. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
3. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
4. Fukunaga, K., Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.

20AI603 DATA VISUALIZATION 3 0 2 4

Course Objectives

- Understand the methodologies used to view large data sets
- Analyze the various process used in data visualization
- Explore the fundamentals settings of Interactive data visualization

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
n. Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Understand the representation of complex and voluminous data
2. Design and use various methodologies present in data visualization
3. Analyze the various process and tools used in data visualization
4. Implement the principle of visual perception for various data analysis tasks
5. Apply the interactive data visualization to make inferences.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1		2									2
2	2	2	2		3									3
3	2	3	2		2									3
4	1		1											3
5	2	2	2	1	3									3

UNIT I **9 Hours**

INTRODUCTION TO DATA VISUALIZATION

Context of data visualization – Definition, Methodology, Visualization design objectives. Key Factors – Purpose, visualization function and tone, visualization design options – Data representation, Data Presentation, Seven stages of data visualization, widgets, data visualization tools- Image Visualization

UNIT II **9 Hours**

DATA VISUALIZATION METHODS

Mapping – Locations on a Map- Time series - Connections and correlations – Indicator-Area Chart-Pivot table- Scatter charts, Scatter maps - Tree maps, Space filling and non-space filling methods-Hierarchies and Recursion - Networks and Graphs -Matrix representation for graphs- Info graphics- EDA using Python

UNIT III **9 Hours**

DATA VISUALIZATION PROCESS

Acquiring data, - Where to Find Data, Tools for Acquiring Data from the Internet, Locating Files for Use with Processing, Loading Text Data, Dealing with Files and Folders - Advanced Web Techniques. Parsing data - Levels of Effort, Tools for Gathering Clues, Text Is Best, Text Markup Languages, Regular Expressions (regexps), Grammars and BNF Notation, Compressed Data, Vectors and Geometry, Binary Data Formats, Advanced Detective Work.

UNIT IV **9 Hours**

PRINCIPLES FOR FIGURE DESIGNS

The Principle of Proportional ink – Handling Overlapping points - Common pitfalls of Color use – Redundant coding – Multipanel figures-Title, Captions and Tables- Balance the Data and Context – Use Larger Axis labels

UNIT V **9 Hours**

INTERACTIVE DATA VISUALIZATION

Technology Fundamentals- Setting up D3- Drawing with data – Scales – Axes – Updates, Transition and Motion – Interactivity - Layouts – Geomapping – Exporting.

FOR FURTHER READING

Security Data Visualization – Attacking and Defending Visualization, Data Visualization for Web.

EXPERIMENT 1 **3 Hours**

DATA PREPROCESSING AND CLEANING METHODS ON STUDENT DATASETS

Create an Employee Table with training data set which includes attributes like name, id, salary, experience, gender, phone number. Preprocess the given data by checking the constraints on each attribute

EXPERIMENT 2 **3 Hours**

Import a dataset in any one of the data visualization tools and provide graphical representation in following formats: Bar Chart, Pie Chart, Area Chart, Scatter Chart and Scatter plot.

EXPERIMENT 3 **3 Hours**

Wise Owl Travel Agents					
Country	**Resort Name**	**No of Days**	**Travel Method**	**Price**	**Holiday ID**
Australia	Great Barrier Reef	32	Plane	£750	I990AUS
Australia	Perth	28	Plane	£985	AUS112J
Chile	Santiago	21	Plane	£1,259	CH266H
England	London	3	Train	£69	I456UK
England	Bognor	1	Coach	£12	BG726H
France	Lyon	14	Plane	£399	A7995FR
France	Paris - Euro Disney	5	Train	£269	TH789FR
France	Paris - Euro Disney	3	Train	£125	TH788FR

Create a pivot table from this data, then use the filters within to view the average prices of holidays that have a Travel Method of Plane and a Resort Name that begins with the letter S. Confirm that there are 3 holidays in total, by using the drill-down feature.

EXPERIMENT 4 **3 Hours**

Pick a single data series and create an appropriate data visualization technique for it using Processing. A single series contains one set of values for a single variable. An example might be data representing your height for every year of your life, petrol cost over the last 10 years, or the relative popularity of the top 10 learning websites.

EXPERIMENT 5 **3 Hours**

Take multiple data series and make visualization in Processing that allows someone to easily compare them visually.

EXPERIMENT 6 **3 Hours**

Use the batch yields dataset and construct a monitoring chart using the 300 yield values. Use a subgroup of size 5. Report the target value, lower control limit and upper control limit

EXPERIMENT 7 **3 Hours**

Using the Website traffic data set

1. Create a chart that shows the variability in website traffic for each day of the week.
2. Use the same data set to describe any time-based trends that are apparent.

EXPERIMENT 8 **3 Hours**

Load the room temperature dataset into any one of the tools like R, Python or MATLAB, or whichever software tool you prefer to plot with.

1. Plot the 4 trajectories, FrontLeft, FrontRight, BackLeft and BackRight on the same plot.
2. Comment on any features you observe in your plot.

EXPERIMENT 9 **3 Hours**

Load the six-point board thickness dataset, available from datasets website.

1. Plot a boxplot of the first 100 rows of data to match the figure in these notes
2. Explain why the thick center line in the box plot is not symmetrical with the outer edges of the box.

EXPERIMENT 10 **3 Hours**

Create an information dashboard on COVID cases in a particular location. Map the raw data into a meaningful information

Total: 75 Hours

Reference(s)

1. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008
2. Claus O. Wilke, “Fundamentals of Data Visualization -A Primer on Making Informative and Compelling Figures”, O'Reilly, April 2019
3. Scott Murray, “Interactive data visualization for the web”, O’Reilly Media, Inc., Second Edition, 2017.
4. Stephen Few, "Information dashboard design: Displaying data for at-a-glance monitoring", second edition, Analytics Press, 2013
5. Storytelling with Data: “A Data Visualization Guide for Business Professionals”, Wiley, 2015

20AI604 NATURAL LANGUAGE PROCESSING 3 0 0 3

Course Objectives

- Provide basic mathematical models and methods used in NLP applications to formulate computational solutions.
- Understand the syntax and semantics of natural languages. How they work and how machine can convert from one natural language to another.
- Acquire the knowledge on designing procedures for natural language resource annotation and the use of related tools for text analysis and hands-on experience of using such tools.

Programme Outcomes

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

e. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

l. 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.

m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes

1. Understand the fundamental mathematical models and algorithms in the field of NLP.
2. Apply the mathematical models and algorithms in the applications of software.
3. Implement a rule-based system to tackle morphology/syntax of a language.
4. Analyze the design and implementation issues in various NLP applications such as information retrieval and information extraction.
5. Apply the principles of language resource annotation and its use in machine learning applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	1									2	
2	3	2	2	2	2							1	2	
3	3	2	2	2	2							1	3	
4	3	2	2	2	2								3	
5	3	2	2	1	2							1	3	

UNIT I **9 Hours**

INTRODUCTION

Introduction - Mathematical Foundations - Elementary Probability Theory - Essential Information Theory – Linguistic Essentials- Parts of Speech and Morphology- Phrase Structure- Semantics and Pragmatics - Regular Expressions, Text Normalization, Edit Distance - N-gram Language Models

UNIT II **9 Hours**

SENTIMENT CLASSIFICATION AND LOGISTIC REGRESSION

Naive Bayes Classification and Sentiment - Logistic Regression- Vector Semantics -Neural Nets and Neural Language Models - Sequence Labeling for Parts of Speech- Deep Learning-Architectures for Sequence Processing

UNIT III **9 Hours**

SYNTACTIC PARSING

Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar- Ambiguity – Cocke Kasami Younger (CKY) algorithm - Partial Parsing - Statistical Parsing- Dependency Parsing- Dependency Formalisms-Treebanks- Transition-Based Dependency Parsing- Graph-Based Dependency Parsing.

UNIT IV **9 Hours**

COMPUTATIONAL SEMANTICS AND SEMANTIC PARSING

Computational Desiderata for Representations- Model-Theoretic Semantics- First-Order Logic- Event and State Representations- Logics -Relation Extraction- Relation Extraction Algorithms- Word Senses- Relations between Senses- WordNet: A Database of Lexical Relations- Disambiguation- Alternate WSD algorithms and Tasks -Semantic Role Labeling

UNIT V **9 Hours**

DISCOURSE COHERENCE AND COREFERENCE RESOLUTION

Lexicons for Sentiment, Affect, and Connotation, Discourse Coherence -Coherence Relations- Discourse Structure Parsing- Centering and Entity-Based Coherence- Representation learning models for local coherence- Co reference Resolution- Co reference Tasks and Datasets- Architectures for Co reference Algorithms- A neural mention-ranking algorithm

Total: 45 Hours

Reference(s)

1. Daniel Jurafsky, James H. Martin―Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2. Foundations of Statistical Natural Language Processing by Christopher D. Manning and Hinrich Schuetze, MIT Press, 2018
3. Steven Bird, Ewan Klein and Edward Loper Natural Language Processing with Python, O'Reilly Media; 1 edition, 2009
4. Breck Baldwin, ―Language processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
5. Richard M Reese, ―Natural Language Processing with Java‖, O'Reilly Media, 2015.
6. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
7. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.

20AI607 NATURAL LANGUAGE PROCESSING LABORATORY 0 0 4 2

Course Objectives

- To understand the concepts of Natural Language Processing
- To enable students to work on various advanced techniques like word embeddings, deep learning attention, and more.
- To provide skills to work towards solution of real-life problems.

Programme Outcomes

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

e. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes

1. Apply techniques such as tokenization, stemming in Text processing.
2. Implementation of sentiment classification using parts of speech.
3. Apply n-gram language model for predicting the sequence
4. Implement of various parsing techniques
5. Analyze various deep learning models used in NLP.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	2	2								2	
2	1	2	2	2	2								2	
3	2	2	2	2	2								3	
4	2	2	2	2	2								3	
5	2	2	2	2	2								3	

EXPERIMENT 1 **3 Hours**

Use stemming and tokenization process to get the root words in the given sentences.

EXPERIMENT 2 **4 Hours**

Split the words and display both splitted words and count of the words in the given sentence using tokenizer function.

EXPERIMENT 3 **4 Hours**

Remove connectors and prepositions in a sentence. (Note: connectors and prepositions represent stop words take them in a text file for required output)

EXPERIMENT 4 **3 Hours**

Remove Stop words and identify parts of speech in the given sentence.

EXPERIMENT 5 **4 Hours**

Use n-gram language model to predict the next sequence of word or letter in sentence.

EXPERIMENT 6 **4 Hours**

Construct a parse tree that satisfies the given rule for the sentence using chunk parsing.

EXPERIMENT 7 **4 Hours**

Find the probability of given sentence using PCF Parsing.

EXPERIMENT 8 **4 Hours**

Implement a program that processes a word and discovers synonym, definition and example.

EXPERIMENT 9 **6 Hours**

Apply sentiment analysis and categorizing opinions expressed in a piece of text.

EXPERIMENT 10 **6 Hours**

Use deep learning concepts RNN's, LSTM's and GRU's to solve NLP problems.

EXPERIMENT 11 **6 Hours**

Implement a simple part-of-speech tagger.

EXPERIMENT 12 **6 Hours**

Implement Cricket Game Prediction using deep learning model.

EXPERIMENT 13 **6 Hours**

Implement Query Expansion for Information Retrieval.

Total: 60 Hours

Reference(s)

1. Daniel Jurafsky, James H. Martin―Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2. Foundations of Statistical Natural Language Processing by Christopher D. Manning and Hinrich Schuetze, MIT Press, 2018
3. Steven Bird, Ewan Klein and Edward Loper Natural Language Processing with Python, O'Reilly Media; 1 edition, 2009
4. Breck Baldwin, ―Language processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
5. Richard M Reese, ―Natural Language Processing with Java‖, O'Reilly Media, 2015.

Web References

1.https://www.kaggle.com/
2.https://towardsdatascience.com/gentle-start-to-natural-language-processing-using-python-6e46c07addf3
3.https://github.com/alvations/awesome-community-curated-nlp

20AI608 COMPUTER VISION LABORATORY 0 0 4 2

Course Objectives

- Understand the major techniques in computer vision and image processing.
- Apply computer vision techniques to real-world challenges and applications.

Program Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Modern tool usage**:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.
n. Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Implement noise removal, Perspective projection and shape detection.
2. Detect the edges and corners using edge and corner detection algorithm.
3. Recognize the object using object detection algorithm.
4. Implement the objects and its motion using motion analysis algorithm.
5. Implementation of face detection using OpenCV.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1		2								2	
2	2	3	2		3								3	
3	2	2	2		2								3	
4	2	3	3		3								3	3
5	2	3	3	2	3								3	

EXPERIMENT 1: **3 Hours**

Detect the shape and label the name of the shape in images.

EXPERIMENT 2: **3 Hours**

Remove the noise in image using noise removal algorithms.

EXPERIMENT 3: **4 Hours**

Detect the edges of an object using Edge detection algorithm.

EXPERIMENT 4: **6 Hours**

Build the own lane detection system for indicating the traffic flow, where a vehicle should drive using Perspective projection.

EXPERIMENT 5: **4 Hours**

Detect the corners of an object using corner detection algorithm.

EXPERIMENT 6: **4 Hours**

Detect the particular color from the image.

EXPERIMENT 7: **6 Hours**

Recognize the hand gestures in video streams.

EXPERIMENT 8: **6 Hours**

Detect if this is a Face or not and further recognize whose face is it.

EXPERIMENT 9: **6 Hours**

Classify the vehicles on the road and count the number of vehicles that travel through a road**.**

EXPERIMENT 10: **4 Hours**

Count the number of people passing through a specific scene.

EXPERIMENT 11: **6 Hours**

Build QR Code Scanner utilizing Computer vision for image analysis.

EXPERIMENT 12: **4 Hours**

Detect the face region of the person and use it to blur the image

EXPERIMENT 13: **4 Hours**

Image Segmentation: Divide the image into multiple segments for object detection.

TOTAL: 60 Hours

Reference(s)

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer International, 2011.
2. Reinhard Klette, "Concise Computer Vision: An Introduction into Theory and Algorithms", Springer, 2014.
3. E. R. Davies, "Computer and Machine Vision", Fourth Edition, Elsevier, 2012.

Web References

1. https://www.pyimagesearch.com/start-here/
2. https://www.geeksforgeeks.org/opencv-python-tutorial/

18GE601 SOFT SKILLS-APTITUDE II **0 0 2 0**

Course Objectives

- Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values. It will provide a lot of activities and examples for a student to learn and develop these life skills.

Course Outcomes (COs)

1. Apply the concepts of probability, Sets, Permutation and Combinations in estimating data for real time problems.
2. Understand the concept of logarithms, progressions and Simple and Compound interest to solve various practical problems.
3. Analyse objects involving cubes and cuboids in determining the number of sides colored.
4. Interpret various data from graphs and tables to determine ratio, percentage and averages.
5. Apply the logical reasoning skills for identifying age, relations, visual relations and puzzles.

1 **2 Hours**

PERMUTATION AND COMBINATION

Definition-Fundamental rules-Theorems on Permutation-Theorems on Combination.

2 **2 Hours**

PROBABILITY

Concept and Importance of Probability-Underlying factors for real Life estimation of probability-Basic facts about probability-Some important consideration while defining event.

3 **2 Hours**

SYLLOGISM AND VENN DIAGRAM

Concepts on Syllogisms-Venn diagram-Interpretation-Venn diagram-solving.

4 **4 Hours**

SIMPLE INTEREST AND COMPOUND INTEREST

Introduction-Definition - Effect of change of P, R, T on simple interest-Amount-Amount becomes N times the principle-Repayment of debt in equal installments-Rate and time are numerically equal-Compound Interest-Conversion period-Basic formula-Special cases-To find the principle / Time /Rate-Difference between Compound Interest and Simple Interest-Equal annual installment to pay the borrowed amount.

5 **2 Hours**

MIXTURES AND ALLIGATION

Definition-Alligation rule-Mean value (cost price) of the mixture-Some typical situations where allegation can be used.

6 **4 Hours**

CUBE AND LOGARITHM

Introduction-Basic Concepts of Cube and Cuboid-Problems involving cubes and cuboids of various dimensions-Problems involving coloured cubes and cuboids - Basic concepts of Logarithm-Laws of

Logarithms including change of base-Common logarithm (base 10) - Properties of Logarithms to solve equations involving logarithmic expressions.

7 **2 Hours**

DATA INTERPRETATION

Introduction-Ratio-Percentage-Average-Tables - Graphs and Charts.

8 **2 Hours**

PROGRESSION AND LOGICAL REASONING

Arithmetic progression-Geometric progression-Harmonic progression-Theorems related with progressions.

9 **2 Hours**

PROBLEM ON AGES

Introduction-Basic concept-Usage of Percentage and Averages -Applications.

10 **2 Hours**

ANALYTICAL REASONING

Introduction-Basic concept-Non verbal Analytical Reasoning -Arrangements.

11 **2 Hours**

BLOOD RELATION

Introduction-Basic concept-Kinds of relation-Tree diagram -Relations.

12 **2 Hours**

VISUAL REASONING

Introduction-Basic concepts-Odd man out-Next series-Mirror image and water image

13 **2 Hours**

SIMPLIFICATIONS

Introduction-Basic concepts-Arithmetic operations-Equation solving methods-Puzzles.

Total: 30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc Graw Hill Publications.
2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd, India.
3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.
4. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.
5. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.
6. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

18HS002 PROFESSIONAL ETHICS IN ENGINEERING 2 0 0 2

Course Objectives

- Enable the students to create awareness on Engineering Ethics and Human Values.
- Enable the students to learn Moral, Social Values and Loyalty and to appreciate the rights of others.

Programme Outcomes (POs)

f. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Apply ethics in society.
2. Learn the ethical issues related to engineering.
3. Apply ethics in Work Place.
4. Realize the responsibilities and right in the society.
5. Recognize the global issues and responsibilities of leaders to address the same.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						3		3						
2						3		3						
3						3		3						
4						3		3						
5						3		3						

UNIT I **9 Hours**

HUMAN VALUES

Morals, Values and Ethics –Integrity –Work ethic –Service learning –Civic virtue –Respect for others – Living peacefully –Caring –Sharing –Honesty –Courage –Valuing time –Cooperation –Commitment – Empathy –Self confidence –Character –Spirituality –Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II **9 Hours**

ENGINEERING ETHICS

Senses of 'Engineering Ethics' –Variety of moral issues –Types of inquiry –Moral dilemmas –Moral Autonomy –Kohlberg's theory –Gilligan's theory –Consensus and Controversy –Models of professional roles -Theories about right action –Self-interest –Customs and Religion –Uses of Ethical Theories

UNIT III **9 Hours**

ENGINEERING AS SOCIAL EXPERIMENTATION

Engineering as Experimentation –Engineers as responsible Experimenters –Codes of Ethics –A Balanced Outlook on Law.

UNIT IV **9 Hours**

SAFETY, RESPONSIBILITIES AND RIGHTS

Safety and Risk –Assessment of Safety and Risk –Risk Benefit Analysis and Reducing Risk -Respect for Authority –Collective Bargaining –Confidentiality –Conflicts of Interest –Occupational Crime – Professional Rights –Employee Rights –Intellectual Property Rights (IPR) –Discrimination

UNIT V **9 Hours**

GLOBAL ISSUES

Multinational Corporations –Environmental Ethics –Computer Ethics –Weapons Development –Engineers as Managers –Consulting Engineers –Engineers as Expert Witnesses and Advisors –Moral Leadership – Code of Conduct –Corporate Social Responsibility

TOTAL: 45 Hours

Reference(s)

1. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.
3. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
4. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics –Concepts and Cases”, Cengage Learning, 2009
5. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi,2003
6. Edmund G Seebauer and Robert L Barry, “Fundametals of Ethics for Scientists andEngineers”, Oxford University Press, Oxford, 2001
7. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for PersonalIntegrity and Social Responsibility” Mc Graw Hill education, India Pvt. Ltd.,New Delhi 2013.
8. World Community Service Centre, " Value Education", Vethathiri publications, Erode,2011 Web sources

20AI702 IOT ANALYTICS 3 0 0 3

Course Objectives

- Understand the challenges of IoT analytics systems development and deployment.
- To learn about data analytics and use cloud offerings related to IoT.
- Ability to understand the Searching and security requirements of IoT.
- Acquire the knowledge of Tools, Platform and Services for IoT Analytics.
- To Develop IoT infrastructure for real time scenario.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
l. 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.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.
n. Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Identify the networking protocols for connecting devices and challenges of IoT Analytics.
2. Understand the cloud based IoT and IoT in Data Analytics.
3. Explain the concepts of Security requirements and Searching the IoT.
4. Apply the different tools and services for IoT Analytics platform.
5. Analyze applications of IoT Analytics in real time scenario.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	1								1		
2	2	2	2	2	3							1	2	3
3	2	2	2	2	2							2	2	2
4	2	2	2	2	3							2		3
5	2	2	3	3	3							2		3

UNIT I **9 Hours**

INTRODUCTION TO IoT ANALYTICS

Introduction – IoT Data and Big Data - Challenges of IoT Analytics - Applications - IoT Devices and Networking Protocols

UNIT II **9 Hours**

IoT CLOUD, WEB SERVICES AND DATA ANALYTICS

Cloud based IoT Platform - Iaas, Paas and Saas paradigms - Requirements of IoT in Big Data Analytics Platform - Functional Architecture - Web server: Web server for IoT applications

UNIT III **9 Hours**

SEARCHING THE INTERNET THINGS AND IoT SECURITY

Introduction – A search architecture for social and physical sensors - Local Event Retrieval – Sensor Metadata – Venue Recommendation - Security Requirements in IoT - Security Concerns in IoT Applications - Security Architecture in the Internet of Things - Insufficient Authentication/Authorization - Insecure Access Control - Threats to Access Control, Privacy, and Availability - Attacks Specific to IoT

UNIT IV **9 Hours**

TOOLS AND SERVICE FOR IoT ANALYTICS

Architecture for IoT Analytics Applications – Nodes - Development Examples - Open source framework for IoT Analytics as a service - Sensing as a service Infrastructure Tools and Platforms

UNIT V **9 Hours**

IoT ANALYTICS APPLICATIONS AND CASE STUDIES

Data Analytics and smart Building - Smart City - Data collection to deployment and operationalization using the vital platform

FOR FURTHER READING

Data Science for IoT Analytics – Economics of IoT Analytics, IoT Enabled Technologies

Total: 45 Hours

Reference(s)

1. John Soldatos, Building Blocks for IOT Analytics, River Publisher 2017
2. Andrew Minteer, Analytics for the Internet of Things, Packet Publishing Pvt. Ltd., Birmingham, 2017.
3. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 1st Edition, Academic Press, 2014.
4. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things Key applications and Protocols, Wiley, 2012.
5. Practical Internet of Things Security (Kindle Edition) by Brian Russell, Drew Van,2018

Web References

1. https://www.avsystem.com/blog/iot-protocols-and-standards/
2. https://www.fingent.com/blog/role-of-data-analytics-in-internet-of-things-iot/
3. https://geekflare.com/iot-platform-tools/

20AI703 SOCIAL MEDIA ANALYSIS 3 0 0 3

Course Objective:

- To predict human behavior in social web and related communities.
- To visualize social networks.
- To learn the structure of weak ties, graph portioning, Power laws and social marketing tools.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. 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.

c. 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.

Course Outcomes (COs)

1. Visualize Social Networks.
2. Learn the structure of weak ties and graph portioning.
3. Understand Social influences and web graph
4. Learn Cascading Behavior and Power Laws.
5. Learn the Social marketing and tools

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3												
2	2	2												
3	2	3												
4	2	3												
5	1	2	2											

UNIT I 9 Hours

INTRODUCTION

Introduction - Ingredients Network - Synonymy Network - Web Graph - Social Networks: The Challenge - Google Page Rank - Searching in a Network - Link Prediction - The Contagions -Importance of Acquaintances - Marketing on Social Networks - Social Network Datasets.

UNIT II 9 Hours

STRENGTH OF WEAK TIES

Granovetter's Strength of weak ties - Triads, clustering coefficient and neighborhood overlap - Structure of weak ties, bridges, and local bridges - Embeddedness - Structural Holes - Social Capital - Finding Communities in a graph (Brute Force Method) - Community Detection Using Girvan Newman Algorithm - Tie Strength, Social Media and Passive Engagement - Betweenness Measures and Graph Partitioning

UNIT III **9 Hours**

LINK ANALYSIS

Selection and Social Influence - Interplay between Selection and Social Influence - Homophily - Definition and measurement - Introduction to Fatman Evolutionary model – The Web Graph - Collecting the Web Graph - Equal Coin Distribution - Random Coin Dropping - Google Page Ranking Using Web Graph

UNIT IV **9 Hours**

CASCADING BEHAVIOR IN NETWORKS AND POWER LAWS

Diffusion in Networks - Modeling Diffusion - Impact of Communities on Diffusion - Cascade and Clusters - Knowledge, Thresholds and the Collective Action - Introduction to Power Law - Power Law emerges in WWW graphs - Detecting the Presence of Power Law - Rich Get Richer Phenomenon - Rich Get Richer - The Long Tail – Epidemics - Basic Reproductive Number - SIR and SIS spreading models - Comparison between SIR and SIS spreading models

UNIT V **9 Hours**

SOCIAL MEDIA MARKETING

Introduction of Social media marketing – The most important Social media websites – Blogging – Social Media Engagement – Social Media and Target audience – Sharing Content on Social media – Social Book-Marking websites – Approach to Social media – Tools for managing social media – Social Analytics.

Total: 45 Hours

Reference(s)

1. Networks, Crowds and Markets by David Easley and Jon Kleinberg, Cambridge University Press, 2010.
2. Social and Economic Networks by Matthew O. Jackson, Princeton University Press, 2010.

20AI704 AI FOR ROBOTICS 3 1 0 4

Course Objectives

- To understand the principles of reinforcement learning which is one of the key learning techniques for robots.
- To understand uncertainty handling in robotics through probabilistic approaches.
- To learn how measurements, work for robots.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Understand the various logics implemented to design and control the behaviors of robots.
2. Design software agents to solve a problem.
3. Design autonomous agents for mobile and control the agent activities
4. Use software tools to program humanoid robots and control the navigation of robots.
5. Implement principles of robotics intelligence for solving real world problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2		1								2	
2	3	2	2		1								2	
3	3	3	3		3								3	
4	3	3	3		3								3	
5	3	3	3	3	3								3	

UNIT I **9 Hours**

INTRODUCTION

The history of AI – AI and Society – Propositional Logic – First Order Logic (FOL) – Syntax – Semantics – Quantifiers and Normal Forms – Resolution – Limitations of logic – Logic programming with PROLOG.

UNIT II **9 Hours**

SOFTWARE AGENTS

Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems.

UNIT III **9 Hours**

FROM AI TO ROBOTS

AI for Robots – Embodied AI: Making of autonomous agents – Anthropomorphism –Evaluating Performance - Control paradigms for mobile robots: Control paradigms –Deliverable approach – Reactive approach

UNIT IV **9 Hours**

IMPLEMENTATION OR HOW TO MAKE ROBOTS

The tools: Navigation and adaptivity – Navigation, Path Planning and Mapping –Adaptibility and learning- Software for robotics – A very short introduction to ROS.

UNIT V **9 Hours**

HUMAN – ROBOT INTERACTION AND ROBOTS FOR HUMAN SOCIETY

Human Robot Interaction: Distributed cognition – Social Robotics: Design for social robots – Applications: Service robots – Robots in elderly care – Companion robot and robot therapy – Museum guide and receptionist robots.

Total: 60 Hours

FOR FURTHER READING

Robot Hardware – Robotic Perception – Planning to move – Planning uncertain movements – Robotic software architecture.

Reference(s)

1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition, 2009.
2. Gerhard Weiss, ―Multi Agent Systems‖, Second Edition, MIT Press, 2013.
3. Bhaumik and Arkapravo "From AI to Robotics : Mobile, Social, and Sentient Robots" by CRC Press Taylor Francis 2017.
4. M. Tim Jones, ―Artificial Intelligence: A Systems Approach (Computer Science) ‖, Jones and Bartlett Publishers, Inc.; First Edition, 2008
5. Wolfgang Ertel and Nathanael T. Black "Introduction to Artificial Intelligence" Springer second edition 2018.
6. David L. Poole and Alan K. Mackworth "Artificial Intelligence: Foundations of Computational Agents" Cambridge 2010.

20AI707 IOT ANALYTICS LABORATORY 0 0 4 2

Course Objectives

- Understand the challenges of IOT analytics systems development and deployment.
- To learn about data analytics and use cloud offerings related to IOT.
- To develop IOT infrastructure for real time scenario

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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.
d. 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.
e. 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.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.
n. Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Understand the IoT controllers and the process of cloud configuration.
2. Implement the real time applications using IoT.
3. Deploy the application using HTTP, MQTT.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	2	2									
2	3	3	3	2	2								2	2
3	3	3	3	3	3								2	
4														
5														

EXPERIMENT 1 **3 Hours**
Familiarization with the concept of IoT controller with necessary software installation.

EXPERIMENT 2 **3 Hours**
Understand the connectivity and configuration of IoT Controller circuit with basic peripherals, LEDS. Understand the GPIO and the process of cloud configuration.

EXPERIMENT 3 **3 Hours**
Create an application to measure the distance using Ultrasonic Sensor and Make Led Blink.

EXPERIMENT 4 **3 Hours**
Develop an application for Automatic Room Temperature Controller.

EXPERIMENT 5 **3 Hours**
Create an application to detect the movements using PIR Sensor.

EXPERIMENT 6 **3 Hours**
Develop the IOT based Weather Reporting System.

EXPERIMENT 7 **4 Hours**
Implement the IoT based Smart Dustbin.

EXPERIMENT 8 **3 Hours**
Develop an application to detect obstacles and notify users with LEDs.

EXPERIMENT 9 **4 Hours**
Create an application for Automatic Room Lighting system.

EXPERIMENT 10 **5 Hours**
Create an application using IoT Controller to control the operation of a hardware simulated traffic signal.

EXPERIMENT 11 **5 Hours**
Develop an application for password door lock security system.

EXPERIMENT 12 **7 Hours**
Develop a smart home application with following requirements:
When user enters into the house, the required appliances like fan, light should be switched ON.

EXPERIMENT 13 **7 Hours**
Develop an application to monitor an IoT device using IoT platform cloud.

EXPERIMENT 14 **7 Hours**
Develop a Smartphone application to control an IoT device using the IoT Platform cloud.

Total: 60 Hours

Reference(s)

1. John Soldatos, Building Blocks for IOT Analytics, River Publisher 2017
2. Andrew Minteer, Analytics for the Internet of Things, Packet Publishing Pvt. Ltd., Birmingham, 2017.
3. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 1st Edition, Academic Press, 2014. Christopher M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006
4. Olivier Hersent, David Boswarthick, Omar Elloumi , The Internet of Things Key applications and Protocols, Wiley, 2012.
5. Practical Internet of Things Security (Kindle Edition) by Brian Russell, Drew Van,2018

Web References

1. https://randomnerdtutorials.com/arduino-vs-raspberry-pi-vs-beaglebone-vs-pcduino/
2. https://www.intechopen.com/books/internet-of-things-iot-for-automated-and-smart-applications/smart-home-systems-based-on-internet-of-things

DISCIPLINE ELECTIVES

20AI001 ARTIFICIAL INTELLIGENCE FOR MEDICAL IMAGE ANALYSIS 3 0 0 3

Course Objectives

1. To understand the medical imaging modalities.
2. To focus on the analysis of clinical parameters for the extraction of knowledge from medical images.
3. To integrate machine intelligence to automate the process in the medical imaging.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

b. 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.

c. 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.

d. 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.

e. Modern tool usage**:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

n. Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Demonstrate the fundamentals of medical imaging system on various acquisition methods.
2. Classify the model and analyse information from medical data using machine learning.
3. Develop applications to help diagnosis, treatment and monitoring of diseases through soft computing based algorithms.
4. Build soft computing based algorithms for medical image analysis in real time applications.
5. Demonstrate medical image segmentation based on deep learning methods.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	2	2								3	1
2	2	2	1	2									2	2
3	3	1	3	1	2								1	1
4	1	2	3	2									3	2
5	3	1	2		2								2	2

UNIT I **9 Hours**

MEDICAL IMAGE ACQUISITION

X ray- Generation, Attenuation, Detection – Fluoroscopy and Angiography - Mammography - Contrast Enhancement in X-ray Computed Tomography – Magnetic Resonance Imaging – Artefacts in MR Imaging - MR Angiography - Perfusion Imaging - Diffusion Imaging – Image Analysis on Magnetic Resonance Images - Ultrasound - Image Analysis on Ultrasound Images .

UNIT II **9 Hours**

MEDICAL IMAGE STORAGE AND TRANSFER

Information Systems in a Hospital - The DICOM Standard - The DICOM File Format - Technical Properties of Medical Images - Compression of Medical Images - Image Enhancement - Measures of Image Quality - Image Enhancement Techniques - Contrast Enhancement - Resolution Enhancement - Edge Enhancement - Noise Reduction - Median Filtering - Diffusion Filtering.

UNIT III **9 Hours**

MEDICAL IMAGE FEATURE DETECTION

Edge Tracking - Hough Transform – Corners – Blobs - SIFT and SURF Feature - Key-Point-Independent Features - Saliency and Gist - Segmentation: Principles and Basic Techniques - Data Knowledge - Domain Knowledge about the Objects - Homogeneity-Based Segmentation - The Watershed Transform: Computing Zero-Crossings - Seeded Regions.

UNIT IV **9 Hours**

SOFT COMPUTING BASED MEDICAL IMAGE ANALYSIS

Fuzzy based techniques – Clustering, Partition, C-means clustering – Neural network based technique – neuron model and network architecture, Artificial Neural Networks – Genetic Algorithm based techniques. Case study: Medical Image Segmentation Using Fruit Fly Optimization method.

UNIT V **9 Hours**

DEEP LEARNING BASED MEDICAL IMAGE DETECTION AND RECOGNITION

Efficient Medical Image Parsing - Multi-Instance Multi-Stage Deep Learning - Interpretation of Carotid Intima–Media Thickness - CIMT Protocol - Deep Cascaded Networks for Sparsely Distributed Object Detection. Case Study: Detection of Covid 19 in lung CT and X-ray images.

Total: 45 Hours

Reference(s)

1. Guide to Medical Image Analysis: Methods and Algorithms (Advances in Computer Vision and Pattern Recognition), Klaus D. Toennies, 2nd Edition, Springer, 2017. (Unit I,II,III)
2. Deep Learning for Medical Image Analysis, S. Kevin Zhou, Hayit Greenspan, Dinggang Shen, Academic Press, ISBN: 9780128104095, 2017. (Unit V)
3. Medical Image Processing Concepts and Applications, Sinha, G.R..,Patel, bhagwati charan, PHI Learning, 2014. (Unit IV)

20AI002 AUTONOMOUS SYSTEMS AND DRONES 3 0 0 3

Course Objectives

- Understand the basic concepts of Drones and Autonomous systems.
- To know the basic algorithms on which the Drones are modelled.
- To analyze various methods of Drone launching.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

b. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

d. 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.

m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Explain the fundamentals of Unmanned Aerial Vehicle.
2. Illustrate the components of UAV and its applications.
3. Represent the concept and role of Drones.
4. Illustrate the modelling and control of Drone.
5. Apply the various UAV Propulsion methods.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2											1	
2	2	2											1	
3	2	1											2	
4	3	3		2									2	
5	3	3		2									2	

UNIT I **9 Hours**

UNMANNED AERIAL VEHICLE

Introduction – Typical Physical Parameters of UAVs for Commercial Applications – Categories of Unmanned Vehicles – Chronological History of UAVs and Drones – Deployment Restriction on UAVs – Small Unmanned Aerial Vehicle – Types of Small UAV - Civilian Applications of UAVs – UAVs for Combat Operations – Role of Sensors aboard the UAV.

UNIT II **9 Hours**

COMPONENTS FOR UNMANNED AERIAL VEHICLES

RF Components for UAV and UCAV Sensors – RF and Microwave Passive Components – RF Components for Reconnaissance and Surveillance – Receivers – Connectors and Cables for Tactical Data Link – Semiactive Passive Microwave Components for UAVs – Electro-Optical Sensors for UAVs – Forward-Looking Infrared Sensors – IR and Television Cameras.

UNIT III **9 Hours**

DRONES AND UNMANNED AUTONOMOUS VEHICLE TECHNOLOGY

Introduction to Drones and UAV Autonomous Technology – Example of UAV with Autonomous Capability – Military Role of Unmanned Autonomous Vehicle - Smart Components - Integrated Simulation Capability of UAV – Description and Performance of Sensors aboard Autonomous UAVs.

UNIT IV **9 Hours**

UAV NAVIGATION SYSTEM AND FLIGHT CONTROL SYSTEM

Critical Requirements – UAV Navigation System – Algorithms – SINS Correction Algorithm – Requirements of UAVs Automatic Flight Control System – Software for AFCS – Programming and Adjustment of AFCS – UAV Fault Detection and Isolation – Kalman Filtering.

UNIT V **9 Hours**

PROPULSION SYSTEMS

Power Sources for Commercial Drones Tactical Drones and Mini Drones – Power Sources for Electronic Drones and Micro-UAVs - Suitability and Deployment of Appropriate Sources for UAV - UAV Propulsion – Propulsion Systems for Full-Size UAVs and UCAVs - Propulsion Systems for Unmanned Autonomous Vehicles.

Total: 45 Hours

Reference(s)

1. Jha, Theory, Design and Applications of Unmanned Aerial Vehicles, CRC Press, 2016.
2. Karsten Berns, Ewald Puttkamer, Springer,Autonomous Land Vehicles: Steps towards Service Robots,2009. (IV and V)
3. Sebastian Thrun, Wolfram Burgard, Dieter Fox., Probabilistic robotics. MIT Press, 2005.
4. Daniel Watzenig and MartinHorn(Eds.), Automated Driving: Safer and More Efficient Future Driving, Springer,2017.
5. Markus Maurer, Autonomous driving: technical, legal and social aspects. Springer, 2016.

20AI003 INTELLIGENT TRANSPORTATION SYSTEMS 3 0 0 3

Course Objectives

- To learn the fundamentals of ITS.
- To study the ITS functional areas.
- To have an overview of ITS implementation in developing countries.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

b. Problem analysis**:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

e. Modern tool usage**:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

n. Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcome (COs)

1. Demonstrate the functionality of the transport system and security issues.
2. Classify the building blocks of intelligent transport system.
3. Construct the various data collection methodologies for ITS.
4. Summarize various communication protocols that can be used in transportation system.
5. Interpret the significance of ITS under Indian conditions.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1		2								2	
2	2	2	2		3								2	1
3	2	3	2		2								1	
4	1		1										2	2
5	2	2	2	1	3								2	2

UNIT I **8 Hours**

INTRODUCTION TO INTELLIGENT TRANSPORT SYSTEM

Transport system characteristics - Intelligent Transport System (ITS) – Functions of ITS Components – Importance of ITS Architectures – Challenges and Opportunities in ITS – Understanding the ITS Architecture – Logical Architecture – Physical Architecture – Organizational Architecture – Example of ITS Architecture. Case Study: National ITS Architecture in US.

UNIT II **9 Hours**

TECHNOLOGY BUILDING BLOCKS OF ITS

Data Acquisition – Communication tools – Data Analysis – Traveler Information – wireless adhoc networks – Tele communication technologies – Cellular wires – Wireless application protocols - Data and Information processing technologies – Data warehousing – Online Analytical Processing – Voice Processing and Internet – Internet protocol.

UNIT III **10 Hours**

DATA COLLECTION METHODS FOR ITS

Detection and Sensing technologies – Road way sensors – Environmental Sensors – probe based sensors – Blue tooth – RFID – Passive – Active and BAP RFID systems – Real time traffic monitoring using GPS probe – Smart cards – Traffic management system components – Traffic management measures – ITS for traffic management – TMC- ATMS – Emergency management – Incident management.

UNIT IV **9 Hours**

ITS COMMUNICATION SYSTEM

Vehicle to infrastructure communication – Mobility management – Software defined networking – vehicle to vehicle communication- routing and data dissemination protocols – Adhoc routing – Geo graphic positioning protocol – Cluster protocol –Broadcast protocol – Multicast protocol – Geo cast protocol.

UNIT V **9 Hours**

TRAVELLER AND INFORMATION SYSTEM

Basic TIS Concepts – Smart Route System – Data Collection – Process – Dessemination to Travelers – Evaluation of Information – Value of Information – Business Opportunities. Case Studies: applications in metro and highways.

Total: 45 Hours

Reference(s)

1. Sarkar, Pradip Kumar, Amit Kumar Jain, Intelligent Transport Systems, PHI Learning, 2018. (Unit I, II,III)
2. Rodolfo I. Meneguette, Robson E. De Grande, Intelligent Transport System in Smart Cities: Aspects and Challenges of vehicular networks and cloud, Springer, 2018. (Unit IV)
3. R.P Roess, E.S. Prassas, W.R. McShane. Traffic Engineering, Pearson Educational International, Fifth Edition, 2019.
4. Sussman, J.M. Perspectives on Intelligent Transportation Systems, Springer, Berlin, 2010.

20AI004 ARTIFICIAL INTELLIGENCE IN CYBER SECURITY 3 0 0 3

Course Objectives

- Understand the fundamentals of Artificial Intelligence in Cyber security.
- Gain knowledge about different attacks in cyber security.
- Analyze the different techniques in prevention and detection of network attacks.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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 public health and safety, and cultural, societal, and environmental considerations.

d. 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.

f. 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.

g. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.

l. 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.

m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Outline the fundamentals of Artificial Intelligence in cyber security.
2. Illustrate the different network semantics for Cyber security.
3. Categorize the different exploit prediction model and exploit analysis.
4. Examine the machine learning techniques in the detection of network intrusion.
5. Justify how the detection of network attack helps in fraud detection.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3			2			2					2	2	
2	1	2	2	2								3	2	
3	2	3				2							1	
4	3		2	2									2	
5	3	3					2						3	

UNIT I **9 Hours**

INTRODUCTION

Fundamentals of Cybersecurity- Applications of Cybersecurity-purpose of Cyber security- Types of Cybersecurity attacks- prevention and protection from cyber-attacks- need of AI - Applications of AI in cyber security-AI systems' support to cybersecurity: System robustness - System resilience - System response. Ontologies for Cyberthreat intelligence- The ontology for digital forensics.

UNIT II **9 Hours**

NETWORK SEMANTICS FOR CYBER-SITUATIONAL AWARENESS

Preliminaries- Communication Network Concepts: Networks and Topologies, Network Interfaces and IP addressing, Routers, Autonomous System and Routing- Representing Network knowledge using ontology definitions-Representing Network Data provenance - Representing Network Data Uncertainty-Representing Network Data Vagueness.

UNIT III **9 Hours**

DETECTION OF SOFTWARE VULNERABILITIES

Preliminaries: Supervised learning approaches- challenges of exploit prediction- Exploit prediction model: Data sources, Feature Description-Vulnerability and Exploit analysis: Likelihood of exploitation, Time-Based Analysis, vendor-/Platform-based analysis, Language-based analysis- Adversarial data manipulation.

UNIT IV **9 Hours**

NETWORK INTRUSION DETECTION

Network Intrusion detection: network intrusion detection systems- deployment methods, detection methodologies - ML in network intrusion detection- Fuzzy inference systems, Deployment of ML-based NIDSes. Detecting malware using SVM: SVM- feature settings- hyperparameter tuning-Evaluation metrics.

UNIT V **9 Hours**

AI TO NETWORK ATTACK DETECTION

AI methods to network attack detection - Training the binary classifier for detecting network attacks- CASE STUDY: An Obfuscation Technique for Malware Detection and Protection in Sandboxing- A long short term memory model for credit card fraud detection.

Total: 45 Hours

Reference(s)

1. Leslie F.Sikos "AI in Cybersecurity. Germany", Springer International Publishing, 2018.
2. Das, Ravi. "Practical AI for Cybersecurity". United States, CRC Press, 2021.
3. Ventre, Daniel. "Artificial Intelligence, Cybersecurity and Cyber Defence", United Kingdom, Wiley, 2020.
4. "Confluence of AI, Machine, and Deep Learning in Cyber Forensics". United States, IGI Global, 2020.
5. "Implications of Artificial Intelligence for Cybersecurity": Proceedings of a Workshop. United States, National Academies Press, 2020.

20AI005 BLOCKCHAIN TECHNOLOGY 3 0 0 3

Course Objectives

- Understand the fundamental concepts of Blockchain technology.
- Analyze the different consensus mechanisms to solve Byzantine problems.
- Enable the students to learn Blockchain techniques to support real time applications.

Program Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

b. 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.

c. 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.

d. 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.

e. Modern tool usage**:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Illustrate the concepts, benefits and the challenges of Blockchain Technology.
2. Make use of the different Blockchain Consensus Mechanism to solve Byzantine problems.
3. Examine the Cryptography techniques for Blockchain Technology.
4. Implement the Bitcoin Cryptocurrency concepts.
5. Apply the Smart Contracts and solidity in the Ethereum Cryptocurrency and different blockchain applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1												1	
2	1	1	2										2	
3	2	2	2		2								2	
4	3	3	3	2	3								3	
5	3	3	3	2	3								3	

UNIT I **9 Hours**

INTRODUCTION TO BLOCKCHAIN

Distributed Systems - Blockchain Introduction - History of Blockchain – Generic Elements of Blockchain - Features of Blockchain - Types of Blockchain - Blockchain Benefits and Challenges – Distributed and Shared Ledgers.

UNIT II **9 Hours**

CONSENSUS

Byzantine General Problems and Fault Tolerance - Practical Byzantine Fault Tolerance Algorithm – Introduction to Consensus Mechanism – Consensus Protocols - Types of Consensus Mechanisms: Proof of Work - Proof of Stake - Proof of Delegated Stake -Proof of Authority - Proof of Capacity - Proof of Elapsed time- Proof of Burn - Proof of Identity- Proof of Storage - Proof of Activity.

UNIT III **9 Hours**

CRYPTOGRAPHY BEHIND BLOCKCHAIN

Introduction to Cryptography - Cryptographic Primitives: Hash Function – Hash Pointers –- Digital Signatures - Merkley Tree - Symmetric Cryptography - Public Key Cryptography: Asymmetric Cryptography - Public and Private Keys - Encryption and Decryption using RSA - Elliptic Curve Cryptography- Memory Hard Algorithm - Zero Knowledge Proof.

UNIT IV **8 Hours**

BITCOIN

Introduction to Bitcoin – Digital Keys and Addresses – Transactions - Blocks - Bitcoin Mining - Wallets – Bitcoin Network - Bitcoin Consensus - Bitcoin Limitations – Privacy and anonymity- Forks - Double Spending.

UNIT V **10 Hours**

ETHEREUM AND BLOCKCHAIN APPLICATIONS

Introduction to Ethereum - Bitcoin vs Ethereum - Ethereum Virtual Machine (EVM) - Consensus in Ethereum - Wallets for Ethereum - Smart Contracts and Solidity - Smart contracts Vulnerabilities - Ethereum Programming Languages. Applications: Blockchain for Healthcare Informatics, Agriculture, Financial Technology, Government Applications, Internet of Things.Case Study: Medical Record Management System.

Total: 45 Hours

Reference(s)

1**.** Imran Bashir, "Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained", Packt Publishing, 2nd Edition, 2018. ISBN: 9781788839044.

2. Arvind Narayanan, J. Bonneau, E Felten, A Miller, and S Goldfeder, "Bitcoin and Crypto currency Technologies: A comprehensive Introduction", Princeton University Press, 2016.

3. Andreas M. Antonopoulos, "Mastering Bitcoin: Unlocking digital cryptocurrencies", O'Reilly Media, Inc., 2017, ISBN: 9781491954386.

4. Josh Thompson, Blockchain: The Blockchain for Beginners Guide to Blockchain Technology and Leveraging Blockchain Programming, Kindle Edition.

5. S. Shukla, M.Dhawan,S.Sharma,S. Venkatesan "Blockchain Technology: Cryptocurrency and Applications" ,Oxford University Press 2019.

6. Joseph Bonneau et al, SoK: Research perspectives and challenges for Bitcoin and cryptocurrency, IEEE Symposium on security and Privacy, 2015.

7. ArshdeepBahga and Vijay K. Madisetti, Blockchain Applications: A Hands-on Approach, 2018.

20AI006 GAME THEORY FOR AI 3 0 0 3

Course Objectives

- Understand the fundamentals of Game theory for AI.
- Explore how game theory can be applied in different ambit of AI.
- Analyse the different path finding techniques in game theory.
- Acquire the knowledge of decision-making techniques used in game theory.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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 public health and safety, and cultural, societal, and environmental considerations.
d. 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.
e. 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.
f. 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.
g. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.
l. 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.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Illustrate the foundation of game theory and AI.
2. Outline the techniques involved in game AI.
3. Identify how the game theory works with different path finding techniques.
4. Examine how the decision-making algorithms works with game theory.
5. Outline the different board games from the Game AI techniques.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2					1							2	
2	3	3	2										1	
3	2	1	2	2	2							2	3	
4	3	3	2				2						2	
5	2		2	3	2	1	3					3	3	

UNIT I **9 Hours**

INTRODUCTION

Introduction to AI and Games: Academic AI- Game AI- Model of Game AI: Movement- Decision Making-strategy- Infrastructure- Agent-based AI- GAME AI: The complexity fallacy- The perception window-changes of behavior- Speed and Memory- Processor issues- memory concerns- PC constraints- console constraints.

UNIT II **9 Hours**

GAME AI TECHNIQUES

AI Techniques: Hard-coded AI- Randomization- weighted randoms. Finite state machines- decision trees-fuzzy logic- utility theory- goal-oriented action planning-AI ENGINE: structure of an AI engine- toolchain concerns.

UNIT III **9 Hours**

PATHFINDING TECHNIQUES

Pathfinding: The pathfinding graph- Dijkstra - data structure and interfaces, performance of dijkstra - A* - data structure and interfaces, algorithm performance of A*- node array A*- Open goal path pathfinding-dynamic pathfinding-low memory algorithms- interruptible pathfinding-pooling planners- Continuous time pathfinding.

UNIT IV **9 Hours**

DECISION MAKING

Decision trees: the algorithms- implementation nodes- performance of decision trees- balancing the trees-random decision tree. State machines: Data structure and interfaces-hard-coded FSM- Hierarchical state machines- Combining decision trees and state machines. Fuzzy Logic: Fuzzy logic decision making- fuzzy state machines. Markov Processes- Markov State machines.

UNIT V **9 Hours**

BOARD GAMES

Types of games- the game tree- Minimaxing: The static evaluation function- minimaxing- the minimaxing algorithm- megamaxing- AB pruning- The search window- Negascout. Transposition tables and memory: Hashing Game states- Hash table implementation- Replacement strategies-transposition tables and its issues. Memory-enhanced test algorithms: The MTD algorithm.

Total: 45 Hours

Reference(s)

1. Ian Millington, John Funge, "Artificial Intelligence for Games (Second Edition)", Morgan Kaufmann, (2009).
2. Toni Lääveri "Integrating AI for Turn-Based 4X Strategy Game" Helsinki Metropolia University of Applied Sciences, 2017.
3. Mike McShaffry, David Rez Graham, "Game Coding complete fourth edition", Delmar Learning, (2012).
4. Bourg, David M., and Glenn Seemann, "AI for Game Developers". Sebastopol CA: O'Reilly, (2004).
5. Russell, Stuart J. and Peter Norvig. "Artificial intelligence - a modern approach, 2nd Edition." Prentice Hall series in artificial intelligence (2003).
6. Leyton-Brown, Kevin, and Shoham, Yoav. "Essentials of Game Theory: A Concise Multidisciplinary Introduction". United States, Morgan & Claypool Publishers, 2008.

20AI007 VIRTUAL REALITY AND AUGMENTED REALITY 3 0 0 3

Course Objectives

- To impart the fundamental concepts and applications of Virtual Reality.
- Describe how Augmented Reality systems work and list the applications of Augmented Reality.
- Use computer vision concepts for Augmented Reality applications.

Program Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

- Illustrate the various input and output devices used for virtual reality.
- Make use of the different geometric modelling to visual virtualization.
- Implement the Virtual Reality applications using Unity.
- Explain the basic concepts of Virtual Reality.
- Use computer vision concepts for augmented reality applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1											1	
2	2	2											2	
3	3	3	3	2	3								3	
4	1	1											1	
5	3	3	3	2	3								3	

UNIT I **9 Hours**

INTRODUCTION TO VIRTUAL REALITY

Introduction to Virtual Reality - The three I's of VR – Basic components of a VR system – Computing Architectures of VR - VR input devices: 3D position trackers – Navigation and manipulation interfaces – Gesture interfaces – Output Devices: Graphics Displays - Sound displays & haptic feedback.

UNIT II **10 Hours**

GEOMETRIC MODELLING

Geometric Modeling: Virtual Object Shape- Object Visual Appearance- Kinematics Modeling: Homogeneous Transformation Matrices- Object Position- Transformation Invariants- Object Hierarchies Viewing the Three-Dimensional World- Physical Modeling: Collision Detection- Surface Deformation- Force Computation Force Smoothing and Mapping- Haptic Texturing - Behavior Modeling: Model Management Level-of-Detail Management- Cell Segmentation.

UNIT III **7 Hours**

UNITY AND VR APPLICATIONS

Introduction to Unity – 3D Space - Unity User Interface - Navigating in Unity - Creating Objects in Unity- Positioning, Scaling, and Transforming Primitives in Unity - Keyframe Animation in Unity - Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – VR Applications in Manufacturing – Applications of VR in Robotics.

UNIT IV **9 Hours**

AUGMENTED REALITY

Introduction to Augmented Reality – Displays: Multimodal Displays - Visual Perception - Spatial Display Model - Visual Displays -Tracking: Tracking, Calibration, and Registration -Coordinate Systems - Characteristics of Tracking Technology - Stationary Tracking Systems - Mobile Sensors - Optical Tracking – Sensor Fusion.

UNIT V **10 Hours**

COMPUTER VISION FOR AUGMENTED REALITY & CALIBRATION

Computer Vision for Augmented Reality: Marker Tracking - Multiple-Camera Infrared Tracking - Natural Feature Tracking by Detection - Incremental Tracking - Simultaneous Localization and Mapping - Outdoor Tracking - Calibration and Registration: Camera Calibration - Display Calibration – Registration - Visual Coherence – Visualization – Interaction - Application areas of Augmented Reality.

Total: 45 Hours

Reference(s)

1. C. Burdea & Philippe Coiffet, "Virtual Reality Technology", Second Edition, Gregory, John Wiley & Sons, Inc., 2016.
2. Augmented Reality: Principles and Practice (Usability) by Dieter Schmalstieg and Tobias Hollerer, Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016. ISBN: 9780321883575
3. Jason Jerald. 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool, New York, NY, USA.
4. Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability), Steve Aukstakalnis, Addison-Wesley Professional; 1 edition, 2016.
5. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India; First edition (12 October 2016), ISBN-10: 9332578494.

20AI008 COGNITIVE COMPUTING 3 0 0 3

Course Objectives

- Understand the fundamentals of Cognitive Computing.
- To apply advanced analytics to cognitive computing
- Explore how cognitive computing used in healthcare system.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. 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.

c. 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 public health and safety, and cultural, societal, and environmental considerations.

d. 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.

f. 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.

g. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.

m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Represent the fundamentals of Cognitive Computing and design principles.
2. Interpret how Natural language processor used in cognitive computing.
3. Apply advanced analytics to cognitive computing.
4. Examine the use of cognitive computing in business.
5. Outline the applications of cognitive computing in healthcare system.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1		1										2	
2	2	3	3	2									2	
3	1	2	2	3			1						3	
4	2	2	4				2						1	
5	1	3	3	1		2	1						2	

UNIT I **9 Hours**

INTRODUCTION TO COGNITIVE COMPUTING

The Foundation of Cognitive Computing- Principal technology enablers of Cognitive computing: Big Data and Data Science- Performance, Scalability, and Elasticity- Distributed Computing Architectures- Cognitive Computing Architecture and Approaches- Cognitive Computing Systems and Applications: Intelligent tutoring systems- Problem solving systems-Question Answering- Human-Robot interaction.

UNIT II **9 Hours**

NATURAL LANGUAGE PROCESSING IN COGNITIVE SYSTEMS

Natural Language Processing in Support of a Cognitive System - The Role of NLP in a Cognitive System- Semantic Web - Applying Natural Language Technologies to Business Problems. Representing Knowledge in Taxonomies and Ontologies - Representing Knowledge Defining Taxonomies and Ontologies - Explaining How to Represent Knowledge - Models for Knowledge Representation - Implementation Considerations.

UNIT III **9 Hours**

ADVANCED ANALYTICS IN COGNITIVE COMPUTING

Applying Advanced Analytics to Cognitive Computing- Time-Evolving Graphs- Properties of Time-Evolving Graphs- Visual Analytics as a framework for Time-Evolving Graphs: Visual Analytics Frameworks- Data Management- Graph Analytics- Visualization-Visual Representation.

UNIT IV **9 Hours**

COGNITIVE SYSTEMS APPROACH

The Business Implications of Cognitive Computing: Preparing for Change - Advantages of New Disruptive Models - The Difference with a Cognitive Systems Approach - Meshing Data Together Differently - Using Business Knowledge to Plan for the Future - Building Business Specific Solutions - Making Cognitive Computing a Reality.

UNIT V **9 Hours**

BUILDING A COGNITIVE APPLICATION

CASE STUDY: Building a Cognitive Healthcare Application Foundations of Cognitive Computing for Healthcare - Constituents in the Healthcare Ecosystem - Cognitive Applications across the Healthcare Ecosystem - Emerging Cognitive Computing Areas - Future Applications for Cognitive Computing.

Total: 45 Hours

Reference(s)

1. Judith H Hurwitz, Marcia Kaufman, Adrian Bowles, “Cognitive computing and Big Data Analytics”, Wiley, 2015.
2. Vijay Raghvan, Venu Govindaraju, C.R. Rao, Cognitive Computing: Theory and Applications", by Elsevier publications, North Holland Publication, 1st Edition, 2016.
3. Bernadette Sharp (Author), Florence Sedes (Author), Wieslaw Lubaszewski (Author), Cognitive Approach to Natural Language Processing Hardcover, First Edition May 2017.
4. Arun Kumar Sangaiah, Arunkumar Thangavelu, et al., Cognitive Computing for Big Data Systems over IoT: Frameworks, Tools and Applications: Lecture Notes on Data Engineering and Communications Technologies 1st edition 2018.
5. Min Chen and Kai Hwang, Big-Data Analytics for Cloud, IoT and Cognitive Computing Wiley Publication, 1st Edition, 2017.
6. Mallick, Pradeep Kumar, Borah, Samarjeet," Emerging Trends and Applications in Cognitive Computing”, IGI Global Publishers, 2019.

20AI009 EXPERT SYSTEMS 3 0 0 3

Course Objectives

- Understand the concepts of intelligent agents, searching, knowledge and reasoning, planning and learning in expert systems.
- Illustrate the knowledge representation and acquisition in expert systems.
- Analyse the features, tools, limitations and applications of expert systems.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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 public health and safety, and cultural, societal, and environmental considerations.
d. 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.
e. 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.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Interpret the solutions for AI problems that leads to expert systems.
2. Illustrate the features, tools, limitations and applications of expert systems.
3. Outline the procedure to build an expert system.
4. Analyze the requirement of knowledge acquisition in expert systems.
5. Compare the knowledge representation using rules, semantic nets, and frame in expert systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1											1	
2	3	2	3	1	2								2	
3	2	2	2	2	3								2	
4	2	2	2	2	2								3	
5	2	3	2	2	2								3	

UNIT I **9 Hours**

INTRODUCTION TO AI PROBLEMS AND SEARCH STRATEGIES

Intelligent agents – AI Problems - State Space Search: The Search problem - Search Techniques - Types - Uninformed search strategies – Informed search strategies - Heuristic Search Strategies.

UNIT II **9 Hours**

EXPERT SYSTEMS

Definition – Features of an expert system – Architecture and Components of Expert System-Stages in the development of an Expert System - Problem Selection - Conceptualization - Formalization - Prototype Construction - Implementation - Evaluation - Probability based Expert Systems – MYCIN – EMYCIN - Limitations and Applications of Expert Systems.

UNIT III **9 Hours**

BUILDING AN EXPERT SYSTEM

Expert system tools - Selecting a tool - Evaluating the System Building tool - Knowledge acquisition process - Resources, Inherent Limitations - Common pitfalls in planning, development - Pitfalls in dealing with Domain Expert.

UNIT IV **9 Hours**

KNOWLEDGE ACQUISTION IN EXPERT SYSTEMS

Knowledge Acquisition - Knowledge Engineer - Difficulties - Knowledge Acquisition techniques - Natural Techniques - Contrived Techniques - Modelling Techniques.

UNIT V **9 Hours**

KNOWLEDGE REPRESENTATION IN EXPERT SYSTEMS

Definition- Characteristics - Properties of the symbolic representation of knowledge Knowledge representation using rules, semantic nets, frames - Nature of Expert System tools - System Building Aids - Knowledge Engineering Languages and Examples.

FOR FURTHER READING

Markov chains, Odds of Belief, Role of uncertainty in inference chains, Implications of combining evidence, Role of inference nets in expert systems

Total: 45 Hours

Reference(s)

1. Gupta, G. Nagpal, "Artificial Intelligence and Expert Systems", Mercury Learning & Information, 2020.
2. Donald. A. Waterman, “A Guide to Expert Systems”, 3rd Edition, Pearson Education, 2009.
3. J. Giarratano and G. Riley, “Expert Systems -- Principles and Programming”, 4th Edition, PWS Publishing Company, 2004.
4. 2. Peter Jackson, “Introduction to Expert Systems”, Addison Wesley Longman, 1999.
5. Patterson, “Introduction to Artificial Intelligence and Expert Systems”, Pearson Education India, 2015.
6. Nikolopoulos, “Expert Systems”, Marcel Dekker Inc. 1997

20AI010 GPU ARCHITECTURE AND PROGRAMMING 3 0 0 3

Course Objectives

- Understand the basics of GPU architectures.
- Implement the Programs for GPUs using CUDA / OpenCL.
- Understand the issues in mapping algorithms for GPUs.

Program Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

e. Modern tool usage**:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Illustrate the basics of GPU architecture.
2. Implement the programs for parallel processors using CUDA.
3. Analyze the issues in mapping algorithms for GPUs.
4. Develop the simple programs using OpenCL.
5. Implement algorithms in GPUs to get maximum occupancy and throughput.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2			1									
2	3	3	3		3								2	
3	2	2	2		3									
4	3	3	3		3								2	
5	2	3	2	1	3								2	

UNIT I **9 Hours**

GPU ARCHITECTURE

Evolution of GPU architectures - Understanding Parallelism with GPU –Typical GPU Architecture - CUDA Hardware Overview - Threads, Blocks, Grids, Warps, Scheduling - Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory-NVIDIA GPU Architecture Case Study.

UNIT II **9 Hours**

CUDA PROGRAMMING

Introduction – CUDA Program Structure – Multi GPU - Multi GPU Solutions - Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.

UNIT III **9 Hours**

PROGRAMMING ISSUES

Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors.

UNIT IV **9 Hours**

OPENCL BASICS

OpenCL Standard – Kernels – Host Device Interaction – Execution Environment – Memory Model – Basic OpenCL Examples.

UNIT V **9 Hours**

ALGORITHMS ON GPU

Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix - Matrix Multiplication - Programming Heterogeneous Cluster.

Total: 45 Hours

Reference(s)

1. Shane Cook, CUDA Programming: ―A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing), First Edition, Morgan Kaufmann, 2012

2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, "Heterogeneous computing with OpenCL", 3rd Edition, Morgan Kauffman, 2015.

3. Nicholas Wilt, ―CUDA Handbook: A Comprehensive Guide to GPU Programming, Addison - Wesley, 2013.

4. Jason Sanders, Edward Kandrot, ―CUDA by Example: An Introduction to General Purpose GPU Programming, Addison - Wesley, 2010.

5. David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors - A Hands-on Approach, Third Edition, Morgan Kaufmann, 2016.

6. http://www.nvidia.com/object/cuda_home_new.html.

7. http://www.openCL.org.

20AI011 HUMAN COMPUTER INTERACTION 3 0 0 3

Course Objectives

- Understand the fundamentals of human computer interaction.
- Explore the social and emotional human computer interactions.
- Acquire the knowledge of data analysis and interpretation in human computer interaction.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. 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.
c. 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 public health and safety, and cultural, societal, and environmental considerations.
d. 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.
e. 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.
f. 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.
g. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Illustrate the knowledge of human and computer in the process of human computer interaction.
2. Examine the techniques involved in Human computer interfaces.
3. Outline the process of interaction design.
4. Examine how social and emotional interactions works in human computer interaction.
5. Outline the process of data analysis in human computer interaction.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		1			2							2	
2	2	2	3		2								3	
3	2	2	1				2						1	
4	1	3	2				2						3	
5	3	3	2	3									2	

UNIT I **9 Hours**

INTRODUCTION

Introduction to Interaction Design: User Experience – The process of Interaction Design – Interaction design and User Experience. Understanding and Conceptualizing Interaction: Conceptual Models – Interface Metaphors – Interaction Types – Paradigms and Frameworks. Cognitive Aspects: Cognition– Cognitive Framework. Social Interaction – Emotional Interaction.

UNIT II **10 Hours**

HUMAN MACHINE INTERFACES

Interfaces: Types – Natural User Interfaces, Data Gathering: Key Issues – Data Recording – Interviews– Questionnaires – Observation – Choosing and Combining Technique. Data Analysis, Interpretation and Presentation: Qualitative and Quantitative – Simple Analysis – Tools -Theoretical Frameworks – Presenting the Findings.

UNIT III **9 Hours**

PROCESS OF INTERACTION DESIGN

Process of Interaction Design: Introduction. Establishing Requirements: Data Gathering for Requirements – Task Description – Task Analysis, Design, Prototyping and Construction: Prototyping and Construction – Conceptual Design and Physical Design – Using Scenarios, Prototypes in Design. Evaluation: Introduction – Evaluation Framework.

UNIT IV **9 Hours**

SOCIAL AND EMOTIONAL INTERACTION

Social Interaction: Being social- Face-to-face conversations-remote conversations. Emotional Interaction: What is Emotional Interaction- Emotions and User Experience- Expressive Interfaces and Emotional design- Annoying Interfaces- Conversational User Experience: What is Conversation user experience- Strategic Benefits of Conversational Experience- Streamlined Browsing Experience-Improved Customer Service & satisfaction.

UNIT V **8 Hours**

DATA ANALYSIS, INTERPRETATION AND PRESENTATION

Data analysis, interpretation and presentation: Quantitative and qualitative - Basic quantitative analysis- basic qualitative analysis- different analytic frameworks- tools to support data analysis-interpreting and presenting the findings- Approaches to collecting and analysing data- visualizing and exploring concerns.

Total: 45 Hours

Reference(s)

1. Preece, J., Rogers, Y., Sharp, H. "Interaction Design: Beyond Human-Computer Interaction". Hoboken, NJ: Wiley. ISBN: 978-1-119-02075-2, (2015).
2. Becker, Christopher Reid. Learn Human-Computer Interaction: Solve Human Problems and Focus on Rapid Prototyping and Validating Solutions through User Testing. N.p., Packt Publishing, 2020.
3. MacKenzie, I. Scott. "Human-Computer Interaction: An Empirical Research Perspective". Netherlands, Elsevier Science, 2012.
4. Wilbert O. Galitz, "The Essential Guide to User Interface Design: An Introduction to Gui Design Principles and Techniques", Third Edition, John Wiley Sons, 2002.
5. Benyon, D., Turner, P., and Turner, S, "Designing Interactive Systems: People, Activities, Contexts, and Technologies", Addison-Wesley, 2005.

20AI012 KNOWLEDGE REPRESENTATION AND REASONING 3 0 0 3

Course Objectives

- Understand the fundamentals of the reasoning.
- Analyse the Procedural Control of Reasoning & Rules in Production Systems**.**
- To understand the basics of the Object-Oriented Representation and structured description in knowledge representation.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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 public health and safety, and cultural, societal, and environmental considerations.

m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Interpret the Language of First-Order Logic and Expressing Knowledge with Knowledge Engineering.
2. Outline the basics of reasoning system.
3. Apply the rules in Production Systems.
4. Illustrate the basics of Object-Oriented Representation.
5. Examine the knowledge representation in Structured Descriptions.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	1										1	
2	2	3	2	1									1	
3	3	1	2	2									1	
4	2	2	2										2	
5	3	3	2	3									2	

UNIT I **9 Hours**

INTRODUCTION TO KNOWLEDGE, REPRESENTATION AND REASONING

Overview of Knowledge-Based Systems - The Role of Logic - The Language of First-Order Logic: Syntax - The Semantics - Interpretations - Denotation - Satisfaction and Models - The Pragmatics - Logical Consequence - Explicit and Implicit Belief - Expressing Knowledge: Knowledge Engineering, Vocabulary, Basic Facts, Complex Facts, Terminological Facts, Entailments, Abstract Individuals.

UNIT II **9 Hours**

RESOLUTION AND REASONING WITH HORN CLAUSES

The Propositional Case: Resolution Derivations, An Entailment Procedure, Handling Variables and Quantifiers: First-Order Resolution, Answer Extraction, Skolemization, Equality, Dealing with Computational Intractability - Horn Clauses - SLD Resolution - Computing SLD Derivations.

UNIT III **9 Hours**

PROCEDURAL CONTROL OF REASONING & RULES IN PRODUCTION SYSTEMS

Rule Formation and Search Strategy - Algorithm Design - Specifying Goal Order - Committing to Proof Methods - Controlling Backtracking - Negation as Failure - Dynamic Databases - Production Systems: Basic Operation - Working Memory - Production Rules - Conflict Resolution - Making Production Systems More Efficient - Applications and Advantages.

UNIT IV **8 Hours**

OBJECT-ORIENTED REPRESENTATION

Objects and Frames - A Basic Frame Formalism - Generic and Individual Frames - Inheritance - Reasoning with Frames - Uses of Frames - Extensions to the Frame Formalism - Object-Driven Programming with Frames.

UNIT V **10 Hours**

STRUCTURED DESCRIPTIONS

Noun Phrases - Concepts, Roles, and Constants - A Description Language - Meaning and Entailment - Interpretations - Truth in an Interpretation - Entailment - Computing Entailments - Simplifying the Knowledge Base - Normalization - Structure Matching - The Correctness of the Subsumption Computation - Computing Satisfaction - Taxonomies and Classification Applications of Description Logics

Total: 45 Hours

Reference(s)

1. Ronald J. Brachman, Hector J. Levesque, "Knowledge Representation and Reasoning", In the Morgan Kaufmann Series in Artificial Intelligence, Morgan Kaufmann, 2009.

2. Franz Baader, Ian Horrocks, Carsten Lutz, Uli Sattler, “An Introduction to Description Logic”, Cambridge University Press, First Edition, 2017.

3. “Handbook of Knowledge Representation. Frank van Harmelen, Vladimir Lifschitz and Bruce Porter (Eds). Foundations of Artificial Intelligence, 2008.

4. Pascal Hitzler, Markus Kroetsch, and Sebastian Rudolph, “Foundations of Semantic Web Technologies”, Chapman and Hall, CRC Textbooks in Computing, 2009.

20AI013 REINFORCEMENT LEARNING 3 0 0 3

Course Objectives

- To learn the core principles behind the RL, including policies, value functions, deriving Bellman equations.
- Acquire the knowledge on how to define Markov Decision Processes with its properties.
- Explore the Monte Carlo Methods to solve real-world problems.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

c. 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 public health and safety, and cultural, societal, and environmental considerations.

d. 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.

m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Interpret the importance of Reinforcement Learning primitives.
2. Outline the RL Framework and Markov Decision Process.
3. Illustrate how to define RL tasks and the core principles behind the RL, including policies and value functions.
4. Classify the policy iteration and value iteration in Reinforcement Learning.
5. Make use of the Monte Carlo methods and RL algorithms for real world problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	2										1	
2	2	2	2										2	
3	1	2	3	2									2	
4	2	2	2	1									2	
5	2	3	2	2									3	

UNIT I **10 Hours**

REINFORCEMENT LEARNING PRIMITIVES

The Reinforcement Learning Problem- Elements of Reinforcement Learning - Limitations and Scope - Multi-arm Bandits - An n-Armed Bandit Problem - Tracking a Non stationary Problem - Upper-Confidence-Bound Action Selection - Gradient Bandits.

UNIT II **10 Hours**

MARKOV DECISION PROCESS

The Agent–Environment Interface - Goal and Rewards - Returns - Unified Notation for Episodic and Continuing Tasks - The Markov Property - Markov Decision Processes - Sequential Decision Making with Evaluative Feedback - Learning Action Values - Estimating Action Values Incrementally.

UNIT III **9 Hours**

VALUE FUNCTIONS & BELLMAN EQUATIONS

Specifying Policies-Value Functions - Bellman Equation Derivation -Why Bellman Equations - Optimal Policies - Optimal Value Functions - Using Optimal Value Functions to Get Optimal Policies.

UNIT IV **9 Hours**

DYNAMIC PROGRAMMING

Policy Evaluation vs. Control - Iterative Policy Evaluation - Dynamic Programming: Polices (Evaluation - Improvement - Iteration - Value Iteration) - Asynchronous Dynamic Programming - Generalized Policy Iteration - Efficiency of Dynamic Programming.

UNIT V **7 Hours**

MONTE CARLO METHODS

Monte Carlo Prediction - Estimation of Action Values - Control and Control without Exploring Starts - Off-policy Prediction via Importance Sampling - Incremental Implementation - Off-Policy Monte Carlo Control - Importance Sampling on Truncated Returns - Applying RL for Real-World Problems.

FOR FURTHER READING

Temporal Difference (TD) algorithms - Model-Free Vs. Model-Based Reinforcement Learning - Deep Reinforcement Learning - Policy Optimization in RL.

Total: 45 Hours

Reference(s)

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An Introduction", Second Edition, MIT Press, 2019.
2. Phil Winder, “Reinforcement Learning”, O'Reilly Media, First Edition, 2020
3. Michael Wooldridge, “An Introduction to Multi Agent Systems”, John Wiley, 2002.
4. Marco Wiering, Martijn Van Otterlo, "Reinforcement learning State-of-the-Art", Springer Berlin Heidelberg, 2012

20AI014 BIG DATA ANALYTICS 3 0 0 3

Course Objectives

- Understand the fundamentals of big data analytics.
- Acquire knowledge on Stream Memory and Real Time Analytics Platform (RTAP) applications.
- Apply the NoSQL Data Management and Graph analytics in real time.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

b. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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 public health and safety, and cultural, societal, and environmental considerations.

d. 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.

e. 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.

n. Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Interpret the fundamentals of big data analytics.
2. Illustrate the big data tools, techniques and applications.
3. Categorize the data by clustering and classification algorithms for big data.
4. Outline the principles of analytics on data streams.
5. Implement the NoSQL database management for big data and visualization.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		1											1
2	2		1	1										2
3	3	3	2	2										2
4	1	2	2	2	1									2
5	1	2	3	1	1									3

UNIT I **9 Hours**

INTRODUCTION TO BIG DATA

Market and Business Drivers for Big Data Analytics - Business Problems - Big Data Use Cases - Characteristics of Big Data Applications - Perception and Quantification of Value - Achieving Organizational Alignment - Big Data and Data Governance - High-Performance Appliances.

UNIT II **9 Hours**

BIG DATA TOOLS, TECHNIQUES AND APPLICATIONS

Understanding Big Data Storage - Overview of High-Performance Architecture - HDFS - MapReduce - YARN - HBase - Hive - Pig - Mahout - Considerations - Developing Big Data Applications: Application Development Framework - MapReduce Programming Model.

UNIT III **9 Hours**

CLUSTERING AND CLASSIFICATION

Overview of Clustering: K-means - Use Cases - Determining the Number of Clusters - Diagnostics - Reasons to Choose and Cautions - Classification: Decision Trees - Overview of a Decision Tree - The General Algorithm - Decision Tree Algorithms - Evaluating a Decision Tree - Decision Trees in R - Naïve Bayes - Baye's Theorem - Naïve Bayes Classifier.

UNIT IV **9 Hours**

STREAM MEMORY

Introduction to Streams Concepts - Stream Data Model and Architecture - Stream Computing, Sampling Data in a Stream - Filtering Streams - Counting Distinct Elements in a Stream - Estimating moments - Counting oneness in a Window - Decaying Window - Real Time Analytics Platform (RTAP) applications.

UNIT V **9 Hours**

NOSQL DATA MANAGEMENT AND GRAPH ANALYTICS FOR BIG DATA

NoSQL Databases: Schema-less Models - Increasing Flexibility for Data Manipulation - Key Value Stores- Document Stores - Tabular Stores - Object Data Stores - Graph Databases - Graph analytics: Representation as Triples - Graphs and Network Organization - Technical Complexity of Analyzing Graphs - Best Practices for Big Data analytics - Case Studies : Real Time Sentiment Analysis - Stock Market Predictions Using Graph Analytics for Big Data.

Total: 45 Hours

Reference(s)

1. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", Elsevier Science & Technology Books, 2014.
2. Paul C Zikopoulos, Chris Eaton, "Understanding Big data", McGraw Hill, 2012.
3. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015.
4. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015.
5. Kim H. Pries and Robert Dunnigan, "Big Data Analytics: A Practical Guide for Managers", CRC Press, 2015.

20AI015 GEOSPATIAL DATA ANALYSIS 3 0 0 3

Course Objectives

- Acquire knowledge on spatial data analysis.
- To provide the ability to analyze GIS data of all sorts.
- To understand the uses and limitations of GIS data.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
b. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. 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.
n. Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Represent the concept of spatial data analysis and the modeling.
2. Illustrate editing and managing of Geodatabases.
3. Demonstrate the methods of spatial data Analysis.
4. Outline the techniques of spatial interpolation.
5. Examine the models used for visualization of spatial data.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	1												
3	3	2		1										1
4	3	2		2										2
5	3	3		2										2

UNIT I **9 Hours**

INTRODUCTION

Introduction to Spatial Data Analysis - Need for Spatial Analysis - Types of Spatial Data - Autocorrelation- Mantel's Tests for Clustering - Measures on Lattices - Localized Indicators - Autocorrelation Functions - Effects of Autocorrelation on Statistical Inference.

UNIT II **9 Hours**

GRAPHICAL INFORMATION SYSTEMS

Data and Data models - Databases in GIS - Referencing systems and projections – Georeferencing - Geocoding - Spatial scale - Spatial Data Collection - Sources of data error - Visualizing spatial data - Querying data – Statistics.

UNIT III **9 Hours**

SPATIAL DATA ANALYSIS

Distances – Measuring Lengths and Perimeters – Measuring Areas – Distances from Objects – Moving Windows – Geographical Weights – Spatial Dependence and Autocorrelation – Combining Data Layers – Network Analysis – Exploring Spatial Point Patterns – Exploring Spatial Patterning in Data Values.

UNIT IV **9 Hours**

SPATIAL INTERPOLATION

Introduction – Triangulated Irregular Networks – Regression for Prediction – Inverse Distance Weighting – Thin Plate Splines – Ordinary Kriging - Cokriging– Other Approaches and Issues – Area Interpolation – Variogram Estimation.

UNIT V **9 Hours**

ANALYSIS OF GRIDS AND SURFACES

Map Algebra – Image Processing – Spatial Filters – Derivatives of Attitude - Other Products Derived from Surfaces – Digital Elevating Models – Methods of Representing DEM – Data Sources - Applications.

Total: 45 Hours

Reference(s)

1. Christopher D.Lloyd, (2010), Spatial Data Analysis, An Introduction For GIS Users, Oxford University Press, New York.
2. Oliver Schabenberger, Carol A. Gotway, (2017), Statistical Methods for Spatial Data Analysis, Chapman & Hall/CRC.
3. Burrough, Peter A. and Rachael McDonnell, (2016), Principles of Geographical Information Systems. Oxford University Press, New York.
4. Laurini, Robert and Derek Thompson, Fundamentals of Spatial Information Systems. Academic Pr., London
5. Paul Longley, Michael Goodchild, David Maguire and David Rhind: (Editors) (2005), Geographical Information Systems Principles, Techniques, Applications and Management. John Wiley & Sons.

20AI016 PREDICTIVE ANALYTICS 3 0 0 3

Course Objectives

- Learn the fundamentals of predictive analytics.
- Explore the predictive modeling and its techniques.
- Apply regression model, classification model and Model Evaluation Techniques for decision making and to measure the performance.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
b. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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 public health and safety, and cultural, societal, and environmental considerations.
d. 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.
e. 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.
n. Ability to identify and use analytic skills for massive datasets to extract insights by applying suitable Data analytic tools and techniques.

Course Outcomes (COs)

1. Interpret the importance of predictive analytics.
2. Illustrate the data preprocessing, overfitting and model tuning in predictive analytics.
3. Compare the various predictive modeling techniques.
4. Outline the regression model for decision making and to measure the performance.
5. Categorize the classification models in predictive analytics.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		1											1
2	2													2
3	3	3			1									2
4	1	2	2	1	2									3
5	1	2	3	1	3									3

UNIT I **9 Hours**

UNDERSTANDING DATA

Introduction to predictive analytics – Business analytics: types, applications- Models: predictive models – descriptive models – decision models - applications - analytical techniques - Data types and associated techniques – complexities of data – data preparation, pre-processing – exploratory data analysis.

UNIT II **9 Hours**

DATA PREPROCESSING, OVERFITTING AND MODEL TUNING

Data transformations for individual predictors and multiple predictors - Dealing with missing values - Adding, Binning, Removing predictor - Over fitting and model tuning - Data splitting - resampling techniques - Data splitting recommendations - Case study on credit scoring.

UNIT III **9 Hours**

PREDICTIVE MODELING

Propensity models - Cluster models- Modeling Techniques - Empirical Bayes Method - Point Estimation - Robbins method: non-parametric empirical Bayes (NPEB) - Parametric empirical Bayes - Poisson-Gamma model - Bayesian Linear regression.

UNIT IV **9 Hours**

REGRESSION MODELS

Measuring Performance in Regression Models - Linear Regression - Non-Linear Regression Models - Regression Trees and Rule-Based Models - Case Study: Compressive Strength of Concrete Mixtures.

UNIT V **9 Hours**

CLASSIFICATION MODELS & TIME SERIES ANALYSIS

Measuring Performance in Classification Models - Discriminant Analysis and Other Linear Classification Models - Non-Linear Classification Models - Classification Trees and Rule-Based Models – Model Evaluation Techniques - Time series Model: ARMA, ARIMA, ARFIMA - Temporal mining - Box Jenkinson method, temporal reasoning and temporal constraint networks.

Total: 45 Hours

Reference(s)

1. Jeffrey Strickland, “Predictive analytics using R”, Simulation Educators, Colorado Springs, 2015.
2. Max Kuhn and Kjell Johnson, “Applied Predictive Modeling”, 1st edition Springer, 2013
3. John D. Kelleher, Brian Mac Namee, Aoife D'Arcy , "Fundamentals of Machine Learning for Predictive Data Analytics", MIT Press, Second Edition, 2020
4. "An Introduction to Statistical Learning, with Applications in R", James, Witten, Hastie, Tibshirani, 2013, New York: Springer.

20AI017 TIME SERIES ANALYSIS AND FORECASTING 3 0 0 3

Course Objectives

- Understand the basic concepts of Time Series data and its analysis.
- Acquire the knowledge of Statistical and State Space models in Time series.
- Illustrate how to process time series data using Machine and Learning and Deep Learning Techniques.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
b. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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 public health and safety, and cultural, societal, and environmental considerations.
d. 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.
e. 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.
n. Ability to identify and use analytic skills for massive datasets to extract insights by applying suitable Data analytic tools and techniques.

Course Outcomes (COs)

1. Illustrate the time series data analysis and different types of plotting and visualization techniques used for time series data.
2. Outline the simulation of time series data and storage of temporal data.
3. Categorize the Stationary and Non-Stationary Time series models.
4. Illustrate how to process time series data using Machine and Learning and Deep Learning Techniques.
5. Examine the performance of Time series data.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	2	2	2										1	
3	3	3	3		2								2	
4	2	2	2	2	3								2	
5	3	2	3		2								3	

UNIT I **9 Hours**

INTRODUCTION

Origin of Time series analysis - Finding and Wrangling Time Series data - Retrofitting a Time Series Data Collection from a Collection of Tables – Constructing Time Series - Exploratory Data Analysis for Time Series – Familiar methods - Understanding and Identifying Self-Correlation – Visualization - Time Series in Diverse Applications.

UNIT II **9 Hours**

SIMULATING AND STORING TEMPORAL DATA

Simulating Time Series Data - Simulation Versus Forecasting - Simulations in Code - A Physics Simulation - Statistical Simulations - Deep Learning Simulations - Storing Temporal Data - Defining Requirements - Live Data Versus Stored Data - Database Solutions - SQL Versus NoSQL -Popular Time Series Database and File Solutions.

UNIT III **9 Hours**

STATISTICAL MODELS AND STATE SPACE MODELS FOR TIMES SERIES

Statistical methods developed for Time Series - Autoregressive models - Moving Average models - Autoregressive Integrated Moving Average models - Vector Autoregression - Variations on statistical models - Introduction to ARIMAX and SARIMAX - State Space Models for Time Series : The Kalman Filter - Hidden Markov Models - Bayesian Structural Time Series - Generating and Selecting Features for a Time Series - General Considerations When Computing Features - Domain Knowledge-External Considerations.

UNIT IV **9 Hours**

MACHINE LEARNING AND DEEP LEARNING FOR TIME SERIES

Machine Learning for Time Series - Time Series Classification-Selecting and Generating Features – Decision Tree Methods – Clustering - Generating Features from the Data - Temporally Aware Distance Metrics - Deep Learning for Time Series - Programming a Neural Network - Data, Symbols, Operations, Layers, and Graphs - Training Pipeline- Feed Forward Network- Convolution Model – RNNs.

UNIT V **9 Hours**

PERFORMANCE ANALYSIS

Measuring Error - The Basics: How to Test Forecasts - Model-Specific Considerations for back testing - Estimating Uncertainty - Predicting Multiple Steps Ahead - Recursive Approach to Distant Temporal Horizons - Multitask Learning Applied to Time Series - Model Validation Gotchas - Performance Considerations in Fitting and Serving Time Series Models.

Total: 45 Hours

Reference(s)

1. Aileen Nielsen, "Practical Time Series Analysis - Prediction with Statistics and Machine Learning", O'Reilly publications, First Edition, 2019.
2. Peter J. Brockwell Richard, A. Davis, "Introduction to Time Series and Forecasting", Second Edition, Springer, 2016.
3. James Douglas Hamilton, "Time Series Analysis", Princeton University Press, 2020
4. William.W.S.Wei, "Time Series Analysis – Univariate and Multivariate Methods", Second Edition, Pearson, 2006.
3. Chatfield, C., "The Analysis of Time Series", Chapman & Hall/CRC, 2004.

20AI018 VISUAL ANALYTICS 3 0 0 3

Course Objectives

- Understand the fundamentals of Visual Analytics.
- Gain knowledge about the different aspects on representations, transformations and statistics of data.
- Analyse the data management techniques in Visual Analytics.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. 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.

c. 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 public health and safety, and cultural, societal, and environmental considerations.

d. 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.

f. 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.

g. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.

l. 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.

n. Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Illustrate the fundamental concepts of visual analytics.
2. Interpret the different aspects on representations, transformations and statistics of data.
3. Examine the different techniques of data management.
4. Categorize the Geospatial, Temporal, Spatio-temporal and Multivariate data.
5. Outline the temporal and spatial statistics on data.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3			1			2					2		2
2	3	3	1	2								3		3
3	2	2	2			2								2
4	3	1	2	2			2					2		2
5	3	3				1								3

UNIT I **9 Hours**

INTRODUCTION TO VISUAL ANALYTICS

Fundamentals of Visual Analytics- Analytical reasoning techniques- Application of visual Analytics- Historical perspective on Visual Analytics- The visual analytics process- building blocks of visual analytics- visualization- data management- data mining- data transformation.

UNIT II **9 Hours**

ANALYTICAL REASONING AND DATA TRANSFORMATION

Intelligence analysis: critical thinking- situation awareness. Human aspects on Cognition, perception, sensemaking- Data aspects on representations, transformations, statistics- Visual Aspects on visualization, interaction. Data transformation: Purpose of Data transformation- Implementation of Data transformation.

UNIT III **9 Hours**

DATA MANAGEMENT

Relational Technology-Data Integration-Data Warehousing, OLAP and Data Mining- Data reduction and abstraction-Data quality- Visual data mining- Visual OLAP- Visual data reduction. Challenges and opportunities: Uncertainty- Data integration-semantic management-Data Provenance and Integrity of Results-Data Streaming.

UNIT IV **9 Hours**

SPACE AND TIME

Space and Time: Analysis of Geospatial data- Analysis of temporal data- Analysis of Spatio-temporal data. Multivariate data: projection-based methods- Visual methods. Graph and network: graph layout methods- Clutter reduction methods.

UNIT V **9 Hours**

TEMPORAL AND SPATIAL STATISTICS

Spatio-temporal models and its applications: S-and T-mode Empirical Orthogonal function- Canonical correlation analysis-Singular spectrum analysis-CASE STUDY: Data Preparation with Tableau Prep:Connecting to Data- Wildcard Unions- Additional Connections-Inspecting the Data- Removing unneeded Formatting.

Total: 45 Hours

Reference(s)

1. Daniel A.Keim, Jorn Kohlhammer, “Mastering the Information Age - Solving Problems with Visual Analytics”. Germany, Eurographics Association, 2010.
2. Loth, Alexander. “Visual Analytics with Tableau”. United States, Wiley, 2019.
3. Sang C. Suh, Thomas Anthony, “Big Data and Visual Analytics”. Germany, Springer International Publishing, 2018.
4. Aanderud, Tricia, et al. “An Introduction to SAS Visual Analytics: How to Explore Numbers, Design Reports, and Gain Insight into Your Data”. United States, SAS Institute, 2017.
5. Fuchs, Georg, et al. “Visual Analytics for Data Scientists”. Germany, Springer International Publishing, 2020.

20AI019 ROBOTIC PROCESS AUTOMATION 3 0 0 3

Course Objectives

- To understand the basic concepts, methodologies and tools in RPA.
- To implement the exception handling and automation techniques using RPA.

Program Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Modern tool usage**:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Illustrate the basic concepts and methodologies in RPA.
2. Design the UiPath building blocks by using the RPA tools.
3. Develop the RPA techniques for creating the concept of automation.
4. Apply the exception handling and create the database by using BOT.
5. Implement the RPA to solve real time problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2		2								2	
2	2	2	3		3								2	
3	2	2	3		3								3	
4	2	3	3		3								3	
5	2	3	3		3								3	

UNIT I **9 Hours**

RPA SKILLS AND PROCESS METHODOLOGIES

Introduction to RPA – Flavors of RPA- RPA Compared to BPO, BPM, & BPA – Skills: On-Premise Vs. the Cloud- Process Methodologies: Lean – Six Sigma.

UNIT II **9 Hours**

UiPath BUILDING BLOCKS

UiPath – Installation and activation – interfaces – types of workflow – packages – reusing library – control flow – sequences – debug – common UiPath functions – activities - Orchestrator.

UNIT III **9 Hours**

AUTOMATION CONCEPTS & TECHNIQUES

Recording: Introduction – types of recording – Scraping: UI elements – output or screen scraping methods – web scraping – data scraping – Automation: text – image – mouse – keyboard – OCR.

UNIT IV **9 Hours**

EXCEPTION HANDLING AND BOT

Exception Handling – Logging – Debugging – Tracing – BOT: Server Creation - Using Server to control the bots - Creating a provision Robot from the Server - Connecting a Robot to Server - Deploy the Robot to Server.

UNIT V **9 Hours**

APPLICATIONS IN RPA

Excel Automation: Read & Write data – Copy & Paste Data – Append & Filter Data – Email Automation: Mail configuration – Send mail with / without attachment – Receive mail – SQL Automation: Set connection- Execute queries.

Total: 45 Hours

Reference(s)

1. Tom Taulli, "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", Monrovia, CA, USA, APress, 2020.
2. Alok Mani Tripathi, "Learning Robotic Process Automation", Packt Publishing, 2018.
3. Christian Czarnecki, Peter Fettke, "Robotic Process Automation: Management, Technology, Applications", 2021
4. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation, 1st Edition 2015.

Web References

1. https://www.uipath.com/rpa/robotic-process-automation
2. https://www.academy.uipath.com

20AI020 CYBER THREAT INTELLIGENCE 3 0 0 3

Course Objectives

- To understand the Cyber Threat Intelligence fundamentals and applications.
- Apply secure methods to detect and prevent the threats.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Modern tool usage**:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Outline the threats, intelligence types and stages of a threat intelligence life cycle.
2. Illustrate the various frameworks in cyber threat intelligence.
3. Analyze the cyber threat modeling and adversary analysis for optimizing network security.
4. Interpret the efficiency of cyber threat intelligence to ensure data security.
5. Implement the concepts of artificial intelligence in cyber threat intelligence.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	2	2									2	
2	2	3	2	3	3								2	
3	3	3	3	3	3								3	
4	3	3	3	3	3								3	
5	3	3	3	3	3								3	

UNIT I **9 Hours**

INTRODUCTION TO THREAT INTELLIGENCE

TI Introduction - Importance of TI - Benefits and challenges of Threat Information Sharing - Creating Cyber Threat Information - Phases of Life cycle - Direction, Collection, Processing, Analysis, Dissemination and Feedback - Indicators Of Compromise (IOC) and Indicators of Attack (IOA)

UNIT II **9 Hours**

THREAT INTELLIGENCE FRAMEWORKS

Intelligence Frameworks overview -Lockheed martin's cyber kill chain framework - MITRE's ATT&CK knowledge based framework - Diamond model for intrusion analysis framework – Industrial Control System Threat Analysis.

UNIT III **9 Hours**

CYBER THREAT MODELING AND ADVERSARY ANALYSIS

The strategic threat modeling process - Threat modeling methodologies - Threat modeling use cases - User behavior logic - Adversary analysis techniques - Standard approach and modeling for the malware analysis - Window Cleaning Warehouse (WCW) on IoT and Cloud Infrastructure.

UNIT IV **9 Hours**

EFFECTIVE DEFENSE TACTICS AND DATA PROTECTION

Enforcing the CIA triad – Overview, Challenges and pitfalls in cyber threat mechanisms -Data monitoring and active analytics - Vulnerability assessment and data risk analysis -Encryption - Tokenization - Masking and quarantining - End point management - Unified Threat Management

UNIT V **9 Hours**

AI APPLICATIONS IN CYBER THREAT INTELLIGENCE

SOAR (Security Orchestration, Automation, and Response) platform - AI and cyber threat intelligence - Machine learning for better Threat Intelligence - AI Integration – QRadar advisor approach.

Total: 45 Hours

Reference(s)

1. Christopher Ahlberg, "The Threat Intelligence Handbook: Moving Toward a security Intelligence Program, Second Edition", CyberEdge Group, 2019.

2. Jean Nester M. Dahj, "Mastering Cyber Intelligence: Gain comprehensive knowledge and skills to conduct threat intelligence for effective system defense e book", Packt Publishing, 2022.

3. Florian Skopik, "Collaborative Cyber Threat Intelligence: Detecting and Responding to Advanced Cyber Attacks at the National Level", CRC Press, 2017.

20AI021 PATTERN RECOGNITION 3 0 0 3

Course Objectives

- To provide the basic knowledge about the pattern recognition and its applications.
- Implement the supervised and unsupervised algorithms for pattern classification.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. 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.
e. Modern tool usage**:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Illustrate the basic concepts of pattern recognition.
2. Apply supervised learning models for assigning class label to the input pattern.
3. Implement unsupervised algorithms to group similar patterns into clusters.
4. Apply feature selection algorithms to select the features.
5. Analyze the various fuzzy techniques used in pattern classification.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1		1	2								2	
2	3	2		3	3								3	
3	3	3		3	3								3	
4	3	3		2	3								3	
5	2	3		2	3								3	

UNIT I **9 Hours**

INTRODUCTION TO PATTERN RECOGNITION

Importance of Pattern Recognition – Features - Feature Vectors and Classifiers - Supervised, Unsupervised and Semi-supervised learning - Introduction to Bayes Decision Theory - Discriminant Functions and Decision Surfaces - Gaussian PDF and Bayesian Classification for Normal Distributions.

UNIT II **9 Hours**

CLASSIFIERS

Estimation of Unknown Probability Density Functions - Maximum Likelihood Parameter Estimation - Maximum Entropy Estimation - The Naive-Bayes Classifier - Linear Classifiers - Perceptron Algorithm - Least Square Methods - Support Vector Machines for Classification.

UNIT III **9 Hours**

CLUSTERING

Clustering for Unsupervised Learning and Classification - C-means Algorithm - Hierarchical Clustering Procedures - Graph Theoretic Approach to Pattern Clustering - Validity of Clustering Solutions.

UNIT IV **9 Hours**

FEATURE EXTRACTION AND SELECTION

Introduction - Basis Vectors and Images - Entropy Minimization – Karhunenloeve Transformation – Feature Selection through Functions Approximation – Binary Feature Selection – K-NN.

UNIT V **9 Hours**

RECENT ADVANCES

Fuzzy Classification: Fuzzy Set Theory - Fuzzy and Crisp Classification - Fuzzy Clustering - Fuzzy Pattern Recognition – Elementary Neural Network for Pattern Recognition – Hebbnet – ADALINE - Case Study: Handwritten Digit Recognition.

TOTAL: 45 Hours

Reference(s)

1. Richard O. Duda, Peter E. Hart, David G. Stork, “Pattern Recognition”, John Wiley & Sons, 2021.
2. M. Narasimha Murthy, V. Susheela Devi, “Pattern Recognition”, Springer, 2011.
3. Pattern Recognition: Sergios Theodoridis, Konstantinos Koutroumbas, Elsevier India Pvt. Ltd (Paper Back), 4th edition.
4. Andrew R. Webb, Keith D. Copsey, “Statistical Pattern Recognition”, 3rd Edition, Wiley Publication, November 2011.
5. Christopher M. Bishop, “Pattern Recognition and Machine Learning (Information Science and Statistics)” Hardcover, 2010.
6. Pattern Recognition and Image Analysis Earl Gose: Richard Johnsonbaugh, Steve Jost, ePub eBook.

20AI022 RECOMMENDATION SYSTEMS 3 0 0 3

Course Objectives

- To develop state-of-the-art recommender systems that automate a variety of choice-making strategies with the goal of providing affordable, personal, and high-quality recommendations.
- To design and implement a recommender system using collaborative filtering.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Modern tool usage**:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f. 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.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Illustrate the concepts of recommendation systems.
2. Build the recommendation system based on the user reviews with similar preferences.
3. Generate recommendation from the features associated with products and ratings from the user.
4. Develop hybrid recommendation systems to improve the quality of predictions.
5. Implement a simple recommender system.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	2	1	2	2							3	
2	2	2	3	2	3	3							3	
3	2	2	3	2	3	3							3	
4	2	2	3	2	3	3							3	
5	2	2	3	2	3	3							3	

UNIT I **9 Hours**

INTRODUCTION

Overview of Information Retrieval - Retrieval Models - Search and Filtering Techniques: Relevance Feedback - User Profiles - Recommender system functions - Matrix operations - covariance matrices - ratings - Applications of recommendation systems - Issues with recommender system

UNIT II **9 Hours**

COLLABORATIVE FILTERING

Ratings Matrices – User-based nearest neighbor recommendation, Item-based nearest neighbor recommendation – Model based collaborative filtering – Attacks on collaborative recommender systems.

UNIT III **9 Hours**

CONTENT-BASED RECOMMENDATION

High level architecture of content-based systems - Advantages and drawbacks of content based filtering - - Pre-processing and feature extraction - Learning User Profiles and Filtering - Similarity based retrieval - Content-Based Versus Collaborative Recommendations - Case study: A Recommender system for E-commerce web store.

UNIT IV **9 Hours**

KNOWLEDGE BASED AND HYBRID RECOMMENDATION

Constraint-Based and Case-Based Recommendation system - Hybrid RS's- Opportunities for hybridization - Monolithic hybridization - Parallelized hybridization design - Pipelined hybridization design - Limitations of hybridization strategies - Case study :Recommendation system for Netflix's.

UNIT V **9 Hours**

EVALUATING RECOMMENDATION SYSTEMS

Evaluating Recommender Systems: Evaluation Paradigms - Design Issues in Offline Recommender Evaluation – Accuracy Metrics in Offline Evaluation – Limitations of Evaluation Measures - Case Study: Personalized game recommendations on the mobile Internet

Total: 45 Hours

Reference(s)

1. Charu C. Aggarwal, "Recommender Systems: The Textbook", First Ed., Springer, 2016.
2. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011), 1st ed
3. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press, 1 st Edition, 2011.
4. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer, 1st Edition, 2013.
5. Kim Falk., Practical Recommender Systems, Manning Shelter Island, 2019.

20AI023 BUSINESS ANALYTICS 3 0 0 3

Course Objectives

- Knowledge of using statistical tools to analyze complex business issues and prepare an analysis of the same.
- Apply analytics to know future issues and get better plans to solve the problems.

Program Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

e. Modern tool usage**:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

n. Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Illustrate the real world business problems and model with analytical solutions.
2. Apply the Regression analysis to explore the data.
3. Analyze the Predictive and Prescriptive modeling to support business decision-making.
4. Determine the ability to translate data into clear, actionable insights.
5. Apply spreadsheet skills for business decision making and problem solving.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2		2								2	
2	2	3	2		2								2	
3	3	3	3		3								3	
4	2	3	3		3								3	
5	2	3	3		3								3	

UNIT I **9 Hours**

BUSINESS ANALYTICS AND STATISTICAL TOOLS

Overview of Business Analytics - Scope of Business Analytics - Business Analytics Process - Relationship of Business Analytics Process and Organization Decision Making- Competitive advantages of Business Analytics- Statistical Tools: Statistical Notation - Descriptive Statistical methods - Review of Probability Distributions and Data Modeling - Sampling and Estimation methods overview

UNIT II **9 Hours**

TRENDLINES AND REGRESSION ANALYSIS

Modeling Relationships and Trends in Data - Simple Linear Regression - Important Resources - Business Analytics Personnel - Data and models for Business Analytics - Problem Solving - Visualizing and Exploring Data - Business Analytics Technology

UNIT III **9 Hours**

BUSINESS MODELING AND ANALYTICS

Descriptive Analytics - Predictive Analytics - Predictive Modeling - Predictive Analytics analysis - Data Mining - Data Mining Methodologies - Prescriptive Analytics and its step in the Business Analytics Process - Prescriptive Modeling - Nonlinear Optimization

UNIT IV **9 Hours**

FORECASTING TECHNIQUES

Qualitative and Judgmental Forecasting - Statistical Forecasting Models - Forecasting Models for Stationary Time Series - Forecasting Models for Time Series with a Linear Trend - Forecasting Time Series with Seasonality - Regression Forecasting with Casual Variables - Selecting Appropriate Forecasting Models.

UNIT V

SPREADSHEET MODELING AND ANALYSIS **9 Hours**

Model Building Strategies- Implementing Models on Spreadsheets - Descriptive Spreadsheet Models - Predictive Spreadsheet Models - Prescriptive Spreadsheet Models.

Total: 45 Hours

Reference(s)

1. R. Evans James, Business Analytics, Pearson Education 2021.
2. Marc J. Schniederjans, Dara G. Schniederjans and Christopher M. Starkey, " Business Analytics Principles, Concepts, and Applications - What, Why, and How" , Pearson Ed, 2014.
3. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2016.
4. VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.
5. Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016.
6. 5. Mahadevan B, “Operations Management -Theory and Practice”, 3rd Edition, Pearson Education, 2018.

20AI024 HEALTHCARE ANALYTICS 3 0 0 3

Course Objectives

- Understand the various forms of electronic health care information.
- Understand the predictive models for clinical data
- Apply the techniques adopted to analyse health care data.

Program Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Modern tool usage**:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.
n. Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Interpret the medical parameters and policy in healthcare analytics.
2. Illustrate the preprocessing and feature selection techniques for health care data.
3. Analyze health care data using appropriate analytical techniques.
4. Apply analytics for decision making in healthcare services.
5. Apply data mining to integrate health data from multiple sources and develop efficient clinical decision support systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2										2	2
2	3	3	3	3									3	3
3	2	2	2	2									2	2
4	3	3	3	3									3	3
5	3	3	3	2									3	3

UNIT I **9 Hours**

INTRODUCTION TO HEALTHCARE ANALYSIS

Overview - History of Healthcare Analysis Parameters on medical care systems- Health care policy- Standardized code sets – Data Formats – Machine Learning Foundations: Tree Like reasoning , Probabilistic reasoning and Bayes Theorem, Weighted sum approach.

UNIT II **9 Hours**

ANALYTICS ON HEALTHCARE DATA

Machine Learning: Pipeline - Pre-processing - Visualization: Biomedical Image Analysis- Mining of Sensor Data in Healthcare- Biomedical Signal Analysis- Genomic Data Analysis for Personalized Medicine.

UNIT III **9 Hours**

ANALYTICS FOR HEALTHCARE

Natural Language Processing and Data Mining for Clinical Text- Mining the Biomedical Data- Social Media Analytics for Healthcare- Temporal Data Mining for Healthcare Data - Visual Analytics for Healthcare.

UNIT IV **9 Hours**

HEALTH CARE MODELS AND METHODS

Review of Clinical Prediction Models-Predictive Models for Integrating Clinical and Genomic Data- Information Retrieval for Healthcare- Privacy-Preserving Data Publishing Methods in Healthcare.

UNIT V **9 Hours**

APPLICATIONS ON HEALTHCARE

Data Analytics for Pervasive Health- Fraud Detection in Healthcare- Data Analytics for Pharmaceutical Discoveries - Healthcare and Emerging Technologies – ECG Data Analysis.

Total: 45 Hours

Reference(s)

1. Chandan K.Reddy, Charu C. Aggarwal, “Health Care data Analysis”, First edition, CRC, 2015.
2. Vikas Kumar, “Health Care Analysis Made Simple”, Packt Publishing, 2018.
3. Nilanjan Dey, Amira Ashour, Simon James Fong, Chintan Bhatl, “Health Care Data Analysis and Management, First Edition, Academic Press, 2018.
4. Hui Jang, Eva K.Lee, “HealthCare Analysis: From Data to Knowledge to Healthcare Improvement”, First Edition, Wiley, 2016.
5. Kulkarni, Siarry, Singh, Abraham, Zhang, Zomaya , Baki, “Big Data Analytics in HealthCare”, Springer, 2020.

20AI025 VIDEO ANALYTICS 3 0 0 3

Course Objectives

- To impart the knowledge on the basic principles and concepts in video analytics.
- Implement motion estimation and segmentation techniques to provide an intelligent video analysis.

Programme Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. 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.
e. Modern tool usage**:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
n. Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Illustrate the fundamental concepts of video processing and analytics.
2. Apply the motion estimation approaches to determine the motion vectors in video sequence.
3. Implement the segmentation techniques to provide an intelligent video analysis.
4. Outline the approaches for action representation and recognition.
5. Implement the video analytics in real time applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1		2	2									2
2	2	3		3	3									2
3	2	3		3	3									3
4	2	3		3	3									3
5	2	3		3	3									3

UNIT I **9 Hours**

INTRODUCTION

Image Processing: Image Segmentation Approaches – Gaussian Image Processing- Fourier Transform for Image Processing - Edge Detection - Wavelet Processing - Object Detection: SSD -YOLO – Digital Video Basics – Analog to Digital Conversion – Color Representation and Chroma SubSampling – Video Sampling Rate and Standards Conversion – Digital Video Formats.

UNIT II **9 Hours**

MOTION ESTIMATION

Fundamentals of Motion Estimation – Optical Flow – Pose Estimation - OpenPose, DensePose – Block Based Point Correspondences – Gradient Based Intensity Matching – Feature Matching – Frequency Domain Motion Estimation.

UNIT III **9 Hours**

VIDEO SEGMENTATION AND ANALYTICS

Video Segmentation – Video Shot Boundary Detection – Model Based Annotation – Video Mining – Multimodal Approach to Image and Video Data Mining – Probabilistic Semantic Mode-Instance Segmentation: Mask RCNN.

UNIT IV **9 Hours**

ACTION RECOGNITION AND ACTION REPRESENTATION

Action Recognition -Video based rendering - Context and scene understanding - Action Representation Approaches: Classification of Various Dimensions of Representation - View Invariant Methods - Gesture Recognition and Analysis - Facial Recognition: Haar Cascade Algorithm – LBPH Algorithm - Optical character recognition .

UNIT V **9 Hours**

MINING DATA STREAMS

Introduction to Streams Concept - Sampling Data in a Stream - Filtering Streams - Counting Distinct Elements in a Stream - Case Study: Affective Video Content Analysis – Parsing a Video into Semantic Segments – Automatic Video Trailer Generation.

Total: 45 Hours

Reference(s)

1. Murat Tekalp, “Digital Video Processing”, Second Edition, Prentice Hall, 2015.
2. Rafael C. Gonzalez University of Tennessee Richard E. Woods, “Digital Image Processing”, Pearson Education, 2018.
3. Szeliski, “Computer Vision: Algorithms and Applications”, Springer, 2011.
4. Alan C. Bovik, “Handbook of Image and video processing”, Second Edition, Academic Press, 2005.
5. Thierry Bouwmans, FatihPorikli, Benjamin Hoferlin and Antoine Vacavant,“Background Modeling and Foreground Detection for Video Surveillance: Traditional and Recent Approaches, Implementations, Benchmarking and Evaluation", CRC Press, Taylor and Francis Group, 2014.

20AI026 DIGITAL MARKETING 3 0 0 3

Course Objectives

- To provide students with the knowledge about business advantages of digital marketing and its importance for marketing success.
- To make the students explore the various online modes of reaching customers and market the products and brand effectively.

Programme Outcomes (POs)

b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. 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.
e. Modern tool usage**:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Develop a digital marketing plan that will address common marketing challenges.
2. Improve website visibility on search engines through search engine optimization to get more leads for the business.
3. Apply the latest digital ad technologies that generate more leads at minimal costs.
4. Apply various social media marketing platforms to reach consumers.
5. Implement the marketing experiments to improve the outcome of the campaign.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		3		2	2								2	
2		3		3	3								3	
3		3		3	3								3	
4		3		3	3								3	
5		3		2	2								2	

UNIT I **9 Hours**

INTRODUCTION

Introduction to Digital Marketing –Importance of Digital Marketing-Traditional Vs. Digital Marketing-Types of Digital Marketing- Planning Digital Marketing Campaigns –Branding-Website design - Optimization of Website - Essentials of a website.

UNIT II **9 Hours**

SEARCH ENGINE OPTIMIZATION

Introduction to Search Engine Optimization - Keyword Research and Analysis - On page Optimization - Off page Optimization - Local SEO - Search Engine Algorithm Updates - SEO Reporting-Search Engine Marketing (SEM)

UNIT III **9 Hours**

GOOGLE ADWORDS

Introduction to Online Advertising and Adwords –Adwords Bidding and Budgeting-Adwords Tools- Pay Per Click(PPC) Advertising - Display Advertising - Google Shopping Ads -Introduction to Bing Ads - Mobile Marketing - Video Marketing - Google online Advertising program

UNIT IV **9 Hours**

SOCIAL MEDIA MARKETING

Introduction to SMM - Facebook Marketing - Facebook Advertising - Twitter Marketing & Ads - YouTube Marketing - LinkedIn Marketing - InstaGram Marketing - Email Marketing - Pinterest Marketing - Content Marketing - Online Reputation Management -Inbound Marketing - Google Analytics - Audience Reports - Traffic Reports - Behavior Reports

UNIT V **9 Hours**

EXPERIMENTAL TESTING

Conversion Tracking - Personality Development - Google AdSense - Getting Started as Freelancer - Affiliate Marketing - Case Study: Optimizing the website

Total: 45 Hours

Reference(s)

1. Damian Ryan, "Understanding Digital Marketing Marketing strategies for engaging the digital generation", 3rd edition, Kogan Page, 2014.
2. Philip kolter and Gary Armstrong, Principles of marketing, Pearson education, 2010.
3. Shivani Karwal, Digital Marketing Handbook: A Guide to Search Engine Optimization Paperback - Import, 25 Nov 2015.
4. Adam Clarke, "SEO 2015: Learn search engine optimization with smart internet marketing strategies", Digital Book Guru, Publisher, 2015.
5. Helen Strong, "Marketing and Management Models: A Guide to Understanding and Using Business Models", Business Expert Press, 2014.

20AI027 OPEN STACK ESSENTIALS 3 0 0 3

Course Objectives

- To understand the deployment architectures of Open Stack and its supporting technologies.
- Familiarize students with the installation and configuration procedure of compute, storage and networking components of Open Stack platform for establishing enterprise private cloud.

Program Outcomes (POs)

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

e. Modern tool usage**:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

m. Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Illustrate the Open stack Architecture and its components.
2. Interpret the Identity Management and the role of image management using web interface.
3. Integrate the Open Stack Networking Neutron to attach the interface.
4. Implement the block storage to the instance using Dashboard.
5. Outline the architecture of rings and its role in object storage.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	1		1								2	
2	2	2	2		3								2	
3	2	2	3		3								3	
4	2	3	3		3								3	
5	2	3	3		3								3	

UNIT I **9 Hours**

ARCHITECTURE AND COMPONENTS

Introduction to Cloud Computing- Service Models - Openstack Architecture - Basic Requirements - OpenStack Components - Virtualization Concepts

UNIT II **9 Hours**

IDENTITY AND IMAGE MANAGEMENT

Identity Management- Roles - Services in Identity service - Configuring keystone and its dataset - Image service - Types of images - Managing Glance.

UNIT III **9 Hours**

OPENSTACK COMPUTE AND NETWORKING

Compute service - Installing Nova with its API - Managing security groups - Database systems - Networking service - Managing neutron services - Manage networking methods - Types

UNIT IV **9 Hours**

DASHBOARD AND STORAGE SERVICE

Dashboard Service - Horizon Installation - GUI Management and Maintenance - Block Storage Component - Cinder - Snapshot management - Volume Attachment

UNIT V **9 Hours**

OBJECT STORAGE

Object Storage Components - Characteristics - Cluster Architecture - Implementation Levels - Rings - Roles - User management - Data Management - Metadata - Case Study: Open stack cloud in healthcare

Total: 45 Hours

Reference(s)

1. Dan Radez, OpenStack Essentials, PackT publishing, 2015
2. Omar Khedhar, "Mastering Openstack", PackT Publishing, 2015
3. docs.openstack.org

OPEN ELECTIVE

20AI0YA FUNDAMENTALS OF DATA SCIENCE 3 0 0 3

Course Objectives

- Understand the fundamentals of data science.
- Visualize the data using python libraries.
- Analyse the relationship between data dependencies using statistics.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
l. 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.
n. Ability to identify and use analytic skills for massive datasets to extract insights by applying suitable Data analytic tools and techniques.

Course Outcomes (COs)

1. Apply the skills of data inspecting and cleansing.
2. Determine the relationship between data dependencies using statistics.
3. Represent the useful information using mathematical skills.
4. Perform data operations using primary tools used for data science in python.
5. Apply the knowledge for data describing and visualization using tools.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3		3									3
2	3	3	2		3									3
3	2	3	3		3									3
4	3	3	3		3							2		3
5	3	3	3		3							3		3

UNIT I **9 Hours**

INTRODUCTION

Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications.

UNIT II **9 Hours**

DESCRIPTIVE STATISTICS I

Frequency distributions – Outliers – relative frequency distributions – cumulative frequency distributions – frequency distributions for nominal data – interpreting distributions – graphs – averages – mode – median – mean – averages for qualitative and ranked data – describing variability– range – variance – standard deviation – degrees of freedom – interquartile range.

UNIT III **9 Hours**

DESCRIPTIVE STATISTICS II

Normal distributions – z scores – normal curve problems – finding proportions – finding scores – more about z scores – correlation – correlation coefficient for quantitative data – computational formula for correlation coefficient – regression – regression line – least squares regression line – standard error of estimate – interpretation of r2.

UNIT IV **9 Hours**

VISUALIZATION TECHNIQUES

Basics of Numpy arrays – aggregations – computations on arrays – comparisons, masks, boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – hierarchical indexing – combining datasets – aggregation and grouping.

UNIT V **9 Hours**

DATA VISUALIZATION WITH PYTHON

Types of data visualization: Exploratory, Explanatory, visualization with matplotlib – line plots – scatter plots – visualizing errors – density and contour plots – histograms, binnings, and density – three-dimensional plotting– geographic data – data analysis using statmodels and seaborn – graph plotting using Plotly.

Total: 45 Hours

Reference(s)

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing DataScience", Manning Publications, 2016. (Unit I)

2. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017. (Units II and III)

3. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016. (Units IV and V)

4. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green TeaPress, 2014.

ONE CREDIT COURSES

20AI0XA **TENSORFLOW** **0 0 0 1**

Course Objectives

- Understand the fundamental concepts of TensorFlow Framework and Keras.
- Implementation of deep learning concepts in 2D data using TensorFlow.

Programme Outcomes

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

e. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Understand the basics of TensorFlow Framework Architecture.
2. Apply the concept of deep learning in Keras.
3. Analyze the outcome of the Deep Learning models and the optimization technique to improve the model performance.

UNIT I **15 Hours**

Need for AI in Industry- Introduction to ML and DL- Introduction to TensorFlow – Basic Components of TensorFlow –Architecture of Tensor Flow- Deep Learning Fundamentals – Introduction to Keras – Application of Keras on Deep Learning Problems– Optimizers – Case study on Prediction analysis on 2-Dimensional data- Case study on Prediction analysis on Image analytics.

Total: 15 Hours

Reference(s)

1. Hands-on machine learning with Scikit-learn Keras and TensorFlow by Aurelion Geron published by O` Reilley.

2. https://www.tensorflow.org/api_docs

3. https://www.kaggle.com/learn/intro-to-deep-learning.

20AI0XB **TABLEAU** **0 0 0 1**

Course Objectives

Learn how to build visualizations, organize data and design dashboards to empower more meaningful business decisions.

Programme Outcomes

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

e. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Understand the main concepts of data visualization.
2. Create data visualizations and dashboards using Tableau.

UNIT I **15 Hours**

Introduction to Tableau - Different Products by Tableau - Advantages of Tableau- Introduction to Data Visualization- Applications of Tableau- Companies using Tableau- Features of Tableau- Tableau Terminologies- Tableau Navigations- Tableau Design Flow- How to Connect to a File Source- Understanding of Different Data Sources- Data Source Filters- Data Types - Tableau Operators- String Functions in Tableau- Date Functions - Logical Statements - Aggregate Functions- Joins- Data Blending- Field Operator-Filter- Changing Data Type of a Field from Data Pane-Formatting- Worksheet- Line Chart- Bar Chart- Histogram- Scatter Plot- Pie Chart- Bubble chart- Tableau Forecasting- Tableau Dashboard.

Total: 15 Hours

Reference(s)

1. https://help.tableau.com/current/guides/get-started-tutorial/en-us/get-started-tutorial-home.htm

20AI0XC	TYPESCRIPT WITH JEST TESTING FRAMEWORK	0 0 0 1

Course Objectives

- Understand the fundamental concepts of TypeScript and use JEST framework to test the JavaScript code.

Programme Outcomes

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

e. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Infer the fundamental concepts of TypeScript.
2. Develop the real world application using TypeScript and Jest Testing Framework.

TypeScript **10 Hours**

Introduction to JavaScript – Difference between JavaScript and TypeScript – Why do we need to prefer TypeScript over JavaScript – Introduction to TypeScript – Features of TypeScript – Access Modifiers – Data Types – Keywords – Flow Control – Interface, Class, Objects – Practical Session on writing TypeScript Code

Jest Testing Framework **5 Hours**

Introduction to Jest Testing – Features of Jest – Writing unit tests – Testing the code written in Typescript – Practical Session on Jest Testing Frame work

Total: 15 Hours

Reference(s)

1. https://www.udemy.com/course/typescript-for-beginners-u/

20AI0XD **REACT JS** **0 0 0 1**

Course Objectives

- Understand the fundamental concepts of ReactJS to develop web applications.

Programme Outcomes

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

e. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Infer the fundamental concepts of ReactJS.
2. Develop the real-world applications using ReactJS.

Unit I

Introduction to React - React vs. Angular vs. Vue - Installing Node.js and npm - Creating a new React project using Create React App - Familiarizing with the React project structure - React Components: class components and functional components - Creating a simple functional component - Using JSX to write HTML - like code in JavaScript - Rendering the component in the browser - Props and State-Modifying state in component - Creating a form in React - Handling form submission -Validating form input-React Router - Setting up React Router in a React project - Event Handling - Redux

Total: 15 Hours

Reference(s)

1. https://www.udemy.com/course/react-redux/