ANNAMALAI UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

B.E. COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence and Machine Learning)

Regulations & Curriculum – 2019

HAND BOOK

2019

ANNAMALAI UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

B.E. (Four Year) Degree Programme (FULL–TIME)

Choice Based Credit System (CBCS)

REGULATIONS 2019

1. Condition for Admission

Candidates for admission to the first year of the four year B.E. Degree programmes shall be required to have passed the final examination of the plus 2 Higher Secondary Course with Mathematics, Physics and Chemistry as courses of study and candidates who have passed the Higher Secondary Examination through vocational stream under Engineering, conducted by the Board of Secondary Education, Government of Tamil Nadu or an examination of any other authority accepted by the Syndicate of this University as equivalent thereto. They shall satisfy the conditions regarding qualifying marks, age and physical fitness as may be prescribed by the Syndicate of the Annamalai University from time to time.

Candidates who have passed the Diploma programme in Engineering of the State Board of Technical Education, Tamil Nadu (listed in Annexure-I) will be eligible for admission to the second year of the four year degree programme in B.E. under the lateral entry scheme provided they satisfy other conditions.

2. Branches of Study in B.E.

BRANCH I	-	Chemical Engineering
BRANCH II	-	Civil Engineering
BRANCH III	-	Civil and Structural Engineering
BRANCH IV	-	Computer Science and Engineering
BRANCH V	-	Electrical and Electronics Engineering
BRANCH VI	-	Electronics and Communication Engineering
BRANCH VII	-	Electronics and Instrumentation Engineering
BRANCH VIII	-	Information Technology
BRANCH IX	-	Mechanical Engineering
BRANCH X	-	Mechanical Engineering (Manufacturing)
BRANCH XI	-	Computer Science and Engineering (Artificial Intelligence and Machine learning)
BRANCH XII	-	Computer Science and Engineering (Data Science)

3. Courses of Study and Scheme of Examinations

The courses of study with respective syllabi and the scheme of Examinations are given separately.

4. Choice Based Credit System (CBCS)

The curriculum includes six components namely Humanities / Social Sciences /Management, Basic Sciences, Engineering Sciences, Professional Core, Professional

Electives and Open Electives in addition to Seminar & Industrial Training and Project. Each semester curriculum shall normally have a blend of theory and practical courses. The total credits for the entire degree Programme is 166 (124 for lateral entry students).

5. Eligibility for the Degree

A candidate shall be eligible for the degree of Bachelor of Engineering if the candidate has satisfactorily undergone the prescribed courses of study for a period of four academic years and has passed the prescribed examinations in all the four academic years. For the award of the degree, a student has to

5.1 Earn a minimum of 166 credits (124 for lateral entry students).

5.2 Serve in any one of the Co-curricular activities such as

- National Cadet Corps (NCC)
- National Service Scheme (NSS)
- National Sports Organization (NSO) and
- Youth Red Cross (YRC)

for at least one year. The students enrolled in any one of the co-curricular activities (NCC / NSS / NSO / YRC) will undergo training for about 80 hours and attend a camp of about seven days. The training shall include classes on hygiene and health awareness and also training in first-aid. While the training activities will normally be during weekends, the camp will normally be during vacation period.

(or)

Enrol as a student member of a recognized professional society such as

- Student Chapters of Institution of Engineers (India)
- Student Chapters of other Professional bodies like ICI, ISA, IIChE, IEEE, SAE, ASHRAE, CSI and IWS

5.3 B.E (Honours) Degree

A student shall be eligible to get Under Graduate degree with Honours, if he/she completes an additional 20 credits. Thus the total credits are 186. Out of 186 credits (144 credits for lateral entry students), 20 credits must be earned by studying additional course offered by the same or allied Departments (listed in Annexure-II) in sixth, seventh and eighth semesters. These additional 20 credits could be acquired through the MOOC courses of SWAYAM portal also.

5.4 B.E Degree with Minor Engineering

A student shall be eligible to get Under Graduate degree with additional Minor Engineering, if he/she completes an additional 20 credits. Out of the 186 credits, 20 credits must be earned from the courses offered by any one of the Departments (listed in Annexure-II) in the Faculty of Engineering and Technology in sixth, seventh and eighth semesters . These additional 20 credits could be acquired through the MOOC courses offered in SWAYAM portal also.

6. Assignment of Credits for Courses

Each course is normally assigned one credit per hour of lecture/tutorial per week and half credit for one hour for laboratory or practical or drawing course per week.

7. Duration of the Programme

A student is normally expected to complete the B.E. programme in four years but in any case not more than seven years from the time of admission.

8. Registration for Courses

A newly admitted student will automatically be registered for all the courses prescribed for the first, second and third semesters without any option.

Every other student shall enrol for the courses intended to be credited in the succeeding semester in the current semester itself by completing the registration form indicating the list of courses. This registration will be done a week before the last working day of the current semester.

A student is required to earn 166 (124 for lateral entry students) credits in order to be eligible for obtaining the degree. However the student is entitled to enjoy an option to earn either more or less than the total number of credits prescribed in the curriculum of a particular semester on the following guidelines:

8.1 Slow Learners

The **slow learners** may be allowed to withdraw certain courses with the approval by the Head of the Department and those courses may be completed by them in the fifth year of study and still they are eligible to be awarded with I Class. A student can withdraw a maximum of 2 courses per semester from IV semester to VII semester and take up those courses in the fifth year of study. However, courses withdrawn during odd semesters (V and VII) must be registered in the odd semester of fifth year and courses withdrawn during even semesters (IV and VI) must be registered in the even semester of fifth year.

8.2 Advance Learners

The **advance learners** may be allowed to take up the open elective courses of eighth semester in sixth and seventh semesters one in each to enable them to pursue industrial training/project work in the entire eighth semester period provided they should register those courses in the fifth semester itself. Such students should meet the teachers offering those elective courses themselves for clarifications. No specific slots will be allotted in the time table for such courses.

9. Mandatory Internship (Industrial Training)

To promote industrial internship at the graduate level in technical institutes and also to enhance the employability skills of the students passing out from Technical Institutions, the internship for the students at different stages of the programme, is included in the curriculum. The student has to undergo the internship during the summer vacation, after the II semester / IV semester / VI semester of the programme as per the details outlined below. Further the student has to submit a report on completion of the internship during the subsequent Odd semester that is in the III / V / VII semesters respectively.

9.1 During the summer vacation, after the II Semester,

The student must get involved in any of the following **Inter/ Intra Institutional Activities** for **4 weeks** duration:

i. Training with higher Institutions; Soft skill training organized by Training and Placement Cell.
ii. Contribution at incubation/ innovation /entrepreneurship cell of the institute.
iii. Participation in conferences/ workshops/ competitions.
iv. Learning at Departmental Lab/ Institutional workshop.
v. Working for consultancy/ research project within the University.
vi. Participation in activities like IPR workshop / Leadership Talks/ Idea/ Design/Innovation/ Technical Expos.

9.2 During the summer vacation, after the IV Semester and also after the VI Semester,

The student may choose any of the following **Internship / Innovation / Entrepreneurship** related activities for **4 weeks** duration:

i. Work on innovation or entrepreneurial activities resulting in start-up
ii. Undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/
iii. Medium enterprises
iv. Undergo internship with National Employment Enhancement Mission (NEEM) Facilitator.

10. Project Work

The student typically registers for project at the end of seventh semester and completes it at the end of the eighth semester along with the courses prescribed for study in the eighth semester. However a student who has registered and successfully completed the courses of eighth semester by acquiring additional credits in the earlier semesters can attempt to spend his/her period of study in an industry and complete his/her project work, submit the project report and appear for viva-voce examination at the end of eighth semester.

11. Mandatory Induction program

A 3-week long induction program for the UG students entering the institution, right at the start is proposed. Normal classes start only after the induction program is over. The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

Physical Activity
Creative Arts
Imparting Universal Human Values
Literary Activities
Conduct of crash courses on soft skills
Lectures by Eminent People
Visits to Local Area
Familiarization to Dept./Branch & Innovative practices

12. Electives

The elective courses fall under two basic categories: Professional Electives and Open Electives.

12.1 Professional Elective courses

The Professional Elective courses are offered in the concerned branch of specialization and a student can choose the Professional Elective courses with the approval of the Head of the Department concerned.

12.2 Open Elective courses

Apart from the various Professional elective courses, a student must study three open elective courses two of which offered by the Department concerned and the other open elective course offered by any other Department in the Faculty of Engineering & Technology during either sixth or seventh or eighth semester of study, with the approval of the Head of the Department and the Head of the Department offering the course.

12.3 MOOC (SWAYAM) Courses

Further, the student can be permitted to earn not more than 20 % of his total credits (that is 32 credits) by studying the Massive Open Online Courses offered through the SWAYAM Portal of UGC with the approval of the Head of the Department concerned. These courses will be considered as equivalent to the professional elective and/or open elective courses. Thus the credit earned through MOOC courses can be transferred and considered for awarding Degree to the student concerned.

12.4 Value added courses (Inter Faculty Electives)

Of the four open elective courses, a student must study one value added course that is offered by other Faculties in our University either in sixth or seventh semester of the B.E programme.

12.5 One Credit Courses

One credit courses shall be offered by a Department with the prior approval from the Dean, Faculty of Engineering and Technology.

12.5.1 Industry Expert

For one credit courses, a relevant potential topic may be selected by a committee consisting of the Head of the Department concerned and the Board of Studies member from the Department and a senior faculty member from the Department concerned. An expert from industry familiar with the topic chosen may be accordingly invited to handle classes for the students. The details of the syllabus, time table and the name of the industrial expert may be sent by the above committee to the Dean for approval. The credits earned through the one credit courses shall be over and above the total credit requirement prescribed in the curriculum for the award of the degree. Students can take a maximum of two one credit courses (one each in VI and VII semesters). They shall be allowed to take one credit courses offered in other Departments with the permission of Head of the Department offering the courses. A separate mark sheet shall be issued for one credit courses.

12.5.2 NSQF Courses

A student can be permitted to acquire additional credits not more than two by undergoing any two of the one credit courses conducted under the auspices of National Skills Qualification Framework (NSQF). NSQF is a nationally integrated education and competency based skill and quality assurance framework that will provide for multiple

pathways, horizontal as well as vertical, including vocational education, vocational training, general education and technical education, thus linking one level of learning to another higher level. This will enable a student to acquire desired competency levels, transit to the job market and at an opportune time, return for acquiring additional skills to further upgrade their competencies.

13. Assessment

13.1 Theory Courses

The break-up of continuous assessment and examination marks for theory courses is as follows:

First assessment (Mid-Semester Test-I)	:	10 marks
Second assessment (Mid-Semester Test-II)	:	10 marks
Third Assessment	:	5 marks
End Semester Examination	:	75 marks

13.2 Practical Courses

The break-up of continuous assessment and examination marks for Practical courses is as follows:

First assessment (Test-I)	:	15 marks
Second assessment (Test-II)	:	15 marks
Maintenance of record book	:	10 marks
End Semester Examination	:	60 marks

13.3 Project Work

The continuous assessment marks for the project work will be 40 and to be assessed by a review committee consisting of the project guide and a minimum of two members nominated by the Head of the Department. One of the committee members will be nominated as the Chairman by the Head of the Department. The Head of the Department may be a member or the Chairman. At least two reviews should be conducted during the semester by the review committee. The student shall make presentation on the progress made before the committee. 60 marks are allotted for the project work and viva voce examination at the end of the semester.

13.4 Industrial Internship

After attending the internship during the summer vacation of even semester (II / IV / VI semester), the student has to present a report at the start of the subsequent odd semester (III / V / VII semester) to the committee which will assess and award marks out of 100. The committee is constituted with an Internship Coordinator and a minimum of two members nominated by the Head of the Department for each class.

14. Substitute Assessment

A student, who has missed, for genuine reasons accepted by the Head of the Department, one or more of the assessments of a course other than the final examination, may take a

substitute assessment for any one of the missed assessments. The substitute assessment must be completed before the date of the third meeting of the respective class committees.

A student who wishes to have a substitute assessment for a missed assessment must apply to the Dean / Head of the Department within a week from the date of the missed assessment.

15. Student Counsellors (Mentors)

To help the students in planning their course of study and for general advice on the academic programme, the Dean / Head of the Department will attach a certain number of students to a member of the faculty who shall function as student counsellor for those students throughout their period of study. Such student counsellors shall advise the students, give preliminary approval for the courses to be taken by the students during each semester and obtain the final approval of the Dean / Head of the Department.

16. Class Committee

For all the branches of study during the first two semesters, a common class committee will be constituted by the Dean of the faculty. From among the various teachers teaching the same common course to different classes during each semester of the first year, the Dean shall appoint one of them as course coordinator. The composition of the class committee during first and second semesters will be as follows:

- Course coordinators of all courses.
- All the Heads of the Sections, among whom one may be nominated as Chairman by the Dean.
- The Dean may opt to be a member or the Chairman.
- For each of the higher semesters, separate class committees will be constituted by the respective Head of the Departments. The composition of the class committees from third to eighth semester will be as follows:
- Teachers of the individual courses.
- A seminar coordinator (for seventh semester only) shall be appointed by the Head of the Department
- A project coordinator (for eighth semester only) shall be appointed by the Head of the Department from among the project supervisors.
- One Professor or Associate Professor, preferably not teaching the concerned class, appointed as Chairman by the Head of the Department.
- The Head of the Department may opt to be a member or the Chairman.

The class committee shall meet three times during the semester. The first meeting will be held within two weeks from the date of class commencement in which the type of assessment like test, assignment etc. for the third assessment and the dates of completion of the assessments will be decided.

The second meeting will be held within a week after the completion of the first assessment to review the performance and for follow-up action.

The third meeting will be held after all the assessments but before the University semester examinations are completed for all the courses, and at least one week before the commencement of the examinations. During this meeting the assessment on a maximum of

25 marks for theory/40 marks for seminar/ industrial training, practical and project work will be finalized for every student and tabulated and submitted to the Head of the Department (to the Dean in the case of I & II Semester) for approval and transmission to the Controller of Examinations.

17. Attendance requirements

The students with 75% attendance and above are permitted to appear for the University examinations. However, the Vice Chancellor may give a rebate / concession not exceeding 10% in attendance for exceptional cases only on Medical Grounds.

18. Temporary break of study

A student is permitted to go on break of study for a maximum period of one year either as two breaks of one semester each or a single break of one year.

If a student wishes to apply for break of study, the student shall apply to the Dean in advance, in any case, not later than the last date of the first assessment period. The application duly filled by the student shall be submitted through the Head of the Department. In the case of short term employment/ training/ internship, the application for break of study shall be approved and forwarded by the Head of the Department concerned to the Dean.

However, the student must complete the entire programme within the maximum period of seven years.

19.Procedure for withdrawing from the Examinations

A student can withdraw from all the examinations of the semester only once during the entire programme on valid grounds accepted by the University. Such withdrawal from the examinations of a semester will be permitted only if the candidate applies for withdrawal at least 24 hours before the commencement of the last examination. The letter grade 'W' will appear in the mark sheet for such candidates.

20. Passing and declaration of examination results

All assessments of all the courses on an absolute marks basis will be considered and passed by the respective results passing boards in accordance with the rules of the University. Thereafter, the Controller of Examinations shall convert the marks for each course to the corresponding letter grade as follows, compute the Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA), and prepare the mark sheets.

90 to 100 marks	:	Grade 'S'
80 to 89 marks	:	Grade 'A'
70 to 79 marks	:	Grade 'B'
60 to 69 marks	:	Grade 'C'
55 to 59 marks	:	Grade 'D'
50 to 54 marks	:	Grade 'E'
Less than 50 marks	:	Grade 'RA'
Withdrawn from the examination	:	Grade 'W'

A student who obtains less than 30 / 24 marks out of 75 / 60 in the theory / practical examinations respectively or is absent for the examination will be awarded grade RA.

A student who earns a grade of S, A, B, C, D or E for a course, is declared to have successfully completed that course. Such a course cannot be repeated by the student.

A student who is detained for lack of attendance must re-register for and repeat the courses in the respective semester.

A student who obtains letter grade RA in the mark sheet must reappear for the examination of the courses except for Honours courses.

A student who obtains letter grade W in the mark sheet must reappear for the examination of the courses.

The following grade points are associated with each letter grade for calculating the grade point average and cumulative grade point average.

S - 10; A - 9; B - 8; C - 7; D - 6; E - 5; RA - 0

Courses with grade RA / W are not considered for calculation of grade point average or cumulative grade point average.

A student can apply for re-valuation of one or more of his examination answer papers within a week from the date of issue of mark sheet to the student on payment of the prescribed fee per paper. The application must be made to the Controller of Examinations with the recommendation of the Head of the Department.

After the results are declared, mark sheets will be issued to the students. The mark sheet will contain the list of courses registered during the semester, the grades scored and the grade point average for the semester.

GPA is the sum of the products of the number of credits of a course with the grade point scored in that course, taken over all the courses for the semester, divided by the sum of the number of credits for all courses taken in that semester.

CGPA is similarly calculated considering all the courses taken from the time of admission.

21. Awarding Degree

After successful completion of the programme, the degree will be awarded with the following classification based on CGPA.

21.1 Honours Degree

To obtain **Honours Degree** a student must earn a minimum of **186 credits** within four years (144 credits within three years for lateral entry students) from the time of admission, pass all the courses in the first attempt from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students) and obtain a CGPA of 8.25 or above.

21.2 First Class with Distinction

To obtain B.E Degree First Class with Distinction, a student must earn a minimum of 166 Credits within four years (124 credits within three years for lateral entry students) from the time of admission, by passing all the courses in the first attempt from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students) and obtain a CGPA of 8.25 or above.

21.3 First Class

To obtain B.E Degree First Class, a student must earn a minimum of 166 credits within ***five*** years (124 credits within ***four*** years for lateral entry students) from the time of admission and obtain a CGPA of 6.75 or above for all the courses from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

21.4 Second Class

For Second Class, the student must earn a minimum of 166 credits within **seven** years (124 credits within **six** years for lateral entry students) from the time of admission.

21.5 B.E Degree with Minor Engineering

For Minor Engineering, the student must earn a minimum of 186 credits within four years (144 credits within three years for lateral entry students) from the time of admission, pass all the courses. The rules for awarding the B.E degree in First Class with Distinction or in First Class or in Second Class will be applicable for this also.

22. Ranking of Candidates

The candidates who are eligible to get the B.E. degree with Honours will be ranked together on the basis of CGPA for all the courses of study from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

The candidates who are eligible to get the B.E. degree in First Class with Distinction will be ranked next after those with Honours on the basis of CGPA for all the courses of study from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

The Candidates passing with First Class will be ranked next after those with distinction on the basis of CGPA for all the courses of study from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

The ranking of candidates will be done separately for each branch of study.

23. Transitory Regulations

The University shall have powers to revise or change or amend the regulations, the scheme of examinations, the courses of study and the syllabi from time to time.

Wherever there had been change of syllabi, examinations based on the existing syllabi will be conducted for three consecutive times after implementation of the new syllabi in order to enable the students to clear the arrears. Beyond that the students will have to take up their examinations in equivalent courses, as per the new syllabi, on the recommendations of the Head of the Department concerned.

Annexure-I

Diploma Programmes Eligible for the B.E (Lateral Entry) Programmes offered in FEAT (from 2019-2020)

Sl.No.	Branches of Study	Eligible Diploma Programme (FT / PT / SW)
1.	**Chemical Engineering**	i. Petrochemical Engineering ii. Chemical Engineering iii. Environmental Engineering and Pollution Control iv. Leather Technology (Footwear) v. Leather Technology vi. Plastic Technology vii. Polymer Technology viii. Sugar Technology ix. Textile Technology x. Chemical Technology xi. Ceramic Technology xii. Petro Chemical Technology xiii. Pulp & Paper Technology xiv. Petroleum Engineering
2.	**Civil Engineering**	i. Civil Engineering ii. Civil Engineering (Architecture) iii. Environmental Engineering and Pollution Control (Full Time) iv. Architectural Assistantship v. Civil Engineering (Rural Tech.) vi. Civil and Rural Engineering vii. Agricultural Engineering
3.	**Civil and Structural Engineering**	
4.	**Computer Science and Engineering**	i. Electronics and Communication Engineering ii. Computer Technology iii. Computer Science and Engineering iv. Information Technology v. Computer Engineering vi. Computer Networking vii. Electronics(Robotics) viii. Mechatronics Engineering
5.	**Electrical and Electronics Engineering**	i. Electrical and Electronics Engineering ii. Electronics and Communication Engg. iii. Electronics and Instrumentation Engg iv. Electronics Engineering(Instrumentation) v. Instrument Technology vi. Instrumentation and Control Engineering vii. Electrical Engineering (Instruments and Control) viii. Electrical Engineering ix. Instrumentation Technology x. Electronics (Robotics) xi. Mechatronics Engineering

6.	**Electronics and Communication Engineering**	i. Electronics and Communication Engineering ii. Computer Technology iii. Computer Science and Engineering iv. Information Technology v. Computer Engineering vi. Computer Networking vii. Electronics(Robotics) viii. Mechatronics Engineering ix. Electrical and Electronics Engineering x. Electronics and Instrumentation Engg
7.	**Electronics and Instrumentation Engineering**	i. Electrical and Electronics Engineering ii. Electronics and Communication Engg. iii. Electronics and Instrumentation Engg iv. Electronics Engineering(Instrumentation) v. Instrument Technology vi. Instrumentation and Control Engineering vii. Electrical Engineering (Instruments and Control) viii. Electrical Engineering ix. Instrumentation Technology x. Electronics (Robotics) xi. Mechatronics Engineering
8.	**Information Technology**	i. Electronics and Communication Engineering ii. Computer Technology iii. Computer Science and Engineering iv. Information Technology v. Computer Engineering vi. Computer Networking vii. Electronics(Robotics) viii. Mechatronics Engineering
9.	**Mechanical Engineering**	i. Mechanical Engineering ii. Mechanical and Rural Engineering iii. Mechanical Design and Drafting iv. Production Engineering v. Production Technology vi. Automobile Engineering vii. Automobile Technology viii. Metallurgy ix. Mechatronics Engineering x. Machine Tool Maintenance and Repairs xi. Tool and Die making xii. Tool Engineering xiii. Tool Design xiv. Foundry Technology xv. Refrigeration and Air Conditioning xvi. Agricultural Engineering xvii. Agricultural Technology xviii. Marine Engineering xix. Mechanical Engineering(Production) xx. Mechanical Engineering(Tool &Die) xxi. Mechanical Engineering (Foundry)
10.	**Mechanical Engineering (Manufacturing Engineering)**	

		xxii.	Mechanical Engineering(R & A.C.)
		xxiii.	Electronics(Robotics)
		xxiv.	Mining Engineering
		xxv.	Agricultural Engineering and Farm Machinery
		xxvi.	Equipment Technology
11.	**Computer Science and Engineering (Artificial Intelligence and Machine learning)**	i.	Electronics and Communication Engineering
		ii.	Computer Technology
		iii.	Computer Science and Engineering
		iv.	Information Technology
		v.	Computer Engineering
		vi.	Computer Networking
		vii.	Electronics(Robotics)
		viii.	Mechatronics Engineering
12.	**Computer Science and Engineering (Data Sciences)**	i.	Electronics and Communication Engineering
		ii.	Computer Technology
		iii.	Computer Science and Engineering
		iv.	Information Technology
		v.	Computer Engineering
		vi.	Computer Networking
		vii.	Electronics(Robotics)
		ix.	Mechatronics Engineering

Annexure-II

S.No.	Branch of Study in B.E	Honours Elective Courses from Same and Allied Departments of	Minor Engineering Courses from Other Departments of
1.	Chemical Engineering	1. Chemical Engineering 2. Pharmacy 3. Electronics and Instrumentation Engineering	1. Civil Engineering 2. Mechanical Engineering 3. Electronics and Instrumentation Engg 4. Information Technology 5. Civil and Structural Engg 6. Electrical Engineering 7. Electronics and Communication Engg 8. Mechanical (Manufacturing) Engg 9. Computer Science and Engineering 10. Computer Science and Engineering. (Artificial Intelligence and Machine learning) 11.Computer Science and Engineering. (Data Science)
2.	Civil Engineering	1. Civil Engineering 2. Civil and Structural Engg.	1. Mechanical Engineering 2. Electrical Engineering 3. Chemical Engineering 4. Computer Science and Engineering. 5. Computer Science and Engineering. (Artificial Intelligence and Machine learning) 6. Computer Science and Engineering (Data Science) 7. Mechanical (Manufacturing) Engg 8. Electronics and Instrumentation Engg 9. Information Technology 10. Electronics and Communication Engg
3.	Civil and Structural Engineering		
4.	Computer Science and Engineering	1. Computer Science and Engg. 2. Information Technology 3. Electronics and Communication Engineering 4. Computer Science and Engineering. (Artificial Intelligence and Machine learning) 5. Computer Science and Engineering. (Data Science)	1. Civil Engineering 2. Electronics and Instrumentation Engg 3. Electronics and Communication Engg 4. Mechanical Engineering 5. Mechanical (Manufacturing) Engg 6. Civil and Structural Engg 7. Electrical Engineering 8. Chemical Engineering
5.	Computer Science and Engineering (Artificial Intelligence and Machine learning)		
6.	Computer Science and Engineering (Data Science)		
7.	Electrical and Electronics Engineering	1. Electrical Engineering 2. Electronics and Instrumentation Engineering 3. Electronics and Communication	1. Civil Engineering 2. Civil and Structural Engg 3. Mechanical Engineering
8.	Electronics and Communication Engg.		

9.	Electronics and Instrumentation Engg.	Engineering	4. Chemical Engineering 5. Mechanical (Manufacturing) Engg 6. Computer Science and Engineering 7. Computer Science and Engineering (Artificial Intelligence and Machine learning) 8. Computer Science and Engineering (Data Science) 9. Information Technology
10.	Information Technology	1. Computer Science and Engg. 2. Information Technology 3. Electronics and Communication Engineering 4. Computer Science and Engineering. (Artificial Intelligence and Machine learning) 5. Computer Science and Engineering (Data Science)	1. Civil Engineering 2. Electronics and Instrumentation Engg 3. Electronics and Communication Engg 4. Mechanical Engineering 5. Mechanical (Manufacturing) Engg 6. Civil and Structural Engg 7. Electrical Engineering 8. Chemical Engineering
11.	Mechanical Engineering	1. Mechanical Engineering 2. Mechanical (Manufacturing) Engg.	1. Civil Engineering 2. Civil and Structural Engg 3. Electrical Engineering 4. Chemical Engineering 5. Computer Science and Engineering 6. Computer Science and Engineering (Artificial Intelligence and Machine learning) 7. Computer Science and Engineering (Data Science) 8. Electronics and Instrumentation Engg 9. Information Technology 10. Electronics and Communication Engg
12.	Mechanical (Manufacturing) Engg.		

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B.E. (Four Year) Degree Programme (FULL–TIME)

Choice Based Credit System (CBCS)

B.E. Computer Science and Engineering (Artificial Intelligence and Machine Learning)

CURRICULUM – 2019

SEMESTER I									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
ETBS101	**BS-I**	Physics	3	1	0	25	75	100	4
ETBS102	**BS-II**	Mathematics – I	3	1	0	25	75	100	4
ETES103	**ES-I**	Basic Electrical Engineering	3	1	0	25	75	100	4
ETBP104	**BSP-I**	Physics Laboratory	0	0	3	40	60	100	1.5
ETSP105	**ESP-I**	Electrical Engineering Laboratory	0	0	2	40	60	100	1
ETSP106	**ESP-II**	Engineering Workshop/ Manufacturing Practices	1	0	4	40	60	100	3
						Total Credits			**17.5**

SEMESTER II									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
ETHS201	**HS-I**	English	2	0	0	25	75	100	2
ETBS202	**BS-III**	Chemistry	3	1	0	25	75	100	4
ETES203	**ES-II**	Programming for Problem Solving	3	0	0	25	75	100	3
ETBS204	**BS-IV**	Mathematics – II	3	1	0	25	75	100	4
ETHP205	**HSP-I**	Communication Skills and Language Laboratory	0	0	2	40	60	100	1
ETBP206	**BSP-II**	Chemistry Laboratory	0	0	3	40	60	100	1.5
ETSP207	**ESP-III**	Computer Programming Lab	0	0	4	40	60	100	2
ETSP208	**ESP-IV**	Engineering Graphics and Drafting	1	0	4	40	60	100	3
						Total Credits			**20.5**
Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming III Semester.									

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
CURRICULUM - 2019

SEMESTER III									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
AIBS301	**BS-V**	Statistical Foundations of AI	3	1	-	25	75	100	4
ETES302	**ES-III**	Environmental Studies	3	-	-	25	75	100	3
AIES303	**ES-IV**	Multimedia Signal Processing	3	-	-	25	75	100	3
AIES304	**ES-V**	Digital Electronics	2			25	75	100	2
AIPC305	**PC-I**	Data Structures	3	-	-	25	75	100	3
AIPC306	**PC-II**	Principles of Artificial Intelligence	3	1		25	75	100	4
AISP307	**ESP-V**	Digital Electronics Lab	-	-	3	40	60	100	1.5
AICP308	**PCP-I**	Data Structures Lab	-	-	3	40	60	100	1.5
AICP309	**PCP-II**	Artificial Intelligence Lab	-	-	3	40	60	100	1.5
ETIT310	**IT-I**	Internship Inter/ Intra Institutional Activities*	***Four** weeks during the summer vacation at the end of **II Semester***				100	100	**4.0**
***For the **Lateral entry students** total credit for III Semester is **23.5** as they are exempted from internship during summer vacation of II semester.*						**Total Credits**			**27.5**

SEMESTER IV									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
AIBS401	**BS-VI**	Discrete Mathematics	3	-	-	25	75	100	3
AIES402	**ES-VI**	Operating Systems	2	-	-	25	75	100	2
AIPC403	**PC-III**	Database Management Systems	3	-	-	25	75	100	3
AIPC404	**PC-IV**	Fundamentals of Machine Learning	3	-	-	25	75	100	3
AIPC405	**PC-V**	Haskell Programming	3	-	-	25	75	100	3
AIPC406	**PC-VI**	Computer Organization and Architecture	3	-	-	25	75	100	3
AICP407	**PCP-III**	Database Management Systems Lab	-	-	3	40	60	100	1.5
AICP408	**PCP-IV**	Machine Learning Lab	-	-	3	40	60	100	1.5
AICP409	**PCP-V**	Haskell Programming Lab	-	-	3	40	60	100	1.5
						Total Credits			**21.5**
Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming V Semester.									

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SEMESTER V									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
AIPC501	**PC-VII**	Computer Networks	3	-	-	25	75	100	3
AIPC502	**PC-VIII**	Image and Speech Processing	3	-	-	25	75	100	3
AIPC503	**PC-IX**	Neural Computing in AI	3	-	-	25	75	100	3
AIPC504	**PC-X**	Knowledge Engineering and Inference	3			25	75	100	3
AIPE505	**PE-I**	Professional Elective I	3	-	-	25	75	100	3
AIPE506	**PE-II**	Professional Elective II	3	-		25	75	100	3
AICP507	**PCP-VI**	Computer Networks Lab	-	-	3	40	60	100	1.5
AICP508	**PCP-VII**	Image and Speech Processing Lab	-	-	3	40	60	100	1.5
AICP509	**PCP-VIII**	Neural Computing Lab	-	-	3	40	60	100	1.5
ETIT510	**IT-II**	Industrial Training / Rural Internship/Innovation / Entrepreneurship	***Four** weeks during the summer vacation at the end of **IV Semester***				100	100	**4.0**
						Total Credits			**26.5**

SEMESTER VI									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
AIPC601	**PC-XI**	Deep Learning for Visual Computing	3	-	-	25	75	100	3
AIPC602	**PC-XII**	Embedded Systems and Internet of Things (IoT)	3	-	-	25	75	100	3
AIPE603	**PE-III**	Professional Elective - III	3	-	-	25	75	100	3
AIPE604	**PE-IV**	Professional Elective - IV	3	-	-	25	75	100	3
AIPE605	**PE-V**	Professional Elective -V	3	-	-	25	75	100	3
YYOE606	**OE-I**	Open Elective - I (inter department - FEAT)	3	-	-	25	75	100	3
AICP607	**PCP-IX**	Deep Learning Tools Lab	-	-	3	40	60	100	1.5
AICP608	**PCP-X**	Embedded Systems and Internet of Things (IoT) Lab	-	-	3	40	60	100	1.5
						Total Credits			**21.0**
Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming VII Semester.									

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SEMESTER VII									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
ETHS701	**HS-II**	Social and Ethical Issues in AI	2	-	-	25	75	100	2
AIPC702	**PC-XIII**	Evolutionary Optimization Algorithms	3	-	-	25	75	100	3
AIPE703	**PE-VI**	Professional Elective-VI	3	-	-	25	75	100	3
AIPE704	**PE-VII**	Professional Elective-VII	3	-	-	25	75	100	3
YYOE705	**OE-II**	Open Elective - II (inter department- Allied Branch)	3	-	-	25	75	100	3
AICP706	**PCP-XI**	Optimization Techniques Lab	-	-	3	40	60	100	1.5
ETIT707	**IT-III**	Industrial Training / Rural Internship/Innovation / Entrepreneurship	***Four*** *weeks during the summer vacation at the end of* ***VI Semester***				100	100	**4.0**
						Total Credits			**19.5**

SEMESTER VIII									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
AIOE801	**OE-III**	Open Elective – III (from the same Department)	3	-	-	25	75	100	3
AIOE802	**OE-IV**	Open Elective – IV (from the same Department)	3	-	-	25	75	100	3
AIPV803	**PV-I**	Project Work and Viva-Voce	-	**PR** 10	**S** 2	40	60	100	**6**
						Total Credits			**12**

L	No. of Lecture Hours	**TR**	No. of Hours for Discussion on Industrial Training
T	No. of Tutorial Hours	**S**	No. of Seminar Hours on Industrial Training / Project
P	No. of Practical Hours	**PR**	No. of Hours for Discussion on Project work
CA	Continuous Assessment Marks	**FE**	Final Examination Marks
Credits	Credit points allotted to that course	**Total**	Total Marks

PE – PROFESSIONAL ELECTIVES

1. Expert System Architecture
2. Reasoning and Uncertainty
3. Decision Support Systems
4. NLP with Deep Learning
5. Computational Linguistics and NLP
6. Speech Synthesis
7. AI – Hardware and Software Infrastructure
8. AI Marketing and ML Tools
9. Emotional Analytics in AI
10. Cognitive and Computational Approaches to Machine Vision
11. Data Analytics and Visualization
12. Virtual Reality
13. AI in Cyber security
14. Biometric Security Technology – AI
15. Information Retrieval and web search
16. Vision Systems and Robotics
17. Agent based Modeling and Simulation
18. Recommender Systems
19. Artificial Super Intelligence
20. AI – Challenges and Strategies
21. Deductive and Inductive Reasoning

OE - OPEN ELECTIVES

1. Artificial Intelligence and Knowledge Engineering
2. Machine Learning
3. Natural Language Processing
4. Expert Systems
5. Computer Vision
6. Robotics
7. Internet of Things
8. Big Data Analytics

9. Mining Massive Datasets
10. Deep Generative Models

LIST OF HONOURS ELECTIVE COURSES

S. No.	Course Code	Course Name	Credits
1.	AIHESCN	Computational Neuroscience	4
2.	AIHESCN	Robot Learning and Sensorimotor Control	4
3.	AIHESCN	Human Computer Interaction (or) Enterprise Deep learning	3
4.	AIHESCN	Stochastic Process and Queuing Theory	3
5.	AIHESCN	CNN for Visual Recognition	3
6.	AIHESCN	Machine Learning for Predictive Data Analysis	3

LIST OF MINOR ENGINEERING ELECTIVE COURSES

S. No.	Course Code	Course Name	Credits
1	AIMISCN	Principles of Artificial Intelligence	4
2	AIMISCN	Fundamentals of Machine Learning	4
3	AIMISCN	Haskell Programming	3
4	AIMISCN	Expert System Architecture (or) NLP with Deep Learning	3
5	AIMISCN	Cognitive and Computational Approaches to Machine Vision	3
6	AIMISCN	Vision Systems and Robotics	3

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

B.E. COMPUTER SCIENCE AND ENGINEERING (Artificial Intelligence and Machine Learning)

(Students Admitted From the Academic Year 2019-2020)

VISION

To provide a congenial ambience for individuals to develop and blossom as academically superior, socially conscious and nationally responsible citizens.

MISSION

- **M1**: Impart high quality computer knowledge to the students through a dynamic scholastic environment wherein they learn to develop technical, communication and leadership skills to bloom as a versatile professional.
- **M2**: Develop life-long learning ability that allows them to be adaptive and responsive to the changes in career, society, technology, and environment.
- **M3**: Build student community with high ethical standards to undertake innovative research and development in thrust areas of national and international needs.
- **M4**: Expose the students to the emerging technological advancements for meeting the demands of the industry.

B. E. COMPUTER SCIENCE AND ENGINEERING (Artificial Intelligence and Machine Learning)

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO	PEO Statements
PEO1	To prepare graduates with potential to get employed in the right role and/or become entrepreneurs to contribute to the society.
PEO2	To provide the graduates with the requisite knowledge to pursue higher education and carry out research in the field of Computer Science and Engineering.
PEO3	To equip the graduates with the skills required to stay motivated and adapt to the dynamically changing world so as to remain successful in their career.
PEO4	To train the graduates to communicate effectively, work collaboratively and exhibit high levels of professionalism and ethical responsibility.

B.E.COMPUTER SCIENCE & ENGINEERING (Artificial Intelligenceand Machine Learning) PROGRAMME OUTCOMES (PO)

After the successful completion of the B.E COMPUTER SCIENCE & ENGINEERING (Artificial Intelligence and Machine Learning) degree program the students will be able to :

Sl. No.	Program Outcomes
PO1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**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.
PO3	**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.
PO4	**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.
PO5	**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.
PO6	**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.
PO7	**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.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10	**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.
PO11	**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.
PO12	**Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

B.E.COMPUTER SCIENCE & ENGINEERING (Artificial Intelligence and Machine Learning) - CONSISTENCY OF PEOS WITH MISSION OF THE DEPARTMENT

PEO Statements	Mission Statements			
	M1	M2	M3	M4
PEO1: To prepare the graduates with the potential to get employed in the right role and/or become entrepreneurs to contribute to the society.	2	3	2	3
PEO2: To provide the graduates with the requisite knowledge to pursue higher education and carry out research in the field of Computer Science.	2	2	3	2
PEO3: To equip the graduates with the skills required to stay motivated and adapt to the dynamically changing world so as to remain successful in their career.	2	3	2	3
PEO4: To train the graduates to communicate effectively, work collaboratively and exhibit high levels of professionalism and ethical responsibility.	3	3	2	3

3-Strong Correlation 2-Moderate Correlation 1-Weak Correlation

B.E.COMPUTER SCIENCE & ENGINEERING (Artificial Intelligence and Machine Learning) – MAPPING OF PEOs WITH POs

Mapping of PEOs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1	3	2	3	2	3	1	1	1	2	2	1	2
PEO2	3	2	3	2	2	-	-	-	-	1	-	2
PEO3	2	2	2	1	3	1	1	1	2	2	-	3
PEO4	2	1	2	1	2	1	1	2	2	3	2	1

3-Strong Correlation 2-Moderate Correlation 1-Weak Correlation

AIBS301	STATISTICAL FOUNDATIONS OF AI	L	T	P	C	COURSE
		3	1	0	4	

OBJECTIVES:

- To introduce Probability Theory which is helpful in investigating the important features of the Random experiments.
- To get knowledge about the basic concepts of random variables and its properties.
- To introduce certain probability distribution which is useful in constructing probabilistic models for observed phenomena.
- To learn various hypothesis testing methods.

UNIT – I Random Variables

Discrete random variables - probability distributions and probability mass functions - cumulative distribution functions - mean and variance - moment generating function. Continuous random variables - probability distributions and probability density functions -cumulative distribution functions - mean and variance-moment generating function.

UNIT – II Two Dimensional Random Variables

Probability function of two random variables - Joint probability density function - cumulative distribution functions - properties - margin probability distribution - conditional probability distribution - independent random variables - expected values of a two dimensional random variable- covariance and correlation.

UNIT – III Probability Distributions

Univariate Discrete distributions: Binomial, Poisson and Geometric distributions. Continuous distributions: Uniform, Normal and Exponential distributions. Convergence Concepts and Central Limit Theorem.

UNIT – IV Test of Hypothesis

Parameters and Statistics - Critical region and level of significance - one tailed and two tailed tests - Null hypothesis and Alternate hypothesis - Z test for large sample: Test for single proportion and difference of proportions - Test for single mean and difference of means. Small sample test: t-test for single mean and difference of means, F-test for significance of variance - Chi square test for goodness of fit and independence of attributes.

UNIT – V Analysis of Variance

Design of Experiment - Basic principles of experimental design - Analysis of Variance (ANOVA) - Analysis of Variance for one way classification - completely randomized design - Analysis of Variance for Two Way Classification - Randomized block design.

TEXT BOOKS:

1. Veerarajan. T, Probability, Statistics and Random processes, Tata McGraw –Hill publishing company limited, New Delhi 2014.
2. Kandasamy. P, Thilagavathy K and Gunavathy. K , Engineering mathematics, Volume II, S. Chand & co Ltd, New Delhi 2006.

REFERENCES:

1. Ramana .B.V, Higher Engineering Mathematics, Tata McGraw Hill, 2016.
2. C B Gupta, S R Singh, Mukesh Kumar, Engineering Mathematics, 1st Edition, McGraw Hill,2015
3. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publication, 2012.
4. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2010.

COURSE OUTCOMES:

At the end of this course, the students will able to

1. Acquire basic concepts about the random variables.
2. Investigate the important features of the random experiments.
3. Utilize probability distribution in many engineering applications.
4. Perform various tests for testing hypothesis.
5. Analyze the characteristics of data.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**2**	**-**	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**
CO4	**3**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**3**	**2**	**2**		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

ETES302	**ENVIRONMENTAL STUDIES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To make the students conversant with basic principles of natural resources, forest resources, ecosystem and bio-diversity.
- To get knowledge about pollution and its control.
- To understand the structure and function of an Eco-system.
- To study the role of information technology in human health.

UNIT - I Introduction

Multidisciplinary nature of environmental studies - Definition, scope and importance - Need for public awareness. Natural resources - Forest resources: use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Land resources: Land as a resource,

land degradation, man induced landslides, soil erosion and desertification - Role of an individual in conservation of natural resources- Equitable use of resources for sustainable lifestyles.

UNIT – II Concept of an Ecosystem

Structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem - Ecological succession - Food chains, food webs and ecological - pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem - Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

UNIT – III Bio Diversity

Definition: genetic, species and ecosystem diversity - Bio geographical classification of India - Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, National and local levels - India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT – IV Types of Pollution

Definition - Cause, effects and control measures of Air pollution - Water pollution - Soil pollution - Marine pollution- Noise pollution - Thermal pollution - Nuclear hazards- Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution – Disaster management: floods, earthquake, cyclone and landslides. Sustainable development - Urban problems related to energy - Water conservation, rain water harvesting, and watershed management - Resettlement and rehabilitation of people; its problems and concerns. - Environmental ethics: Issues and possible solutions - Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation - Consumerism and waste products - Environment Protection Act - Air (Prevention and Control of Pollution) Act - Water (Prevention and control of Pollution) Act - Wildlife Protection Act - Forest Conservation Act - Issues involved in enforcement of environmental legislation.

UNIT – V Environment and Human Health

Population growth, variation among nations - Population explosion – Family Welfare Programme - Environment and human health - Human Rights - Value Education - HIV/AIDS - Women and Child Welfare - Role of Information Technology in Environment and human health -Case Studies.

TEXT BOOKS:

1. Environmental Studies, MP Poonia & SC Sharma, Khanna Publishing House, 2017.
2. Textbook of Environmental Studies, Erach Bharucha, University Press, 2005.
3.

REFERENCES:

1. Environmental Studies, Rajagopalan, Oxford University Press, 2005.
2. De A.K., Environmental Chemistry, Wiley Eastern Ltd. New Age International Limited, 3rd Edition, 2003.
3. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T., Environmental Encyclopaedia, Jaico Publ. House, Mumbai, 2001.
4. Wanger K.D., Environmental Management. W.B. Saunders Co. Philadelphia, USA, 1998.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand renewable and non-renewable resources of our ecosystem.
2. Compare ecological system, causes and their relationship.
3. Explain political angers to the species of plants, animals and microorganisms in the environment and the threats to biodiversity
4. Analyse the causes and consequences of natural and man induced disasters (flood, earthquake, landslides, cyclones) and measure pollutions and minimize their effects.
5. Design modes with the help of information technology for eliminating or minimizing the problems of Environment and human health.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**-**	**-**	**-**	**-**	**1**	**3**	**-**	**-**	**-**	**-**	**-**
CO2	**1**	**-**	**-**	**-**	**-**	**1**	**3**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**-**	**-**	**-**	**-**
CO4	**2**	**1**	**-**	**-**	**-**	**2**	**3**	**-**	**-**	**-**	**-**	**-**
CO5	**1**	**-**	**2**	**1**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**-**

AIES303	**MULTIMEDIA SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To make the students conversant with basic principles of digital signal processing such as Fourier analysis, digital filters, sampling and quantization.
- To get knowledge about model-based signal processing like least square error, Wiener-Kolmogorov filters and adaptive filters.
- To develop some applications in speech.
- To create applications in music and mobile communication.

UNIT - I Basic Digital Signal Processing I

Introduction: Signals and Information - Signal Processing Methods - Applications of Digital Signal Processing - Fourier analysis and Synthesis: Introduction - Fourier Series: Representation of Periodic Signals - Fourier Transform: Representation of Non-periodic Signals - Discrete Fourier Transform - Short-Time Fourier Transform - Fast Fourier Transform (FFT) - 2-D Discrete Fourier Transform (2-D DFT) - Discrete Cosine Transform (DCT) - Some Applications of the Fourier Transform.

UNIT - II Basic Digital Signal Processing II

Sampling and Quantisation: Introduction - Sampling a Continuous-Time Signal - Quantisation - Sampling Rate Conversion: Interpolation and Decimation - Digital Filters: Introduction - Linear Time-Invariant Digital Filters - Recursive and Non-Recursive Filters - Filtering Operation: Sum of Vector Products, A

Comparison of Convolution and Correlation - Filter Structures: Direct, Cascade and Parallel Forms - Linear Phase FIR Filters - Design of Digital FIR Filter-banks - Quadrature Mirror Sub-band Filters - Design of Infinite Impulse Response (IIR) Filters by Pole-zero Placements - Issues in the Design and Implementation of a Digital Filter.

UNIT – III Model-Based Signal Processing

Least Square Error, Wiener-Kolmogorov Filters: Least Square Error Estimation: Wiener-Kolmogorov Filter - Block-Data Formulation of the Wiener Filter - Interpretation of Wiener Filter as Projection in Vector Space - Analysis of the Least Mean Square Error Signal - Formulation of Wiener Filters in the Frequency Domain - Some Applications of Wiener Filters - Implementation of Wiener Filters - Adaptive Filters: Introduction - State-Space Kalman Filters - Sample Adaptive Filters - Recursive Least Square (RLS) Adaptive Filters - The Steepest-Descent Method - LMS Filter.

UNIT – IV Applications of Digital Signal Processing to Speech

Speech Processing: Speech Communication - Acoustic Theory of Speech: The Source-filter Model - Speech Models and Features - Linear Prediction Models of Speech - Harmonic Plus Noise Model of Speech - Fundamental Frequency (Pitch) Information - Speech Coding - Speech Recognition - Speech Enhancement: Introduction - Single-Input Speech Enhancement Methods - Speech Bandwidth Extension - Spectral Extrapolation - Interpolation of Lost Speech Segments - Packet Loss Concealment - Multi-Input Speech Enhancement Methods - Speech Distortion Measurements.

UNIT – V Music and Mobile Communication Applications

Music Signal Processing and Auditory Perception: Introduction - Musical Notes, Intervals and Scales - Musical Instruments - Review of Basic Physics of Sounds - Music Signal Features and Models - Anatomy of the Ear and the Hearing Process -Psychoacoustics of Hearing - Music Coding (Compression) - High Quality Audio Coding: MPEG Audio Layer-3 (MP3) - Stereo Music Coding - Signal Processing in Mobile Communication: Introduction to Cellular Communication - Communication Signal Processing in Mobile Systems -Capacity, Noise, and Spectral Efficiency - Multi-path and Fading in Mobile Communication - Smart Antennas – Space-Time Signal Processing.

TEXT BOOKS:

1. Nurulfajar Abd Manap, Multimedia Signal Processing, First Edition, Universiti Teknikal Malaysia Melaka, 2016.
2. Saeed V. Vaseghi, Multimedia Signal Processing, First Edition, John Wiley & Sons Ltd, 2007.

REFERENCES:

1. Hon Keung Kwan, Multimedia Signal Processing and Applications, Edition 1.3, dfisp.org, 2018.
2. Srdjan Stankovic, Irena Orovic, Ervin Sejdic, Multimedia Signals and Systems, Second Edition, Springer International Publishing, 2012.
3. Grgic, Mislav, Delac, Kresimir, Ghanbari, Mohammed (Eds.), Recent Advances in Multimedia Signal Processing and Communications, First Edition, Springer-Verlag Berlin Heidelberg, 2009.
4. Mandal, Mrinal Kr., Multimedia Signals and Systems, First Edition, Springer US, 2003.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the concept of Fourier analysis.
2. Utilize the basic knowledge of digital filters, sampling and quantization.
3. Investigate model-based signal processing like least square error, Wiener-Kolmogorov filters and

adaptive filters.

4. Apply the digital signal processing to speech applications.
5. Employ the applications of digital signal processing to music and mobile communication.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**1**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**2**	**1**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

AIES304	**DIGITAL ELECTRONICS**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

COURSE OBJECTIVES:

- To understand the fundamentals of semiconductor devices, transistors and amplifiers.
- To introduce the laws of Boolean algebra and solve problems in combinational logic.
- To explain sequential logic, memory circuits and systems.
- To study about analog to digital convertors.

UNIT – I Digital Circuits-Introduction

Digital signals - digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations - Boolean algebra - examples of IC gates - number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic codes - error detecting and correcting codes - characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

UNIT – II Standard Representation for Logic Functions

K-map representation - Simplification of logic functions using K-map - minimization of logical functions, Don't care conditions - Multiplexer, De-Multiplexer/Decoders, Adders-Subtractors- BCD arithmetic- carry look ahead adder- serial adder- ALU- elementary ALU design- popular MSI chips- digital comparator- parity checker/generator-code converters- priority encoders-decoders/drivers for display devices- QM method of function realization.

UNIT – III Flip Flops and Counters

A 1-bit memory, the circuit properties of Bi stable latch, the clocked SR flip flop, JK,T and D type flip flops- applications of flip flops- shift registers- applications of shift registers-serial to parallel converter- parallel to serial converter- ring counter- sequence generator- ripple (Asynchronous) counters- synchronous counters- counters design using flip flops-special counter ICs- asynchronous sequential counters- applications of counters.

UNIT – IV ADC and DAC Converters

Digital to analog converters: weighted resistor/converter- R,2R Ladder D/A converter- specifications for D/A converters- examples of D/A converter ICs- sample and hold circuit- analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter-counting A/D converter- dual slope A/D converter-A/D converter using voltage to frequency and voltage to time conversion- specifications of A/D converters-example of A/D converter ICs.

UNIT – V Memory Organization

Memory organization and operation-expanding memory size-classification and characteristics of memories- sequential memory- read only memory (ROM)-read and write memory(RAM)- content addressable memory (CAM)- charge de coupled device memory (CCD)- commonly used memory chips-ROM as a PLD- Programmable logic array- Programmable array logic- complex Programmable logic devices (CPLDS)-Field Programmable Gate Array (FPGA).

TEXT BOOKS:

1. M. M. Mano, Digital logic and Computer design, Pearson Education India, 2016.
2. P. Jain, Modern Digital Electronics, McGraw Hill Education, 2009.

REFERENCES:

1. A.Kumar, Fundamentals of Digital Circuits, Prentice Hall India, 2016.
2. Rishabh Anand, Digital Electronics, 2nd Edition, Khanna Publishing House, 2014.
3. Floyd, Electron Devices, 5th Edition, Pearson Asia, 2013.
4. Donald P Leach, Albert Paul Malvino, Goutan Saha, Digital Principles and Applications, 7th Edition, 2010.
5. Rashid, Microelectronic circuits, Thomson Publications, 2010.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the working of logic families and logic gates.
2. Design and implement Combinational and Sequential logic circuits.
3. Understand the process of Analog to Digital conversion and Digital to Analog conversion.
4. Be able to use PLDs to implement the given logical problem.
5. Knowledge about the Memories.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**2**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**2**	**1**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

AIPC305	DATA STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart the basic concepts of data structures and algorithms.
- To understand concepts about searching and sorting techniques.
- To understand basic concepts about stacks, queues, lists, trees and graphs.
- To enable them to write algorithms for solving problems with the help of fundamental data structures.

UNIT – I Basic Terminologies

Elementary Data Organizations - Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm - Asymptotic Notations - Time-Space trade off. Searching-Linear Search and Binary Search Techniques- their complexity analysis.

UNIT – II ADT Stack and its operations

Algorithms and their complexity analysis- Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue- Types of Queue: Simple Queue, Circular Queue, Priority Queue- Operations on each type of Queues- Algorithms and their analysis.

UNIT – III Linked Lists

Singly linked lists-Representation in memory-Algorithms of several operation- Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue- Header nodes-Doubly linked list: operations on it and algorithmic analysis-Circular Linked Lists- all operations their algorithms and the complexity analysis.

UNIT – IV Trees

Basic Tree Terminologies- Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree- Tree operations on each of the trees and their algorithms with complexity analysis- Applications of Binary Trees-B Tree, B+ Tree: definitions-algorithms and analysis.

UNIT – V Sorting and Hashing

Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort- Performance and Comparison among all the methods - Hashing- Graph: Basic Terminologies and Representations- Graph search and traversal algorithms and complexity analysis.

TEXT BOOKS:

1. Mark Allen Weiss, Algorithms, Data Structures, and Problem Solving with C++, Illustrated Edition, 4th Edition, Addison-Wesley Publishing Company, 2014.
2. Ellis Horowitz, Sartaj Sahni, Fundamentals of Data Structures, Illustrated Edition,Computer Science Press,1983.

REFERENCES:

1. RS Salaria, Data Structures, 5th edition, Khanna Publishing House, 2017.
2. G.A.V. Pai, Data Structures and Algorithms, McGraw Hill, 2017.

3. RB Patel, Expert Data Structures with C++, 2nd edition, Khanna Publications, 2012.
4. Yashwant Kanetkar, Data Structures through, 2nd edition, BPB Publications, 2009.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Analyze the algorithms to determine the time and computation complexity and justify the correctness.
2. Design and implement search algorithms.
3. Implement and analyze the same to determine the time and computation complexity.
4. Compare the performance of various algorithms in term of Space and Time complexity.
5. Implement Graph search and traversal algorithms and determine the time and computation complexity.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-
CO4	1	1	1	-	-	-	-	-	-	-	-	-
CO5	2	2	2	-	-	-	-	-	-	-	-	-

AIPC306	**PRINCIPLES OF ARTIFICIAL INTELLIGENCE**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

COURSE OBJECTIVES:

- The primary objective of this course is to introduce the basic principles, techniques and applications of Artificial Intelligence.
- To become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
- To Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
- To explore the current scope, potential, limitations, and implications of AI Based systems.

UNIT – I Introduction to AI

Problems, Problem Spaces and Search: Defining the Problem as a State space Search, Production Systems, Problem Characteristics, Production system characteristics, Issues in the Design of Search Programs. Heuristic Search Techniques: Generate-and-test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis.

UNIT – II Knowledge Representation

Using Predicate Logic, Representing Simple Facts in logic, Representing Instance and Isa Relationships, Computable Functions and Predicates, Resolution - Representing Knowledge Using Rules: Procedural versus Declarative Knowledge, Logic Programming, Forward versus Backward Reasoning, Matching, Control Knowledge.

UNIT – III Slots and Filler Structures

Weak slot and-filler structures: Semantic Nets, Frames, Strong slot-and-filler structures: Conceptual dependency, Scripts. Symbolic reasoning under uncertainty, Nonmonotonic reasoning, Statistical reasoning.

UNIT – IV Game Playing

Min Max search Procedure, adding alpha beta cutoffs, additional refinements, iterative deepening. Goal stack planning, non linear planning, hierarchical planning, representation for planning, partial order planning algorithm, Understanding: What makes understanding hard, understanding as constraint satisfaction, Learning Concepts : rote learning, learning by taking advices, learning by problem solving, learning from examples, learning by analogy, explanation based learning, neural nets, genetic algorithms.

UNIT – V Natural Language Processing

Syntactic processing, semantic analysis, discourse and programmatic processing, statistical natural language processing, spell checking, Introduction to Expert Systems ,Architecture of expert systems, Roles of expert systems - Knowledge Acquisition –Meta knowledge, Heuristics. Expert systems Case Studies - MYCIN, DART, XOON.

TEXT BOOKS:

1. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, 3rd Edition, Pearson, 2017.
2. Dan W Patterson, Introduction to Artificial Intelligence and Expert Systems, 1st Edition, PHI.,2015

REFERENCES:

1. Patrick Henry Winston, Artificial Intelligence, Pearson Education, 2003.
2. G. Luger, W. A. Stubblefield, Artificial Intelligence, Third Edition, Addison-Wesley, 2007.
3. Elaine Rich & Kevin Knight, Artificial Intelligence, 3rd Edition, Tata McGraw Hill Edition,Reprint, 2008.
4. Russel and Norvig, Artificial Intelligence, Pearson Education, PHI, 2009

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand basic principles of AI in solutions that require problem solving, inference, knowledge representation and learning.
2. Understand knowledge representation using logic and rules
3. Analyze various AI techniques in expert systems, artificial neural networks and other machine learning models.
4. Apply Min-Max Search procedures, iterative deepening, and Learning in game playing
5. Analyze the main approaches to natural language processing and expert systems.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	1	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-
CO4	2	2	-	-	-	-	-	-	-	-	-	-
CO5	1	2	3	2	-	-	-	-	-	2	-	-

AISP307	DIGITAL ELECTRONICS LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To study and experiment the characteristics of semiconductor diode and Zener diode.
- To do estimation of parameters of amplifiers, oscillators and multivibrators.
- To implement the concepts of Digital Logic design such as logic gates, flip flops, multiplexer and demultiplexer.
- To estimate gain and efficiency in power amplifier.

LIST OF EXERCISES

1. Characteristics of semiconductor diode.
2. Characteristics of Zener diode and Zener diode as a voltage regulator.
3. Estimation of ripple factor and efficiency in a full wave / Bridge rectifier with and without filter.
4. Characteristics of CE PNP and NPN transistor.
5. Frequency response of RC coupled amplifier.
6. Estimation of gain and efficiency in a class B power amplifier.
7. Measurement of frequency of the output voltage in a RC phase shift oscillator.
8. Estimation of the frequency of the output voltage of a Bistable Multivibrator.
9. Verification of Truth table of AND / OR / NOT / NAND/ NOR / XOR gates.
10. Reduction of variables using K-Map.
11. Study of multiplexer and Demultiplexer.
12. Verification of state table of RS / JK flipflop.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Analyze the characteristics of diode, Rectifiers, transistors, Oscillators and Multivibrators.
2. Implement Digital logic circuits using logic gates, RS/JK Flip-flops, Multiplexer and De-multiplexer Understand the basic digital circuits and to verify their operation.
3. Demonstrate an ability to listen and answer the viva questions related to programming skills needed for solving real-world problems in Computer Science and Engineering.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	2	3	2	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	2	-	2

AICP308	DATA STRUCTURES LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To learn how the choice of data structures and algorithm design methods impacts the performance of programs.
- To learn object-oriented design principles and gain experience writing programs in C++.
- To study specific data structures such as linear lists, stacks, queues, binary trees, binary search trees, and graphs.
- To study specific algorithm design methods such as the greedy method, divide and conquer, dynamic programming, backtracking, and branch and bound.

LIST OF EXERCISES

1. Write a program to create a Stack and perform insertion and deletion operations on it.
2. Write a program to create a List and perform operations such as insert, delete, update and reverse.
3. Write a program to create a Queue and perform operations such as insertion and deletion.
4. Write a program to Implement Linear Search Algorithm.
5. Using iteration and recursion concepts write programs for finding the element in the array using the Binary Search method.
6. Write a program and simulate various graph traversing techniques.
7. Write a program and simulate various tree traversing techniques.
8. Write a program to Implement Binary Search Tree.
9. Write a program to simulate Bubble sort, quick sort and Merge sort algorithms.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Develop a C++ program to build the basic data structures like stack, queue and list.
2. Develop a C++ program for searching and sorting algorithms using iteration and recursion concept.
3. Demonstrate an ability to listen and answer the viva questions related to programming skills needed for solving real-world problems in Computer Science and Engineering.

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3	2	-	-	-	-	-	-	-	-
CO2	1	2	3	2	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	2	-	2

AICP309	ARTIFICIAL INTELLIGENCE LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To learn Python Programming and Key Python Libraries related to AI.
- To formulate Real World Problems for AI.
- To study specific algorithm design methods related to game playing.
- To understand the process involved in computing with natural language specifically: Texts and Words.

LIST OF EXERCISES

1. Write a program to implement Breadth First Search Traversal.
2. Write a program to implement Water Jug Problem.
3. Write a program to remove punctuations from the given string.
4. Write a program to sort the sentence in alphabetical order.
5. Write a program to implement Hangman game using python.
6. Write a program to implement Tic-Tac-Toe game using python.
7. Write a program to remove stop words for a given passage from a text file using Natural Language Toolkit (NLTK).
8. Write a program to implement stemming for a given sentence using NLTK.
9. Write a program to implement Lemmatization using NLTK.
10. Write a program for Text Classification in a given sentence using NLTK.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the problem as a state space, design heuristics and select amongst different search based techniques to solve them.
2. Analyze the design heuristics and apply different game based techniques to solve game playing problems.
3. Apply Text Classification techniques used in NLP.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	2	3	2	-	-	-	-	-	-	-	-
CO2	1	2	3	2	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	2	-	2

AIBS401	DISCRETE MATHEMATICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study various finite structures of Mathematics which are essential to develop the various concepts of Computer Science.
- To understand set theory and relations.
- To know the principles of Boolean Algebra.
- To introduce the graph theory.

UNIT – I Mathematical Logic

Propositions – Connectives – Tautology and contradiction – Equivalence of prepositions – Tautological Implication – Normal Forms – Theory of Inference – Rules of Inference.

UNIT – II Set Theory and Relations

Set operations – Ordered pairs and Cartesian product – Relations – Type of relations – Operations or relations – Properties of relations – Equivalence classes – Partition of set – Matrix and Graphical representation of relation.

UNIT – III Lattice and Boolean Algebra

Partial ordered set – Hasse diagram – Lattices – Properties of Lattices – Boolean Algebra – Karnaugh map method.

UNIT – IV Group and Group code

Algebraic systems – Semi groups and Monoids – Groups – Permutation Group – Subgroups – Coding Theory – Group codes – Hamming codes – Procedure for Encoding and Decoding Group codes.

UNIT – V Graph Theory

Graphs – Special simple graphs – Matrix representation of graphs – Path cycles and connectives – Eulerian and Hamiltonian graphs – Shortest path algorithms.

TEXT BOOKS:

1. Veerarajan T, Discrete Mathematics with Graph Theory and Combinatorics, Tata McGraw Hill Publishing Company Ltd, 2014.
2. S. K. Chakraborty and B. K. Sarkar, Discrete Mathematics and Its Applications, Oxford,2011

REFERENCES:

1. Venkataraman M K, Discrete Mathematics, The National Publishing Company, 2008.
2. Kolman Busby Ross, Discrete Mathematical Structures, Pearson Education Ltd, 2000.
3. Trembley J P and Manohar R P, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill Publishing Company Ltd, 2005.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Acquire the basic concepts in Mathematical Logic and theory of inferences.
2. Understand the concepts of Set theory, Relations and equivalence classes with matrix representation.
3. Familiarize Lattice theory, Boolean algebra and Group theory.
4. Design coding and encoding group codes concept.
5. Understand the basic concepts of Graph theory, Eulerian and Hamiltonian graphs .

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	2	2	-	-	-	2	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	2	-	-	-	-	-	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	-
CO5	3	3	1	-	-	-	-	-	2	-	-	-

AIES402	**OPERATING SYSTEMS**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

COURSE OBJECTIVES:

- To introduce students with basic concepts of operating system its function and services.
- To teach the features of operating system and the fundamental theory associated with process, memory and file management component of operating systems.
- To provide the knowledge about UNIX operating system.
- To learn about I/O devices, file structure disk structure and disk management.

UNIT - I Introduction

Concept of Operating Systems- Generations of Operating systems-Types of Operating Systems-OS Services-System Calls-Structure of an OS - Layered, Monolithic, Microkernel Operating Systems-Concept of Virtual Machine-Case study on UNIX and WINDOWS Operating System.

UNIT - II Processes and Scheduling

Definition - Process Relationship - Different states of a Process - Process State transitions, Process Control Block (PCB), Context switching-Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads-Process Scheduling-Foundation and Scheduling objectives - Types of Schedulers, Scheduling criteria-CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time-Scheduling algorithms- Pre-emptive and Non pre-emptive, FCFS, SJF, RR-Multiprocessor scheduling-Real Time scheduling-RM and EDF.

UNIT - III Inter- Process Communications

Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution- The Producer Consumer Problem-Semaphores, Event Counters, Monitors, Message Passing-Classical IPC Problems- Reader's & Writer Problem, Dinning Philosopher Problem etc. Deadlocks-Definition, Necessary and sufficient conditions for Deadlock- Deadlock Prevention,

Deadlock Avoidance-Banker's algorithm-Deadlock detection and Recovery.

UNIT – IV Memory Management

Basic concept-Logical and Physical address map, memory allocation-Contiguous Memory allocation – Fixed and variable partition– Internal and External fragmentation -Compaction; Paging-Principle of operation – Page allocation Hardware support for paging, Protection and sharing, Disadvantages of paging -Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

UNIT – V File and Directories

I/O Hardware - I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure:- Disk structure, Disk scheduling algorithms-File Management:-Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance. Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks.

TEXT BOOKS:

1. Silberschatz, Galvin, and Gagne, Operating System Concepts, 9th Edition, WileyIndia Pvt Ltd, 2013.
2. William Stallings, Operating Systems – internals and design principles, 7thEdition, Prentice Hall, 2011.

REFERENCES:

1. Maurice Bach, Design of the Unix Operating Systems, 8th Edition Prentice-Hall of India, 2011.
2. Charles Crowley, Operating System: A Design-oriented Approach, 1st Edition, Irwin Publishing, 1996.
3. Ekta Walia, Operating Systems, 2nd Edition, Khanna Publishing House, Delhi, 2010.
4. Dhananjay M. Dhamdhere, Operating Systems A Concept-Based Approach, 1st Edition, McGraw Hill, 2008.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Create processes and threads.
2. Develop algorithms for process scheduling for a given specification of CPU utilization, throughput, Turnaround Time, Waiting Time, Response Time.
3. Develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time.
4. Design and implement file management system.
5. For a given I/O devices and OS (specify) develop the I/O management functions in OS as part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-
CO3	2	2	3	1	-	-	-	-	-	-	-	-
CO4	1	1	1	-	-	-	-	-	-	-	-	-
CO5	2	1	1	-	-	-	-	-	-	-	-	-

AIPC403	**DATABASE MANAGEMENT SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the fundamentals of DBMS and E-R Diagrams.
- To impart the concepts of the Relational model and SQL.
- To disseminate the knowledge on various Normal Forms.
- To inculcate the fundamentals of transaction management and Query processing.

UNIT – I Introduction

File System vs. DBMS – Views of data – Data Models – Database Languages – Database Management System Services – Overall System Architecture – Data Dictionary – Entity – Relationship (E-R) – Enhanced Entity – Relationship Model.

UNIT – II Relational Approach

Relational Model – Relational Data Structure – Relational Data Integrity – Domain Constraints – Entity Integrity – Referential Integrity – Operational Constraints – Keys – Relational Algebra – Fundamental operations – Additional Operations –Relational Calculus - Tuple Relational Calculus – Domain Relational Calculus - SQL – Basic Structure – Set operations – Aggregate Functions – Null values – Nested Sub queries – Derived Relations – Views – Modification of the database – Joined Relations – Data Definition Language – Triggers.

UNIT – III Database Design

Functional Dependencies – Pitfalls in Relational Database Design – Decomposition – Normalization using Functional Dependencies – Normalization using Multi-valued Dependencies – Normalization using Join Dependencies – Domain - Key Normal form.

UNIT – IV Query Processing and Transaction Management

Query Processing Overview – Estimation of Query Processing Cost - Join strategies – Transaction Processing – Concepts and States – Implementation of Atomicity and Durability – Concurrent Executions – Serializability – Implementation of Isolation – Testing for Serializability – Concurrency control – Lock Based Protocols – Timestamp Based Protocols.

UNIT – V Trends in Data Base Technologies

Distributed Databases - Homogeneous and Heterogeneous Databases - Distributed Data Storage - Distributed Transactions - Commit Protocols - Concurrency Control in Distributed Databases - Availability - Distributed Query Processing - Heterogeneous Distributed Databases- Cloud-Based Databases - Directory Systems.

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, Database System Concepts, 6th Edition, Tata McGraw Hill, 2010.
2. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, 6th Edition, Addision Wesley, 2010.

REFERENCES:

1. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, Third Edition, McGraw Hill, 2002.
2. Peter Rob and Carlos Coronel, Database Systems – Design, Implementation and Management, 7th Edition, Thompson Learning, Course Technology, 2006.
3. C. J. Date, A.Kannan, S.Swamynathan, An Introduction to Database Systems, 8th Edition, Addison Wesley, 2012.
4. Database Management Systems, R.P. Mahapatra & Govind Verma, Khanna Publishing House, 2013.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the fundamental concepts of Database Management Systems and Entity Relationship Model and develop ER Models.
2. Build SQL Queries to perform data creation and data manipulation operations on databases.
3. Understand the concepts of functional dependencies, normalization and apply such knowledge to the normalization of a database.
4. Identify the issues related to Query processing and Transaction management in database management systems.
5. Analyze the trends in data storage, query processing and concurrency control of modern database technologies.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	2	-	-	-	-	-	-	-	-	-
CO2	2	-	2	-	-	-	-	-	-	-	-	-
CO3	-	-	1	-	-	-	-	-	-	-	-	-
CO4	-	1	-	-	1	-	-	-	-	-	-	-
CO5	2	-	-	-	-	-	-	-	-	-	-	-

AIPC404	FUNDAMENTALS OF MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamental concepts of machine learning and its applications
- To learn the classification, clustering and regression based machine learning algorithms
- To understand the deep learning architectures
- To understand the methods of solving real life problems using the machine learning techniques

UNIT – I Bayesian Decision Theory and Normal Distribution

Machine perception - feature extraction - classification, clustering, linear and logistic regression - Types of learning - Bayesian decision theory - classifiers, discriminant functions, and decision surfaces - univariate and multivariate normal densities - Bayesian belief networks.

UNIT – II Classification Algorithms

Perceptron and backpropagation neural network - k-nearest-neighbor rule. Support vector machine: multicategory generalizations - Regression. Decision trees: classification and regression tree - random forest.

UNIT – III Component analysis and Clustering Algorithms

Principal component analysis - Linear discriminant analysis - Independent component analysis. k-means clustering - fuzzy k-means clustering - Expectation-maximization algorithm-Gaussian mixture models - autoassociative neural network.

UNIT – IV Deep Learning Architectures and Applications

Convolution neural network (CNN) - Layers in CNN - CNN architectures. Recurrent Neural Network - Applications: Speech-to-text conversion-image classification-time series prediction.

UNIT – V Combining Multiple Learners

Generating diverse learners - model combination schemes - voting - error-correcting output codes - bagging - boosting - mixture of experts revisited - stacked generalization - fine-tuning an ensemble – cascading.

TEXT BOOKS:

1. R. O. Duda, E. Hart, and D.G. Stork, Pattern classification, Second edition, John Wiley & Sons, Singapore, 2012.
2. Francois Chollet, Deep Learning with Python, Manning Publications, Shelter Island, New York, 2018.

REFERENCES:

1. Ethem Alpaydin, Introduction to Machine Learning, 3rd Edition, MIT Press, 2014.
2. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006
3. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
4. Navin Kumar Manaswi, Deep Learning with Applications using Python, Apress, New York, 2018.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the basic concepts of Bayesian theory and normal densities.

2. Implement different classification algorithms used in machine learning.
3. Implement clustering and component analysis techniques.
4. Design and implement deep learning architectures for solving real life problems.
5. Combine the evidence from two or more models/methods for designing a system.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-
CO3	2	1	2	1	-	-	-	-	-	-	-	-
CO4	2	3	3	2	1	-	-	-	-	-	-	-
CO5	2	3	3	2	1	-	-	-	-	-	-	-

AIPC405	**HASKELL PROGRAMMING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To get the basic concepts of pure functional programming.
- To understand the control structures and higher-order functions in Haskell.
- To declare arrays, modules and files.
- To use built-in modules and to develop applications.

UNIT – I Introduction

Introduction to Haskell and the ghci interpreter - Features of Haskell - Historical background
A Taste of Haskell - Baby's First Functions - Input and Output Actions**:** putStrLn – getLine – getChar - putStr -putChar – print – when – sequence – forever –form - Lazy Evaluation.

UNIT – II Types and Control Structures

Basic types – List types - Tuple types- Function types - Curried functions - Polymorphic types – Overloaded types- Basic classes – Monad – Stack. Control Structures: if-then, if-then-else, nested if, case, do.

UNIT – III Defining Functions and Higher-Order Functions:

Defining Functions: Guards - Pattern Matching - Lambda Expressions. List Comprehensions: Generators - zip function – Lists - Strings - Tuples – Caesar Cipher. Recursive Functions: Basic Concepts – Recursion on Lists – Multiple Arguments - Multiple Recursion – Mutual Recursion. Higher-Order Functions: Map – Filter –Foldable: foldr and foldl functions–Tree example - Composition Operator - String Transmitter.

UNIT – IV Arrays and Modules

Arrays: Immutable Arrays - Mutable IO Arrays- Examples. Sorting Algorithms: Insertion Sort - Bubble sort - Selection sort - Permutation Sort - Merge Sort – Quicksort. Modules: Data.List - Data.Char - Data.Map - Data.Set - Data.Time - Data.Vector- Making Our Own Modules - Monoids: Combining two lists.

UNIT – V Files and Streams

Opening file using openFile – Mode operations(IOMode) – Reading and Writing into/from a file- hGetContents - hGetLine – hPutStr - hPutStrLn – hGetChar – contents- readFile - writeFile – appendFile - hFlush- Closing a file – hClose. Streaming IO: InputStream and OutputStream.Case Study: Industrial Applications Using Haskell: Anti-spam programs in Face Book - Semantic Implementation of GitHub – Unbeatable Tic-Tac-Toe Problem.

TEXT BOOKS:

1. Graham Hutton, Programming in Haskell, 2nd Edition, Cambridge University Press, United Kingdom, 2016.
2. MiranLipovaca, Learn You A Haskell Great Good: A Beginner's Guide, No Starch Press, San Francisco, CA, 2011.

REFERENCES:

1. Will Kurt, Get Programming with Haskell, Manning Publications, 2018.
2. Christopher Allen and Julie Moronuki, Haskell Programming for First Principles, Allen and Moronuki Publishing, 2016.
3. Bryan O'Sullivan, John Goerzen, and Don Stewart, Real World Haskell, O'Reilly Media, Inc., CA, 2008.
4. GoalKicker, Haskell Notes for Professionals (Online Book) https://goalkicker.com/HaskellBook.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Analyze and design a computer program based on pure functional programming.
2. Solve simple problems using basic data types and control structures.
3. Gain the basic knowledge on functions and higher-order functions.
4. Sort the given numbers using arrays and sorting algorithms.
5. Implement a file to store and retrieve the real time data.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	1	1	-	-	-	-	-	-	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-
CO3	2	1	2	1	-	-	-	-	-	-	-	-
CO4	2	3	3	2	1	-	-	-	-	-	-	-
CO5	2	3	3	2	1	-	-	-	-	-	-	-

AIPC406	COMPUTER ORGANIZATION AND ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic structure and operation of digital computer.
- To study the two types of control Unit techniques and the concept of pipelining.
- To study the hierarchical memory system including cache memories and virtual memory.
- To study the different ways of communicating with I/O devices and standard I/O interfaces.

UNIT – I Introduction

Functional Units – Basic operational concepts – Bus structures – Performance and metrics – Instructions and instruction sequencing – Instruction set architecture – Addressing modes – RISC – CISC.

UNIT – II Fundamental Concepts

ALU design – Execution of a complete instruction – Multiple bus organization – Hardwired control – Micro programmed control – Nano programming.

UNIT – III Memory

Semiconductor RAM – ROM – Speed – Size and cost – Cache memories – Improving cache performance – Virtual memory – Memory management requirements – Associative memories – Secondary storage devices.

UNIT – IV I/O Devices

Accessing I/O devices – Programmed I/O – Interrupts – Direct memory access – Buses – Interface Circuits – Standard I/O interfaces (PCI, SCSI, and USB) – I/O Devices and processors.

UNIT – V Parallel Processing

Concept of parallel processing, Pipelining, Forms of parallel processing, interconnect network - Data hazards – Instruction hazards – Influence on instruction sets – Data path and control considerations – Performance considerations – Exception handling.

TEXT BOOKS:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, 5th Edition, McGraw-Hill, 2012.
2. David A. Patterson and John L. Hennessy, Computer Architecture-A Quantitative Approach, 5th Edition, Elsevier, a division of reed India Private Limited, 2012.

REFERENCES:

1. William Stallings, Computer Organization and Architecture – Designing for Performance, 6th Edition, Pearson Education, 2003.
2. Hayes, J.P., Computer Architecture and Organization, 3rd Edition, Tata Mc-Graw Hill, 1998.
3. Ghosh T. K., Computer Organization and Architecture, 3rd Edition, Tata McGraw-Hill, 2011.
4. Behrooz Parahami, Computer Architecture, 8th Impression, Oxford University Press, 2011.
5. Heuring, V.P. and Jordan, H.F., Computer Systems Design and Architecture, 2nd Edition, Pearson Education, 2004.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the functional Units of a computer, bus organizations and addressing modes.
2. Compare and Contrast the Hardwired control and Micro programmed control.
3. Analyze RAM, ROM, Cache memory and virtual memory concepts.
4. Identify the various I/O interfaces that are communicated with computers.
5. Recognize the concept of parallel processing and Pipelining on Computers

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	1	1	1	-	-	-	-	-	-	-	-	-
CO3	1	1	1	-	-	-	-	-	-	-	-	-
CO4	1	-	-	-	-	-	-	-	-	-	-	-
CO5	1	-	-	-	-	-	-	-	-	-	-	-

AICP407	**DATABASE MANAGEMENT SYSTEMS LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To enable students to understand and use a relational database system.
- To understand the role of a database management system in an organization.
- To understand basic database concepts including the structure and operation of the relational data model.
- To construct simple and moderately advanced database queries using Structured Query Language (SQL).

LIST OF EXERCISES

1. Implementation of queries for student data base.
2. Data Definition Language – with constraint and without constraint.
3. Data Manipulation language – Insert, Delete, Update, Select and truncate.
4. Transaction Control Statement – Commit, Save point, Roll back.
5. Data Control Statement – Grant, Revoke.
6. Data Projection Statement – Multi column, alias name, arithmetic operations, Distinct records, concatenation, where clause.
7. Data Selection Statement – Between, and, not in, like, relational operators and logical operators.
8. Aggregate functions – count, maximum, minimum, sum, average, order by, group by, having.
9. Joint queries – inner join, outer join, self join, Cartesian join, or cross join.
10. Sub queries – in, not in, some, any, all, exist, not exist.
11. Set operations – union, union all, intersect, minus.
12. Database objects – synonym, sequences, views and index.

13. Cursor.
14. Functions and procedures.
15. Trigger.
16. Exceptions.
17. Packages.
18. Factorial of a number.
19. Checking whether a number is prime or not.
20. Fibonacci series.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Create a sample database using Structed Query Language (SQL) DDL commands and develop simple and advanced SQL Queries to manipulate the database.
2. Develop PL/SQL Functions, Procedures, Packages to perform database specific operations on a database.
3. Demonstrate an ability to listen and answer the viva questions related to programming skills needed for solving real-world problems in Computer Science and Engineering.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	3	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	2	-	2

AICP408	**MACHINE LEARNING LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To understand the Gaussian densities and its implementation using Python.
- To implement classification, clustering and regression algorithms in Python.
- To implement the convolution neural network architecture using Python.
- To solve the challenging research problems in the area of Speech and Image processing.

LIST OF EXERCISES

1. Linear and logistic regression with error estimation
2. Implementation of univariate and multivariate Gaussian densities
3. Dimensionality reduction using principal component analysis (PCA)
4. Clustering using
    a) k-means
    b) Gaussian mixture modeling (GMM)
5. Classification using
    a) Back propagation neural network (BPNN)

b) Support vector machine (SVM)

6. Construction of decision tree and random forest
7. Implementation of convolution neural network (CNN)
8. Sequence prediction using recurrent neural network (RNN)
9. Isolated-word speech recognition
10. Face detection and tracking
11. Object recognition

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the basic concepts of machine learning.
2. Design and implement the classification, clustering and regression algorithms using Python.
3. Design and implement methods for solving real life problems using a suitable machine learning technique

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	3	2	-	-	-	-	-	-	-	-
CO2	1	2	-	2	-	-	-	-	-	-	-	-
CO3	2	2	-	1	-	-	-	-	-	2	-	2

AICP409	**HASKELL PROGRAMMING LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To understand and be able to use the basic programming principles such as data types, conditionals, array, recursion, higher-order functions and classes.
- To define arrays and use an array to sort the numbers.
- To use build-in modules and to use to develop applications.
- To develop real applications such as Tic-Toe-Toe and Anti-Spam using Haskell.

LIST OF EXERCISES

1. Write a program to find the biggest among any three given numbers using if …then...else Statement.
2. Write a program to find the factorial of the given number using Recursion.
3. Write a program to create a list and reverse it using List comprehensions
4. Write a program to generate Fibonacci series using Lazy evaluation.
5. Write a program to generate a binary tree using foldr and foldl functions.
6. Write a program to simulate insertion sort, bubble sort, selection sort, permutation sort, merge sort, quicksort sort algorithms using built-in functions.
7. Write a program to create two lists and combine them using Monoids.

8. Write a program to copy contents of one file to another file.
9. Write a program to solve unbeatable Tic-Tac-Toe Problem.
10. Write a program to simulate Anti-spam in Face Book.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Analyze and design a computer program based on pure functional programming.
2. Solve simple problems using basic data types and control structures.
3. Implement a file to store and retrieve the real time data using Haskell.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	3	2	-	-	-	-	-	-	-	-
CO2	1	2	-	2	-	-	-	-	-	-	-	-
CO3	2	2	-	1	-	-	-	-	-	2	-	2

AIPC501	**COMPUTER NETWORKS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To develop an understanding of modern network architectures from a design and performance perspective.
- To introduce the student to the major concepts involved in wide-area networks. (WANs), local area networks (LANs) and Wireless LANs (WLANs).
- To provide an opportunity to do network programming.
- To provide a WLAN measurement ideas.

UNIT-I Data communication Components

Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

UNIT-II Data Link Layer and Medium Access Sub Layer

Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA.

UNIT-III Network Layer

Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP– Delivery, Forwarding and Unicast Routing protocols.

UNIT-IV Transport Layer and Application Layer

Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol

(TCP), SCTP Congestion Control; Quality of service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm. Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

UNIT-V Services Mechanism

Attacks-the OSI security architecture-Network security model-Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography).Finite Fields And Number Theory: Groups, Rings, Fields-Modular arithmetic-Euclid's algorithm-Finite fields-Polynomial Arithmetic –Prime numbers-Fermat's and Euler's theorem-Testing for primality -The Chinese remainder theorem- Discrete logarithms.

TEXT BOOKS:

1. William Stallings, Data and Computer Communication, 10th Edition, Pearson Prentice Hall India, 2013.
2. Peter L Dordal, An Introduction to Computer Networks, 1st Edition, 2019.

REFERENCES:

1. M. Dave, Computer Networks, 1st Edition, Cengage Learning India, 2012.
2. Keshav, An Engineering Approach to Computer Networking, 1st Edition, Pearson, 2014.
3. Bhavneet Sidhu, An Integrated Approach to Computer Networks, 1st Edition, Khanna Publications, 2015.
4. Forouzan, Computer Networks: A Top-Down Approach, 1st Edition, McGraw- Hill education, 2017.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the functions of layering and protocols.
2. Summarize the devices, protocols and standards to design a network.
3. Construct and implement the concept of switching and routing.
4. Select appropriate protocol and techniques related to transport layer in order to maintain consistent flow of information.
5. Illustrate the functions of electronic mail, HTTP, DNS and SNMP.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**
CO1	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	1	3	2	-	-	-	-	-	-	-	-
CO4	3	1	3	2	-	-	-	-	-	-	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-

AIPC502	IMAGE AND SPEECH PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn Digital Image and Speech fundamentals.
- To analyze simple Image processing techniques.
- To understand Image compression and Enhancement techniques.
- To learn Short-time Fourier analysis.

UNIT – I Digital Image Processing

Image Categories – Steps in Digital Image Processing – Components of an Image Processing System. Digital Image Fundamentals: Elements of Visual Perception – Electromagnetic Spectrum – Image Sensing and Acquisition – Image Sampling and Quantization - Basic Relationship between Pixels.

UNIT – II Image Enhancement in Spatial Domain

Basic Gray Level Transformations – Histogram Processing – Enhancement using Arithmetic and Logic Operations – Spatial Filtering – Smoothing Spatial Filters – Sharpening Spatial Filters – Combining Spatial Enhancement Methods.

UNIT – III Color Image Processing and Segmentation

Color Fundamentals – Color Models – Pseudocolor Image Processing. Image Segmentation: Detection of Discontinuities – Edge Linking and Boundary Detection – Use of Motion In Segmentation. Basis of Wavelet Transforms. Lossless and Lossy Compression Techniques.

UNIT – IV Fundamentals of Digital Speech Processing

Discrete-Time Signals and Systems – Sampling Speech Signals - Transform Representation of Signals and Systems. Speech Production Mechanism – Acoustic Phonetics. Time-Domain Models for Speech Processing: Time-Dependent Processing of Speech – Short-Time Energy and Average Magnitude – Short-Time Average Zero-Crossing Rate – Speech Vs. Silence Discrimination – Pitch Period Estimation – Short-Time Autocorrelation Function.

UNIT – V Short-Time Fourier Analysis

Fourier Transform of Speech Signal - Linear Predictive Coding of Speech: Linear Predictive Analysis – Computation of Gain – Durbin's Recursive Solution. Man-Machine Communication: Voice-Response Systems – Speaker Recognition Systems – Speech Recognition Systems.

TEXT BOOKS:

1. R.C. Gonzalez and Rafael. C. Woods, Richard E, Digital image processing, fourth edition, Pearson education, 2018.
2. L. R. Rabiner and R.W. Schafer, Digital processing of speech signals, Pearson education, 2005.

REFERENCES:

1. Lizhe Tan Jean Jiang, Digital Signal Processing: Fundamentals and Applications, Third edition, Academic Press, 9th November 2018.
2. D.O'Shaughnessy, Speech communications-Human and machine, second edition, University press (India), 2001.
3. L. Rabiner and B.H. Juang, Fundamentals of speech recognition, Pearson education, 2003.

4. A.K. Jain, Fundamentals of digital image processing, Prentice-Hall of India, New Delhi, 2001.

COURSE OUTCOMES:

At the end of this course, students will be able to

1. Discuss Digital Image and Speech fundamentals.
2. Apply Image Enhancement techniques.
3. Use Image Compression techniques in Image applications.
4. Discuss about Time domain models for Speech processing.
5. Work on Speech Recognition and Speaker Verification systems.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	2	-	-	-	-	-	-	-
CO2	1	1	1	1	2	-	-	-	-	-	-	-
CO3	1	1	1	1	2	-	-	-	-	-	-	-
CO4	1	1	1	1	2	-	-	-	-	-	-	-
CO5	1	1	2	1	2	-	-	-	--	-	-	1

AIPC503	**NEURAL COMPUTING IN AI**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To provide the most comprehensive concept of neural networks in the engineering perspective.
- To understand the important design concepts of neural architectures in different applications.
- To understand the applications associated with many different areas like recommender systems, machine translation, and reinforcement-learning.
- To gain knowledge on methodologies underlying Neuro-Fuzzy and Soft Computing.

UNIT - I Introduction to Neural Network & Learning

Models of a Neuron – Neural Networks Viewed as Directed Graphs – Feedback – Network Architectures – Knowledge Representation – Artificial Intelligence and Neural Networks – Error-Correction Learning – Memory-Based Learning – Hebbian Learning – Competitive Learning – Boltzmann Learning.

UNIT – II Perceptrons

Least-Mean-Square Algorithm – Perceptron – Perceptron Convergence Theorem – Back-Propagation Algorithm – XOR Problem – Output Representation and Decision Rule – Feature Detection – Regularization Networks – Generalized Radial-Basis Function Networks.

UNIT – III Support Vector Machines & Self-Organizing Map

Optimal Hyperplane for Linearly Separable Patterns - Optimal Hyperplane for non separable Patterns – How to build a support vector machine for Pattern Recognition – XOR Problem Revisited – Support

Vector Machines for Nonlinear Regression – Self-Organizing Map – Properties of the Feature Map – Learning Vector Quantization – Hierarchical Vector Quantization – Contextual Maps.

UNIT – IV Fuzzy Systems

Utility of Fuzzy Systems – Limitations of Fuzzy Systems – Uncertainty and Information – Fuzzy Sets and Membership – Classical Sets – Fuzzy Sets – Crisp Relations – Fuzzy Relations – Tolerance and Equivalence Relations – Fuzzy Tolerance and Equivalence Relations – Value Assignments.

UNIT – V Fuzzification & Defuzzification

Features of the Membership Function – Fuzzification – Defuzzification to Crisp Sets – λ-Cuts for Fuzzy Relations – Defuzzification to Scalars – Logic and Fuzzy Systems.

TEXT BOOKS:

1. Raul Rojas, Neural Networks: A Systematic Introduction, Springer Science & Business Media, 2013.
2. Timothy J. Ross, Fuzzy Logic with Engineering Applications, 3rd Edition, John Wiley & Sons Ltd, 2010.

REFERENCES:

1. Alianna J. Maren, Craig T. Harston, Robert M. Pap, Handbook of Neural Computing Applications, Academic Press, 2014.
2. Robert Fuller, Introduction to Neuro-Fuzzy Systems, Springer Science & Business Media, 2013.
3. James J. Buckley, Esfandiar Eslami, An Introduction to Fuzzy Logic and Fuzzy Sets, Springer Science & Business Media, 2013.
4. Simon Haykin, Neural Networks – A Comprehensive Foundation, 2nd edition, Pearson Prentice Hall, 2005.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the concept of neural networks.
2. Acquire knowledge on the aspects of learning process.
3. Apply the design concepts of neural architectures.
4. Implement the learning process associated with many different application areas.
5. Design the methodologies for Neuro-Fuzzy and Soft Computing applications.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	2	-	-	-	-	-	-	-
CO2	1	1	-	1	-	-	-	-	-	-	-	-
CO3	1	1	1	-	-	-	-	-	-	-	-	-
CO4	1	1	-	1	2	-	-	-	-	-	-	-
CO5	1	1	2	1	2	-	-	-	--	-	-	1

AIPC504	KNOWLEDGE ENGINEERING AND INFERENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make the students conversant with concepts central to the creation of knowledge bases and expert systems.
- To be able to elicitate knowledge from experts by using elicitation techniques.
- To examine properties of existing systems, comparing different approaches with a case study
- To implement the expertise model as a prototype

UNIT - I Introduction to Knowledge Engineering

Data, Information and Knowledge , Skills of a knowledge Engineer – An introduction to Knowledge Based Systems, Types of Knowledge Based Systems – Expert Systems, Neural Networks, Case – Based Reasoning, Genetic Algorithms, Intelligent Agents, Data Mining.

UNIT – II Knowledge Representation

Knowledge Acquisition - Representation and Reasoning – Using Knowledge, Logic Rules and Representation, Developing Rule – Based Systems, Semantic Networks, Frames - Lifecycles and Methodologies – The Need for Methodologies, Knowledge Acquisition Design Systems – Hybrid Knowledge Based Systems.

UNIT – III Trends in Knowledge Engineering

Information Technology in Business Management - Management Sources of Information - Information Processing - Multidimensional Management Systems (MMS) - Organizational Marketing, Virtual Management (VM) - Computer-Aided Management and Communications. Issues in Knowledge Engineering: Introduction - Problem-Solving Strategies - The Systematic-Intuitive Approach - Real Time: Can Machines Think - Language and Perceptual Models, Understanding. Knowledge Networking Systems: Life in the Electronic Fast Lane- Organizational Communications - Corporate Management - Knowledge Networking Features - Communications Networks. Real World Applications - Metal Models: Classical Examples - Mechanization of Knowledge -Future Trends in Knowledge Engineering.

UNIT – IV Inferential Knowledge and Problem Solving

State – Space Representation of a problem – Search Tree – Programs for Game – Tree Search – Graph Search – Characteristics of problem Solving Using State Representations – Discovery of an Algorithm.

Use of Heuristic Knowledge – Finding a Solution by the Decomposition of a problem – BlackBoard Model - Knowledge as a Constraint – Mutual Model.

UNIT – V Reasoning in Knowledge

Inference Using Symbolic Logic - Expressions of Rules using Symbolic Logic – Proof using Forward and Backward Reasoning – Proof using the Resolution Principle – Forms Of Questions – logical representation of a Database – Inference In Changing Situations – Other Inference methods.

TEXT BOOKS:

1. Gheorghe Tecuci, Dorin Marcu, Mihai Boicu and David A Schum, Knowledge Engineering Building cognitive assistants for evidence based reasoning, 1st Edition, Cambridge University Press, 2016.
2. Simon Kendal and Malcolm Creen, An Introduction to Knowledge Engineering, 2nd Edition, 2007, Springer.

REFERENCES:

1. Yingxu Wang, Developments in Natural Intelligence Research and Knowledge Engineering: Advancing Applications, Fourth Volume, IGI series, 2012.
2. Makoto Nagao, Knowledge and Inference, 1st Edition, Academic Press, 1990.
3. J Hendler, H Kitano and B Nebel, Foundations of Artificial Intelligence, 1st Edition, Elsevier, 2008.
4. Thomas B Cross, Knowledge Engineering, The uses of Artificial Intelligence in Business, 2nd dition, TECHtionary.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Keep in track with the current trends in knowledge engineering.
2. Acquire and act as per the knowledge of experts.
3. Know the inference of logical agents.
4. Communicate in a network of knowledge based systems.
5. Apply Artificial intelligence in business.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	-	2	-	-	-	-	-	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-
CO3	2	2	1	1	-	-	-	-	-	-	-	-
CO4	2	1	1	1	2	-	-	-	-	-	-	-
CO5	1	1	2	1	2	-	-	-	--	-	-	1

AICP507	**COMPUTER NETWORKS LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To understand the working principle of various communication protocols.
- To analyze the various routing algorithms.
- To know the concept of data transfer between nodes.
- To implement address resolution protocol, remote method invocation, server and client.

LIST OF EXERCISES

1. Networking Commands.
2. Implementation of Socket program for Echo.
3. Implementation of client and server for chat using TCP.
4. File transfer between client and server using TCP/IP.
5. Implementation of Remote command execution.
6. Client and Server application using UDP.

7. Implementation of Address Resolution Protocol.
8. Socket Program to download a web page.
9. Implementation of Remote method Invocation.
10. Implementation of server in C and Client in Java.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Make use of network administration commands and demonstrate their use in different network scenarios
2. Implement the Socket programming for Client Server Architecture, Analyze the Packet Contents of different Protocols and Implementation of the routing Protocols.
3. Demonstrate an ability to listen and answer the viva questions related to programming skills needed for solving real-world problems in Computer science and Engineering.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	3	-	-	-	-	-	-	-
CO2	3	3	2	2	3	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	2	-	2

AICP508	**IMAGE AND SPEECH PROCESSING LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To illustrate the image processing concepts through actual processing of images using python.
- To analyze simple Image enhancement techniques in spatial domain.
- To understand the concept of color image processing.
- To study various concepts in speech processing through various signal processing techniques.

LIST OF EXERCISES

1. Write a program to implement simple and adaptive thresholding for a given image.
2. Smoothening and Sharpening filters in spatial domain.
3. Implementation of Edge detection methods.
4. Write a program to find the histogram equalization
   a) For full image.
   b) For part of the image.
5. Write a program to find the Fourier transform of a given image.
6. Displaying individual color components(R,G,B,Cr,CB,H,S,I) of a color image.
7. Implementation of Huffman encoding and decoding for a given image.
8. Write a program to segment the given image using watershed algorithm.
9. Implementation of morphological dilation and erosion operations for a given image.
10. Write programs to extract SIFT and SURF features for given input image samples.

11. Write a program to perform convolution and correlation of speech signals.
12. Write a program to perform simple low pass filtering and high pass filtering of speech signal.
13. Extraction of pitch and formants for a given speech signal.
14. Write a program to find short time energy and zero crossing rate of pre-processed speech signal.
15. Write a program to extract MFCC feature from sample speech signal.
16. Text dependent speaker recognition using Dynamic Time Warping.

COURSE OUTCOMES:

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

1. Work with Digital Image and Speech fundamentals using python.
2. Analyse how Image Enhancement techniques in spatial domain used in processing of images.
3. Work with applications of image and speech processing.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	2	-	-	-	-	-	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-	2

AICP509	**NEURAL COMPUTING LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To provide the most comprehensive concept of neural networks in the engineering perspective.
- To understand the important design concepts of neural architectures in different applications.
- To acquaint student with various computing algorithms in FLNN using software tools.
- To understand operation of basic elements in fuzzy logic and neural network through simulation.

LIST OF EXERCISES

1. Write a program to implement the concept of Perceptrons.
2. Write a program to simulate Back-Propagation Neural Networks.
3. Write a program to implement the Radial Basis Function Neural Networks.
4. Write a program to implement a real world application using Support Vector Machine.
5. Write a program to design a Self Organizing Map for an application.
6. Write a program to develop fuzzy membership functions and fuzzy set properties.
7. Write a program to develop logic for fuzzy relations.
8. Write a program to verify logic using fuzzy relations.
9. Write a program to design a fuzzy controller systems using fuzzy tool of Matlab.
10. Develop an application using NN/Fuzzy logic.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Demonstrate basic concepts fuzzy logic and neural network through simulation.

2. Develop the logic given in problem statement using operations in fuzzy logic and basics of toolbox studied.
3. Develop real life applications using NN and Fuzzy Logic.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	3	3	2	-	-	-	-	-	-	-
CO2	2	3	2	2	2	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-	2

AIPC601	**DEEP LEARNING FOR VISUAL COMPUTING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To make the students understand the mathematical and machine learning basics of deep learning for Visual Computing.
- To understand the knowledge about deep learning.
- To give insight into various deep learning Visual Computing tools namely python, tensorflow, scala, pytorch,etc,.
- To be able to setup test environment for deep learning of visual computing.

UNIT – I Applied Math and Machine Learning Basics

Linear Algebra - Probability and Information Theory - Numerical Computation - Machine Learning Basics - Modern Practical Deep Networks - Deep Feedforward Networks - Regularization for Deep Learning - Optimization for Training Deep Models - Convolutional Networks - Sequence Modeling: Recurrent and Recursive Nets - Practical Methodology – Applications.

UNIT – II Deep Learning Research

Linear Factor Models – Autoencoders - Representation Learning - Structured Probabilistic Models for Deep Learning - Monte Carlo Methods - Confronting the Partition Function - Approximate Inference - Deep Generative Models.

UNIT – III Fundamentals of Image Based Visual Computing

Data – Visualization – Discretization – Representation – Noise – Techniques – Interpolation - Geometric Intersections. Convolution - Linear Systems - Linear Filters - Implementation Details - Spectral Analysis - Discrete Fourier Transform - Polar Notation -Periodicity of Frequency Domain – Aliasing - Extension for 2D Interpretation – Duality - Feature Detection - Edge Detection – Feature Detection - Other Non-Linear Filters.

UNIT – IV Geometric Visual Computing

Geometric Transformations - Homogeneous Coordinates - Linear Transformations - Euclidean and Affine Transformations - Concatenation of Transformations - Coordinate Systems - Properties of Concatenation - Projective Transformation - Degrees of Freedom - Non-Linear Transformations. The Pinhole Camera - The Model - Considerations in the Practical Camera - Epipolar Geometry – Background - Correspondences in Multi-View Geometry - Fundamental Matrix - Essential Matrix – Rectification -

Applying Epipolar Geometry.

UNIT – V Radiometric Visual Computing

Light – Radiometry - Photometry and Color - Color Reproduction - Modeling Additive Color Mixtures - Color Management - Modeling Subtractive Color Mixture – Limitations - Photometric Processing - Histogram Processing - Image Composition - Photometric Stereo Visual Content Synthesis - The Diverse Domain – Modeling – Processing – Rendering – Application - Interactive Graphics pipeline - Geometric Transformation of Vertices - Clipping and Vertex Interpolation of Attributes - Rasterization and Pixel Interpolation of Attributes - Realism and Performance – Illumination – Shading – Shadows - Texture Mapping - Bump Mapping - Environment Mapping – Transparency - Accumulation Buffer - Back Face Culling - Visibility Culling - Graphics Programming - Development of Graphics Processing Unit - Development of Graphics APIs and Libraries -The Modern GPU and CUDA.

TEXT BOOKS:

1. Aditi Majumder, M. Gopi , Introduction to Visual Computing: Core Concepts in Computer Vision, Graphics, and Image Processing, CRC Press, 2018
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016

REFERENCES:

1. Jon Krohn, Beyleveld Grant and Bassens Aglaé, Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence, Addison-wesley, 2019.
2. Hyatt Saleh, Applied Deep Learning with PyTorch, Packt, 2019.
3. Pradeep Pujari, Md. and Rezaul Karim, Mohit Sewak, Practical Convolutional Neural Networks, Packt Publishing, February 2018.
4. Ragav Venkatesan and Baoxin Li, Convolutional Neural Networks in Visual Computing (Data-Enabled Engineering), CRC Press, September 2017.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand Deep learning for Visual Computing and able to setup development environment.
2. Perform image classification and learning.
3. Detect objects and do convolution neural network auto encoding.
4. Know about radiometric visual computing.
5. Understand Geometric visual computing.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	2	1	1	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	1	1	-	-	-	-	-	-	-	-
CO4	2	1	2	2	2	-	-	-	-	-	-	-
CO5	1	2	2	2	3	-	-	-	-	-	-	-

AIPC602	EMBEDDED SYSTEMS AND INTERNET OF THINGS (IoT)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To familiarize the students about the trends and challenges of Embedded System.
- To impart the knowledge in RTOS and scheduling algorithms.
- To understand the concepts of Internet of Things, its network and communication protocols and to introduce Internet of Everything and its benefits.
- To develop algorithms in Rasberry Pi and Arduino

UNIT – I Introduction to Embedded Systems

Introduction-Applications of embedded system-Features and Attributes of Embedded System-Challenges in Embedded System-Selection of Processors-Recent trends in embedded system-Embedded Firmware design approaches and development languages-embedded development life cycle.

UNIT – II Real Time Operating Systems

Prime Movers: Task states-Task table and data–Multitasking operating systems–Context switches–Kernels–Task swapping methods–Scheduler algorithms –Inter process communication mechanism-memory communication-Message passing-Signals. Overview of ARM Architecture-Programmer's model and Development Tools.

UNIT – III Introduction to IOT

Defining IoT-Characteristics of IoT-Physical design of IoT-Logical design of IoT-Functional blocks of IoT-Communication models & APIs-Machine to Machine-Difference between IoT and M2M-Software defined Network (SDN) – Cloud Computing.

UNIT – IV Network and Communication Aspect

Wireless medium access issues-MAC protocol survey-Survey routing protocols-Sensor deployment & Node discovery-Data aggregation & dissemination – Web of Things - Applications of IoT: Home automation-Industry applications-Surveillance applications-Other IoT applications.

UNIT – V Raspberry Pi with Python and Arduino

Building IoT with Raspberry Pi- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms – Arduino - Evolution of IoE and its benefits.

TEXT BOOKS:

1. Marilyn Wolf, Computers as Components-Principles of Embedded Computing System Design, 4th edition, Morgan Kaufmann Publishers, 2016.
2. Vijay Madisetti, ArshdeepBahga, Internet of Things: A Hands-On Approach, Orient Blackswan Pvt. Ltd., New Delhi, 2015.

REFERENCES:

1. Jeeva Jose, Internet of Things, 1st edition, KBP House, 2018.

2. Shibu K.V, Introduction to Embedded System, Tata McGraw-Hill, 2009.
3. Steve Heath, Embedded Systems Design, 2nd edition, Newnes/An imprint of Elsevier, 2005.
4. Rajkamal, Embedded Systems, Architecture, Programming and Design, Tata McGraw Hill, 2003.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Recognize the key features of embedded systems in terms of computer hardware and be able to discuss their functions.
2. Know the extra-functional that are imposed on embedded systems and the tools used.
3. Identify the key factors and functionalities in IOT.
4. Understand the protocols and applications of IOT through wireless medium.
5. Understand the concepts of IoT and IoE with the combination of Raspberry Pi.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	2
CO5	3	1	1	-	2	1	-	-	-	-	-	-

AICP607	**DEEP LEARNING TOOLS LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To learn how to create and manipulate tensors using Tensorflow tool.
- To get to know Applied Deep Learning with PyTorch.
- To create and manipulate applications for artificial intelligence in the Scala programming language.
- To learn Character-Level RNN.

LIST OF EXERCISES

1. Introduction to TensorFlow.
2. Learning about Features and Outliers.
3. Working with Training Sets and Test Sets.
4. Scala program to demonstrate example of collection list and for loop.
5. Appending and merging Lists using scala.

6. Scala List class and pattern matching
7. L2 Regularization and Correlated Features.
8. Classifying Names with a Character-Level RNN
9. Generating Shakespeare with a Character-Level RNN

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Create and manipulate tensors using Tensorflow tool and to understand tensorflow concepts.
2. Know supervised learning and working with features and labels.
3. Acquire knowledge on CNN, RNN.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	-	2	-	2	-	-	-	-	-	-	-
CO2	-	3	3	1	3	1	-	-	-	-	-	2
CO3	2	2	-	-	-	-	-	-	-	2	-	2

AICP608	**EMBEDDED SYSTEMS AND INTERNET OF THINGS (IoT) LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To understand the working principle of Embedded System.
- To make use of various sensors in IoT.
- To know how to use various tools in IoT for designing applications.
- To get the knowledge about designing GUI, game in python.

LIST OF EXERCISES

EMBEDDED SYSTEMS

1. Alphanumeric LCD interface using 8051.
2. Study of ARM evaluation system.
3. Flashing of LEDs using ARM (LPC2148).
4. Interfacing keyboard and LCD using ARM (LPC2148).
5. Temperature sensor interface using ARM (LPC2148).

IoT

1. Distance Measurement.
2. Identifying Moisture content in Agricultural Land.
3. Fire Alarm Indicator.
4. Basic Home Automation.
5. Identifying Room Temperature.
6. How to Control PWM Signals.

7. Designing a Calculator using NumPi.
8. Designing Game using PyGame.
9. Designing frontend GUI using TKinter.
10. Identification of Earthquake.
11. Implementation of sorting mechanism.
12. Accessing GPIO using Google Assistance.
13. How to create a video player.
14. Uploading data to cloud and monitoring in cloud.
15. Connecting social media (twitter).

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Comprehend the basic elements of Microcontroller and their Programming.
2. Gain knowledge of Raspberry Pi3 in Peripheral and in Trouble shooting.
3. Identify the Kits required for solving the Real World Problem and to write the Code.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	-	2	-	2	-	-	-	-	-	-	-
CO2	-	3	3	1	3	1	-	-	-	-	-	2
CO3	2	2	-	-	-	-	-	-	-	2	-	2

ETHS701	**SOCIAL AND ETHICAL ISSUES IN AI**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

COURSE OBJECTIVES:

- To analyze whether AI pose an existential threat to humanity.
- To check learning algorithms from acquiring morally objectionable biases.
- To study the ethical rules to be followed in using self driving cars.
- To check the accountability while building artificial moral agents.

UNIT – I Artificial Intelligence Ethics

Ethics in Machine learning and other domain-specific AI algorithms-Artificial general intelligence-machines with moral status-minds with exotic properties-superintelligence. Singularity A philosophical Analysis: Argument for a singularity-Intelligence explosion without intelligence-obstacles to singularity-negotiating singularity-internal constraints-external constaints-integration into a post-singularity world-uploading and consciousness-uploading and personal identity.

UNIT – II Superintelligent Agents

Orthogonality of motivation and intelligence-instrumental convergence. Racist AI: Rise of algorithmic decision making: contestable epistemic and normative assumptions-embodied values-algorithmic accountability as public reason-objections, limitations and challenges.

UNIT – III Killer Robots in War and Civil Society

Real world of robots at war-autonomous weapon systems-robot warriors and crimes-human oversight for avoiding problem-responsibility for robot war crimes-robot warriors and child soldiers. Future of workplace automation-interaction of automation and employment-Polarization in labor market-employment polarization to wage polarization-slowdown in growth of high-skill occupations-Polanyi's Paradox.

UNIT – IV Artificial Moral Agent Ethics

Moral agency and moral norms-moral turing test-Theoretical approaches: consequentialism-deontology-models of morality: Virtue approaches-associative learning-evolutionary approaches-role of emotions. Ethics of self driving cars: need for ethics settings-an applied trolley problem-empirical ethics-traditional ethical theories-legal literature-potential responsibility-Agency and human robot collaborations-crash avoidance strategies.

UNIT – V AI as a Positive and Negative factor in Global Risk

Anthropomorphic bias: width of mind design space-Prediction and design-understanding the power of intelligence-capability and motive: Optimization processes-aiming at the target-friendly AI-technical failure and philosophical failure-rates of intelligence increase-hardware-threats and promises-AI vs human intelligence enhancement.

TEXT BOOKS:

1. Bill Hibbord, Ethical Artificial Intelligence, Machine Intelligence Research Institute, CA, 2015.
2. N. Bostrom and E. Yudkowsky, The ethics of artificial intelligence, In W. M. Ramsey and K. Frankish, editors, The Cambridge Handbook of Artificial Intelligence, Cambridge University Press, Cambridge, 2014.

REFERENCES:

1. Chalmers. D., The singularity: A philosophical analysis, Journal of Consciousness Studies, 2010.
2. Bostrom, N., The Superintelligent Will: Motivation and Instrumental Rationality in Advanced Artificial Agents, Minds & Machines, 2012.
3. Sparrow. R., Killer robots, Journal of Applied Philosophy, 2007.
4. Autor, D. H., Why Are here Still SoMany Jobs? The History and Future of Workplace Automation, The Journal of Economic Perspectives, 2015.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Demonstrate knowledge of philosophical issues involved in ethics of AI.
2. Develop a super intelligent system without having to reveal the system itself.
3. Understand workplace automation in employment.
4. Appreciate the potential responsibility in handling ethics of artificial moral agents.
5. To build intelligent systems those are safe without any global risk.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	1	-	-	-	-	-	-	-	-
CO3	2	1	1	1	-	-	-	-	-	-	-	-
CO4	2	-	-	1	-	-	-	-	-	-	-	-
CO5	1	-	-	-	-	-	1	-	-	-	-	-

AIPC702	**EVOLUTIONARY OPTIMIZATION ALGORITHMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To learn the constrained and unconstrained optimization.
- To gain knowledge on more recent evolutionary algorithms.
- To develop biogeography techniques.
- To implement combinatorial optimization problems.

UNIT – I Introduction

Optimization: Unconstrained optimization-constrained optimization-multi-objective optimization-multimodal optimization-combinatorial optimization-hill climbing-intelligence. Genetic algorithms: Simple binary genetic algorithm-continuous genetic algorithm.

UNIT – II More Recent Evolutionary Algorithms

Simulated annealing: simple simulated annealing algorithm-cooling schedules-implementation issues. Ant colony optimization: Pheromone models-ant system-continuous optimization-other ant systems. Particle swarm optimization: Basic PSO algorithm-velocity limiting-inertia weighting and constriction coefficients-global velocity updates-fully informed particle swarm-learning from mistakes.

UNIT – III Biogeography based Optimization

Biogeography-an optimization process-biogeography based optimization-BBO extensions. Other evolutionary algorithms: Tabu search-artificial fish swarm algorithm-group search optimizer-shuffled frog leaping algorithm-firefly algorithm-bacterial foraging optimization-artificial bee colony algorithm-gravitational search algorithm-harmony search-teaching learning based optimization.

UNIT – IV Combinatorial Optimization

Traveling salesman problem-TSP initialization: nearest neighbor initialization-shortest edge initialization-insertion initialization-stochastic initialization. TSP representations and crossover-TSP mutation-evolutionary algorithm for TSP-graph coloring problem.

UNIT – V Constrained Optimization

Penalty function approaches-popular constraint handling methods-special representations and special operators-other approaches to constrained optimization-ranking candidate solutions-comparison of constraint handling methods. Multi objective optimization: Pareto optimality-goals of multi objective optimization-non pareto based evolutionary algorithms- Pareto based evolutionary algorithms-multi objective biogeography based optimization.

TEXT BOOKS:

1. Mike Preuses, Multimodal Optimization by Means of Evolutionary Algorithms, Springer, 2015.
2. Dan Simon, Evolutionary Optimization Algorithms, John Wiley & Sons Inc., 2013.

REFERENCES:

1. Rajesh Kumar Arora, Optimization Algorithms and Applications, CRC Press, 2015.
2. Xinjie Yu, Mitsuo Gen, Introduction to Evolutionary Algorithms, Springer publication, 2010.
3. Kalyanmoy Deb, Multi-Objective Optimization using Evolutionary Algorithms. John Weily and Sons Ltd, 2002.
4. Algorithms for Reinforcement Learning (Synthesis Lectures on Artificial Intelligence and Machine Learning), Morgan & Claypool Publisher series, 2010.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Design constrained and unconstrained optimization problems.
2. Implement more recent optimization techniques.
3. Learn and execute the biogeography based optimization techniques.
4. Acquire knowledge about the combinatorial optimization algorithms.
5. Understand the principles of multi objective optimization techniques.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	1	-	-	-	-	-	-	-	-	-
CO2	2	1	2	1	-	-	-	-	-	-	-	-
CO3	2	1	1	1	-	-	-	-	-	-	-	-
CO4	2	1	1	1	-	-	-	-	-	-	-	-
CO5	1	-	-	-	-	-	1	-	-	-	-	-

AICP706	**OPTIMIZATION TECHNIQUES LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To acquire specific knowledge and skills on optimization techniques.
- To learn the feasibility methods for solving an optimization problem.
- To design algorithms that will lead to find optimized solution.
- To understand and implement optimization techniques using evolutionary algorithms.

LIST OF EXERCISES

1. Write a program to implement constrained optimization using genetic algorithm.
2. Write a program to implement un-constrained optimization using genetic algorithm.
3. Write a program to implement simple simulated annealing algorithm.
4. Write a program to implement ant colony optimization algorithm.
5. Write a program to implement particle swarm optimization algorithm.
6. Write a program to implement Tabu search.
7. Write a program to implement artificial bee colony optimization algorithm.
8. Write a program to solve traveling salesman problem using evolutionary algorithm.
9. Write a program to implement constrained optimization using penalty method.
10. Write a program to implement multi objective optimization using evolutionary algorithm.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand and implement constrained and unconstrained optimization problems.
2. Implement biogeography based optimization techniques.
3. Appreciate the principles of multi objective optimization techniques.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	-	2	-	2	-	-	-	-	-	-	-
CO2	-	3	3	1	3	1	-	-	-	-	-	2
CO3	2	2	-	-	-	-	-	-	-	2	-	2

ETIT707	**SEMINAR/INDUSTRIAL TRAINING**	**L**	**TR**	**S**	**C**
		0	1	2	4

Note: * - Four weeks during the summer vacation at the end of sixth semester

COURSE OBJECTIVES:

- To work/train on a technical topic/field work related to Artificial Intelligence and Machine Learning to acquire the ability of written/oral presentation and to have a practical knowledge in carrying out the Artificial Intelligence and Machine Learning related problems.
- To acquire the ability of writing technical papers for Conferences.
- To train and develop skills in solving problems during execution of the problems related to Artificial Intelligence and Machine Learning.
- To make the students to get hands on working experience in reputed concerns.

The students will work for two periods per week guided by student counsellor. They will be asked to present a seminar of not less than 15 minutes and not more than 30 minutes on any technical topic of student's choice related to Artificial Intelligence and Machine Learning and to engage in discussion with audience. They will defend their presentation. A brief copy of their presentation also should be submitted. Evaluation will be done by the student counsellor based on the technical presentation, the report and also on the interaction shown during the seminar.

The students will individually undertake a training program in reputed concerns in the field of Artificial Intelligence and Machine Learning during summer vacation (at the end of sixth semester) for a minimum stipulated period of four weeks. At the end of training the student has to submit the detailed report on the training undertaken within ten days from the commencement of the seventh semester. The student will be evaluated by a team of staff members nominated by the Head of the Department through a viva-voce examination.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Face the audience and to interact during group discussion in the corporate interviews confidently.

2. Acquire the ability to work in the actual environment and to use the technical resources.
3. Apply prior acquired knowledge in problem solving and to demonstrate the use, interpretation and application of an appropriate international Artificial Intelligence and Machine Learning standard in a specific situation.
4. Analyze a given Artificial Intelligence and Machine Learning problem and to identify and implement appropriate problem solving methodology to propose a meaningful solution.
5. Present the solution acquired in the form of written and oral presentation.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	1	2	2	-	-	-	-	-	-	-	-	3
CO3	1	-	2	1	2	-	-	-	-	-	-	-
CO4	1	-	-	-	-	-	-	-	2	-	2	1
CO5	1	-	-	-	2	-	-	-	-	3	-	-

AIPV803	**PROJECT WORK AND VIVA VOCE**	**L**	**PR**	**S**	**C**
		0	**10**	**2**	**6**

COURSE OBJECTIVES:

- To develop the ability to identify a problem.
- To perform a literature review.
- To implement the problem and to analyze the results.
- To train the students in preparing project reports and to face reviews and viva voce examination.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Take up any challenging practical problems and find solution by formulating proper methodology.
2. Carry out any experiment based on Computer software and Hardware available.
3. Present the conclusions with understandability using appropriate tables and graph in the form of report.
4. Analyze any short coming while implementing a technical problem and to handle the same.
5. Implement any research problem in current thrust area using the gained practice knowledge.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	3	-	-	-	-	-	-	3	-	3	-
CO2	1	2	-	-	-	-	-	-	3	-	3	3
CO3	1	-	2	-	-	-	-	-	3	-	3	-
CO4	1	-	2	2	2	-	-	-	3	-	3	-
CO5	1	-	-	-	-	-	-	-	3	3	3	3

PE – PROFESSIONAL ELECTIVES

AIPESCN	EXPERT SYSTEM ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study components of knowledge in expert system.
- To acquire knowledge and to study the stages in developing the expert systems.
- To use probability and fuzzy logic expert systems.
- To study the tools to develop expert systems.

UNIT – I Introduction

Introduction to Expert System, Definitions, Importance of Expert System, Characteristic features of Expert System, Applications of Expert System, Different categories of Expert Systems, Rule Based System Architecture, Neural Network Architecture - Knowledge Representations: Components of a Knowledge in Expert system, OAV Triplets, Semantic Networks, Frames Representation via Logic Statements, Production Systems, Clause, Properties Rule properties, Rule Conversions, Multiple Conclusions, Neural Networks via Rule Based System

UNIT – II Expert System Design

Knowledge Acquisition: Introduction Knowledge Acquisition and domain Expert, Selection of the domain, Selection of the Knowledge Engineers, Selection of the Expert, Meetings and Plans, Organization of Meetings, Documentation, Multiple domain Experts, Knowledge Acquisition –An Example, Knowledge Acquisition using Rule induction, Generating Rules from Trees, ID3 algorithm for Rule Generation - Design of Expert System: Introduction, Selecting the appropriate Problem, Stages in Developing the Expert System, Errors in Development stages, Software Engineering and Expert Systems, The Expert System Life Cycle, Expert System Design Examples- Certainty factors, Decision Trees.

UNIT – III Inference Engine

Inference Engine, Insight of Inference Engine, Search Strategies, Forward Chaining algorithm, Algorithms for forward Chaining- Baseline Version, Backward Chaining Algorithm, Algorithms for Back ward Chaining-Baseline Version, Mixed Modes of Chaining, Work sheets for Forward and Back ward Chaining.

UNIT – IV Reasoning under Uncertainty

Uncertainty, Types of Error, Error and Induction, Classic Probability, Temporal Reasoning and Morkov Chains, TMS, Fuzzy Logic and Natural Languages computations, Probabilistic Reasoning, probabilistic Networks, Bayesian Networks. Use of Probability and Fuzzy logic in Expert System, Rule Induction by Machine Learning

UNIT – V Expert system Tools and Architectures

Overview of Expert System Tools, Expert System Shells, Multiple Paradigm Environments, Abstract architectures, Potential Implementation Problems, Selecting a Software Tool, Implementation Mechanism of tools, Black Board Architecture, Reasoning under uncertainty and Truth Maintainance Systems - Case-study : A case-study on Financial planning Expert System, Sale Expert system, DENDRAL and MYCIN

TEXT BOOKS:

1. Pan W. Patterson, Introduction to artificial Intelligence & Expert Systems, PHI, 2015.
2. Joseph C. Giarratano, Expert Systems Principles and Programming, Cengage Learning, 2007.

REFERENCES:

1. Giarratano.Rilev, Expert System principals and Programming, 2003.
2. Peter Jackson, Introduction to Expert Systems, Addison Wesley Publishing Company, 2002.
3. V. James P.Iginizo, Introducion to Expert Systems., Mc.Graw-Hill.inc, 1991.
4. R.I. Levine D. E. Drang, Barry Edelson, A Comprehensive Guide to AI and Expert systems, McGraw Hill, 1988.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Identify components of knowledge in expert system.
2. Acquire knowledge and to study the stages in developing the expert systems.
3. Apply forward and backward chaining algorithms.
4. Design probabilistic and Bayesian Networks.
5. Utilize the tools to develop expert systems.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-
CO3	1	2	l	1	-	-	-	-	-	-	-	-
CO4	1	2	-	-	-	-	-	-	-	-	-	-
CO5	2	2	1	-	-	-	-	-	-	-	-	-

AIPESCN	**REASONING AND UNCERTAINTY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- An ability to apply knowledge of computing and mathematics appropriate to the discipline.
- An ability to analyze a problem, identify and define the computing requirements appropriate to its solution.
- An ability to design, implement and evaluate a computer-based system, process, component, or program to meet desired needs.
- An ability to use current techniques, skills, and tools necessary for computing practice.

UNIT - I Quantifying Uncertainty

Acting under Uncertainty - Summarizing uncertainty - Uncertainty and rational decisions - Basic Probability Notation - probabilities - The language of propositions in probability assertions - Probability

axioms and their reasonableness - Inference Using Full Joint Distributions - Independence - Bayes' Rule and Its Use - Wumpus World Revisited.

UNIT – II Probabilistic Reasoning

Representing Knowledge in an Uncertain Domain - The Semantics of Bayesian Networks - Efficient Representation of Conditional Distributions - Exact Inference in Bayesian Networks - Approximate Inference in Bayesian Networks - Relational and First-Order Probability Models - Other Approaches to Uncertain Reasoning.

UNIT – III Probabilistic Reasoning over Time

Time and Uncertainty- States and Observations - Transition and Sensor models - Inference in Temporal Models - Filtering and Prediction – Smoothing - Finding the most likely sequence - Hidden Markov Models - Simplified matrix algorithms - Hidden Markov model example: Localization - Kalman Filters - Dynamic Bayesian Networks - Keeping Track of Many Objects.

UNIT – IV Making Simple Decisions

Combining Beliefs and Desires under Uncertainty - The Basis of Utility Theory - Utility Functions - Multi attribute Utility Functions - Decision Networks - The Value of Information – Decision - Theoretic Expert Systems.

UNIT – V Sequential Decision Problems

Sequential Decision Problems Introduction - Utilities over time - Optimal policies and the utilities of states - Value Iteration - The Bellman equation for utilities - The value iteration algorithm - Convergence of value iteration - Policy Iteration - Partially Observable MDPs - Definition of POMDPs - Value iteration for POMDPs - Online agents for POMDPs - Decisions with Multiple Agents: Game Theory- Single-move games - Repeated games - Sequential games - Mechanism Design – Auctions - Common goods.

TEXT BOOKS:

1. Stuard Russell and Peter Norvig, Artificial Intelligence. A Modern Approach, 3rd edition, Prentice Hall, Inc. 2018.
2. Christophe Simon, Philippe Weber, and Mohamed Sallak, Data Uncertainty and Important Measures, Wiley-ISTE; 1 edition , 2018

REFERENCES:

1. Audun josang, Subjective Logic: A Formalism for Reasoning under Uncertainty, Springer Publishing Company, 2018.
2. Ryan Martin, Chuanhai Liu, Inferential Models: Reasoning with Uncertainty, CRC Press, 1st Edition, 2015.
3. Yingxu Wang, Developments in Natural Intelligence Research and Knowledge Engineering: Advancing Applications, Fourth Volume, IGI series, 2012.
4. Anthony Hunter, Simon Dr Parsons, A. Hunter, Applications of Uncertainty Formalisms, Springer; 1998.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the basic concepts of uncertainty, Probability notations and Bayes rule
2. Demonstrate the various probability networks and Bayesian networks.
3. Understand the fundamentals of knowledge of different transition and sensor models.
4. Demonstrate working knowledge of reasoning in the presence of incomplete and/or uncertain information.
5. Ability to apply knowledge representation, reasoning, and machine learning techniques to real-world problems and also ability to carry out independent (or in a small group) research and communicate it effectively in a seminar setting.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	1	-	-	-	-	-	-	-	-
CO3	1	1	l	1	-	-	-	-	-	-	-	-
CO4	1	1	-	-	-	-	-	-	-	-	-	-
CO5	2	1	1	-	-	-	-	-	-	-	-	-

AIPESCN	**DECISION SUPPORT SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the decision making tasks assigned to the different levels of management.
- To describe the Decision Making Process.
- To understand the architecture of a Decision Support System (DSS).
- To examine the role of Expert Systems and Artificial Intelligence (AI) play in supporting managerial decision making.

UNIT – I Management Support Systems

An Overview: Managers and Decision-Making - Managerial Decision-Making and Information Systems - Managers and Computer Support - Computerized Decision Support and the Supporting Technologies - A Framework for Decision Support - The Concept of Decision Support Systems - Group Support Systems - Enterprise Information Systems - Knowledge Management Systems - Advanced Intelligent Decision Support Systems - Hybrid Support Systems. Decision-Making Systems, Modelling, and Support: Decision-Making: Introduction and Definitions - Systems - Models - Phases of the Decision-Making Process.

UNIT – II Decision Support Systems

DSS Configurations - Characteristics and Capabilities of DSS - Components of DSS - The Data Management Subsystem - The Model Management Subsystem - The User Interface (Dialog) Subsystem - The Knowledge-Based Management Subsystem - The User - DSS Hardware - DSS Classifications. Modelling and Analysis. Modelling - Static and Dynamic Models - Certainty, Uncertainty, and Risk -

Influence Diagrams - MSS Modelling with Spreadsheets - Decision Analysis of a Few Alternatives - The Structure of MSS Mathematical Models - Mathematical Programming Optimization - Problem-Solving Search Methods. Decision Support System Development – Prototyping.

UNIT – III Knowledge Management

Introduction to Knowledge Management - Organizational Learning and Transformation - Knowledge Management Initiatives - Approaches to Knowledge Management - Information Technology in Knowledge Management - Knowledge Management Systems Implementation - Roles of People in Knowledge Management - Ensuring Success of Knowledge Management.

UNIT – IV Artificial Intelligence and Expert Systems

Knowledge Based Systems - Applications of Expert Systems - Structure of Expert Systems - Problem Areas Suitable for Expert Systems - Benefits and Capabilities of Expert Systems - Problems and Limitations of Expert Systems - Types of Expert Systems - Knowledge Acquisition, Representation, and Reasoning- Representation of Knowledge - Reasoning in Rule-Based Systems - Explanation and Meta knowledge - Inferencing with Uncertainty - Expert Systems Development - Knowledge Acquisition and the Internet.

UNIT – V Advanced Intelligent Systems

Genetic Algorithms Fundamentals - Developing Genetic Algorithm Applications - Intelligent Agents - Characteristics of Agents - Classification and Types of Agents - Internet-Based Software Agents - DSS Agents and Multi-Agents - Semantic Web - Representing Knowledge for Intelligent Agents - Web-Based Recommendation Systems - Managerial Issues of Intelligent Agents.

TEXT BOOKS:

1. Turban, Decision Support and Business Intelligent Systems, 9th Edition, Pearson Education India, 2013.
2. Vicki L. Sauter, Decision Support Systems for Business Intelligence, 2nd Edition, Wiley, 2011.

REFERENCES:

1. Efraim Turban, Ramesh E Sharda and Dursun Delen, Decision Support and Business Intelligent Systems, 9th Edition, Prentice-Hall of India, 2010.
2. Ramanathan Sugumaran, John Degroote, Spatial Support Syatems: Principles and Practices, 1st Edition, CRC Press, 2010.
3. V.S.Janakiraman and K.Sarukesi, Decision Support Systems, 1st Edition, Prentice-Hall of India, 2009.
4. Efraim Turban, Jay E. Aronson, Richard V. McCarthy, Decision Support Systems and Intelligent Systems, 7th Edition, Prentice-Hall of India, 2007.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Define the purpose of a DSS.
2. Techniques and technologies that use computer resources to improve human decision making process.
3. Discuss various tools assisting IT professionals surrounding DSS.

4. Use linear programming methods to solve multivariate problems.
5. Explain key areas contributing to DSS such as knowledge acquisition, expert system and knowledge base systems.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1	-	1	-	-	-	-	-	-	-
CO2	-	1	1	-	1	-	-	-	-	-	-	-
CO3	-	1	1	-	1	-	-	-	-	-	-	-
CO4	-	1	1	-	1	-	-	-	-	-	-	-
CO5	1	1	1	-	1	-	-	-	-	-	-	-

AIPESCN	**NLP WITH DEEP LEARNING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the concepts of deep learning for natural language processing (NLP).
- To study and analyse the word vector representations.
- To learn the data preparation, implementation mechanism, and evaluation metrics for deep learning methods in NLP.
- To develop NLP applications such as Neural Machine Translation and Chatbot.

UNIT – I Introduction

Introduction to Natural Language Processing (NLP) and Deep Learning (DL) –NLP libraries – Getting started with NLP - Introduction to deep learning – Types of Neural Networks – Multi Layer Perceptron – Stochastic Gradient Descent – Backpropagation - Deep Learning Libraries – Traditional approach to NLP – deep learning approach to NLP.

UNIT – II Word Vector Representations

Word2vec- Learning Word Embeddings – classical approach to learning word representation – Word2vec – a neural network based approach to learning word representation – the skip-gram algorithm – the Continuous Bag-of-Words algorithm – Advanced Word2vec – Original skip-gram algorithm – Comparing skip-gram with CBOW – Extensions to the word embeddings algorithms – GloVe – Global Vectors representation – Document Classification with Word2vec.

UNIT – III CNN and RNN for NLP

Sentence Classification with Convolutional Neural Networks (CNN) – Introduction - Understanding CNN – Using CNN for sentence classification - Recurrent neural networks (RNN) – Understanding RNN – Backpropagation Through Time BPTT – Applications of RNNs – generating text with RNNs – Evaluating text results output from the RNN – Perplexity – measuring the quality of text result – RNN with Context Features.

UNIT – IV LSTM for NLP

Long Short-Term Memory Networks (LSTM) – Understanding LSTM –vanishing gradient problem – Other variants of LSTMs – Applications of LSTM – Generating text – Data – Implementing LSTM – Comparing LSTMs to LSTMs with peephole connections and GRUs - Applications of LSTM – Image Caption Generation – Machine learning pipeline for image caption generation – Extracting features with CNNs – Implementation with VGG16 – Learning word embeddings - Preparing captions for feeding into LSTMs – Generating data for LSTMs – Defining LSTM - Evaluating results.

UNIT – V NMT and Chatbot

Sequence-to-Sequence Learning – Neural Machine Translation (NMT) – Types of Machine translation – Understanding neural machine translation – Preparing data for NMT system – training the NMT – Inference with NMT – The BLEU score – Training NMT jointly with word embeddings – Improving NMTs - Developing a Chatbot – Introduction to Chatbot – Conversational Bot – Chatbot: Automatic Text Generation - Training a Chatbot – Evaluating Chatbots – Turing test.

TEXT BOOKS:

1. Thushan Ganegedara, Natural language Processing with TensorFlow, PACKT Publishing, 2018.
2. Karan Jain, Palash Goyal Sumit Pandey, Deep learning for Natural Language Processing: Creating Neural Networks with Python, Apress, 2018.

REFERENCES:

1. Stephan Raaijmakers, Deep Learning for Natural Language Processing, MEAP, 2019.
2. Yoav Goldberg, Neural Network Methods in NLP, Morgan & Claypool Publishers, 2017.
3. Uday Lamath, John Liu, Jimmy Whitaker, Deep Learning for NLP and Speech Recognition, Springer, 2019.
4. Ian Goodfellow, Yoshua Bengio and Aaron Courville. Deep learning, The MIT Press, 2016.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Compare traditional and deep learning approaches to NLP.
2. Identify the deep learning model suitable for a given NLP application.
3. Build deep learning models for NLP applications like image captioning, document classification.
4. Evaluate the performance of NLP applications developed used deep learning.
5. Understand and use the NLP and Deep learning library.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1	-	1	-	-	-	-	-	-	-
CO2	-	1	1	-	1	-	-	-	-	-	-	-
CO3	-	1	1	-	1	-	-	-	-	-	-	-
CO4	-	1	1	-	1	-	-	-	-	-	-	-
CO5	1	1	1	-	1	-	-	-	-	-	-	-

AIPESCN	COMPUTATIONAL LINGUISTICS AND NLP	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand language families and rank diversity of languages.
- To understand learning word representation.
- To develop skills to both syntactic and semantic knowledge Base.
- To introduce computational linguistics in present prospective.

UNIT – I Syntactic Parameters and Coding Theory

Introduction – Language Families as Codes – Entropy and Complexity for Language families – Rank Diversity of Languages: Rank Diversity of Words - A Random walk model for Rank Diversity

UNIT – II Distributed Word Representations

Introduction about Learning Word Representation – CBOW model – Prior Knowledge Construction in KCBOW – Learning Word Representation with Prior Knowledge – Experiments and Analysis – Functional and Structural Integration without Competence Overstepping in Structured Sematic Knowledge Base System: Sematic Knowledge Base – Information Storage.

UNIT – III Domains of Application

Speech Recognition – Acoustic Modeling –Case Study: The AMI System – Statistical Parsing:Generative Parsing Models – Discriminative Parsing Models –Transition Based Approaches - Statistical Parsing with CCG – Information Extraction; Name Extraction – Entity Extraction - Relation Extraction – Event Extraction

UNIT – IV Computational Linguistics: Present and Prospective

Classification of Applied Linguistics Systems – Automatic Hyphenation – Spell Checking – Grammar Checking – Style Checking – References to Word and Word Combinations – Information Retrieval – Automatic Translation – Natural Language Interface – Text Generation

UNIT – V Lexical Access in Sign Language

Introduction about Computational Model – Model Architecture – Simulation 1: Timing, Results – Simulation 2: Sub Lexical Frequency – Simulation 3: Number of Neighbors - Web Search Engine: Introduction - System Architecture

TEXT BOOKS:

1. Joseph Booth, Natural Language Processing Succintly, 1st edition, Syncfusion Inc., 2018.
2. David Loper, Computational Linguistics and Natural Language Processing, Magnum Publishing, 2017.

REFERENCES:

1. Alexander Clark, Chris Fox, and Shalom Lappin, The Handbook of Computational Linguistics and Natural Language Processing, 1st Edition, John Wiley & Sons, 2013.
2. Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python, 1st Edition, O Reilly Media, 2009.

3. Patrick Blackbrum, Kristina, Natural Language Processing Techniques in Prolog, 1st Edition, O Reilly Media, 2009.
4. Igor A. Bolshakov, Alexander Gelbukh, COMPUTATIONAL LINGUISTICS Models, Resources, Applications, 1st Edition, Direction Publications, 2004.

COURSE OUTCOMES:

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

1. Explain and apply fundamental algorithms and techniques in the area of Computational Linguistics and Natural Language Processing (NLP).
2. Design the Computational model Architecture.
3. Understand Domain of Applications, and Information Extraction in Computational Linguistics.
4. Understand the System Architecture of Web Search Engine.
5. Ensure better utilization of Natural Language Processing.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	2	-	2	-	1	-	-	-	-	-	-	-
CO3	1	-	1	-	-	-	-	-	-	-	-	-
CO4	1	-	1	-	-	-	-	-	-	-	-	-
CO5	1	1	-	-	2	-	-	-	2	-	-	1

AIPESCN	**SPEECH SYNTHESIS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To learn how to build systems that mimic human capabilities in understanding, generating and coding speech for a range of human-to-human and human-to-machine interactions.
- To investigate virtually every aspect of the unit selection method of concatenative speech synthesis.
- To show that high quality (both intelligibility and naturalness) synthetic speech could be obtained from speech synthesis systems for virtually any task application.
- To understand the problem of converting text to a complete linguistic description of associated sound and to provide a conceptual understanding of the processes involved in a complete text-to-speech synthesis system.

UNIT – I Introduction

Introduction - Text to Speech - Communication and Language- Types of communication - Human Communication - Communication Processes - The Text-to-Speech Problem: Speech and Writing - Reading Aloud - Text-to-speech System Organization – Systems - Key problems in Text-to-speech.

UNIT – II Text Segmentation and Organization

Words and Sentences - Text Segmentation - Processing Documents - Text-to-Speech Architectures - Text Decoding: Finding the words from the text - Text Classification Algorithms - Non-Natural Language Text - Natural Language Text - Natural Language Parsing.

UNIT – III Prosody Prediction from Text

Prosodic Form – Phrasing – Prominence - Intonation and tune - Prosodic Meaning and Function - Determining Prosody from the Text - Phrasing prediction - Prominence Prediction - Intonational Tune Prediction - Prosody in real dialogues..

UNIT – IV Synthesis of Prosody

Synthesis of Prosody - Intonation Overview - Intonational Behaviour - Intonation Theories and Models - Intonation Synthesis with AM models - Intonation Synthesis with Deterministic Acoustic Models - Data Driven Intonation Models – Timing - Klatt rules - The Campbell model

UNIT – V Synthesis Techniques Based on Vocal Tract Models

Synthesis Specification: The Input to the Synthesiser - Formant Synthesis - Classical Linear Prediction Synthesis - Articulatory Synthesis - Synthesis by Concatenation and Signal Processing Modification - Speech Units in Second Generation Systems - Pitch Synchronous Overlap and Add (PSOLA) - Residual Excited Linear Prediction - Sinusoidal Models - Synthesis from Cepstral Coefficients - Concatenation Issues.

TEXT BOOKS:

1. K. Sreenivasa Rao, Predicting Prosody from Text for Text-to-Speech Synthesis, Springer, 2012.
2. Paul Taylor, Text-to-Speech-Synthesis, Cambridge University Press, 2009.

REFERENCES:

1. K. Sreenivasa Rao, N. P. Narendra, Source Modeling Techniques for Quality Enhancement in Statistical Parametric Speech Synthesis, Springer, 2019.
2. Lawrence R. Rabiner, Ronald W. Schafer, Introduction to Digital Speech Processing, now publishers, 2007.
3. John Holmes and Wendy Holmes, Speech Synthesis and Recognition, Taylor and Francis, 2001.
4. Sadaoki Furui, Digital Speech Processing, Synthesis, and Recognition, Marcel Dekker Inc, 2000.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Analyse the various ways of communication and to examine what is involved in performing text-to-speech synthesis.
2. Know how to extract linguistic information from the text input and how to handle control information.
3. Investigate how to predict prosody information from an impoverished text input.
4. Understand the issue of synthesising acoustic representations of prosody.
5. Analyse the second generation synthesis systems in contrast to the first generation systems.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	1	-	-	-	-	-	-	-	-
CO3	2	1	1	1	-	-	-	-	-	-	-	-
CO4	2	-	-	1	-	-	-	-	-	-	-	-
CO5	1	-	-	-	-	-	1	-	-	-	-	-

AIPESCN	**AI – HARDWARE AND SOFTWARE INFRASTRUCTURE**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To learn the hardware requirements of an artificial intelligence system.
- To explore the datasets available for deep learning.
- To learn the software needed for an AI system.
- To know the packages in R-programming.

UNIT – I Introduction

Hardware Infrastructure: Chipset Architectures for Deep Learning- Central Processing Units -Graphics Processing Units- Field-Programmable Gate Arrays- Application-Specific Integrated Circuits- System-on-a-Chip Accelerators- Artificial Intelligence PC Cards-Artificial Intelligence Workstations-Network and Bus Connectivity- Storage and Memory- Cloud Infrastructure.

UNIT – II Bench Mark Datasets

Image datasets: MNIST-MS-COCO-ImageNet-Open Images-VisualQA-CIFAR-10. Text datasets: WordNet-The Wikipedia Corpus. Audio/Speech datasets: Free Spoken Digit Dataset- Free music ArchiveLibriSpeech, VoxCeleb.

UNIT – III Open Source Packages- Python

Basics of Python: Control Structures- Boolean logic -Numeric Data Types- Strings- Text Files- Lists- Dictionaries- Events and Event-driven Programming- Packages: Numpy-Pandas- Matplotlib- Scikit-learn.

UNIT – IV Open Source Packages-R Programming

Basics of R programming - General Properties- Data Types- Variable- Operators – Statements- Decision Making Statements - Loop statements- Array- String- Function-Data Frames Packages: RODBC-Gmodels – Class - Tm.

UNIT – V Artificial Intelligence in Data Analytics

Introduction to Hadoop-Components of Hadoop -Hadoop architecture-HDFS-YARN - Hadoop Eco Systems: Introduction to Pig, Hive, HBase-Hadoop Developer: Moving the data into Hadoop- Moving The Data out from Hadoop- Reading and Writing the files in HDFS -The Hadoop Java API for

MapReduce-Mapper Class-Reducer Class-Driver Class- Writing Basic MapReduce Program In java-Understanding the MapReduce Internal Components. -Moving The Data from Web server Into Hadoop - Real Time Example in Hadoop: Market Basket Algorithms.

TEXT BOOKS:

1. VanderPlas, Jake, Python data science handbook: essential tools for working with data, O'Reilly Media, Inc., 2016.
2. Alex Holmes, Hadoop in Practice, Manning Publications, 2nd Edition, 2014.

REFERENCE BOOKS:

1. Adler J, "R in a nutshell: A desktop quick reference", O'Reilly Media Inc, 2012.
2. Lambert, Kenneth A, "Fundamentals of Python: first programs", Cengage Learning, 2011.
3. www.tractica.com
4. https://www.theregister.co.uk/2018/09/26/build_own_ai/(pc cards)
5. https://www.analyticsvidhya.com/blog/2018/03/comprehensive-collection-deep-learning- datasets/

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Analyze the hardware requirements of artificial Intelligence.
2. Learn about the necessary databases for image, speech and text.
3. Learn the basics of Python language and other packages useful for data science.
4. Learn the basics of other packages of R programming.
5. Understand the basics of Hadoop, Pig, Hive and HBase and its usage in data analytics.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	1	1	-	-	-	-	-	-	-	-
CO2	2	1	1	1	-	-	-	-	-	-	-	-
CO3	2	1	1	1	-	-	-	-	-	-	-	-
CO4	2	1	1	1	-	-	-	-	-	-	-	-
CO5	1	-	-	-	-	-	1	-	-	-	-	-

AIPESCN	**AI MARKETING AND ML TOOLS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- Identify problems that are amenable to solution by AI methods and the concepts of machine learning.
- Discover appropriate AI methods to solve a given problem and the clustering techniques and their utilization in machine learning.
- Formalize a given problem in the language/framework of different AI methods and understand the linear learning models in machine learning.

- Design and carry out an empirical evaluation of different algorithms on problem normalization, and state the conclusions.

UNIT - I Introduction to Machine Learning

Introduction to Autonomic Marketing and Artificial Intelligence for Marketers, AI Umbrella, The Machine that Learns-Machine Learning's Biggest Roadblock, Machine Learning's Greatest Asset-Machines Are Big Babies, Strong versus Weak AI.

UNIT – II Solving the Marketing Problem

Marketing Problem-One-to-One Marketing, One-to-Many Advertising-Marketing Mix Modeling-Econometrics-Customer Lifetime Value, Seat-of-the-Pants Marketing, Marketing in a Nutshell, Market Research, Market place Segmentation-Raising Awareness, Social Media Engagement.

UNIT– III Using AI to Persuade and Retention

The In-Store Experience, The Onsite Experience Web Analytics-Merchandising-Closing the Deal – Attribution, Growing Customer Expectations, Retention and Churn-Customer Sentiment, Customer Service, Predictive Customer Service

UNIT– IV The AI Marketing Platform

Supplemental AI-Marketing Tools from Scratch, A Word about Watson-Machine Mistakes, Human Mistakes-The Ethics of AI-Strategic Role in On boarding AI-AI to Leverage Humans-Collaboration at Work- Role as Manager-AI for Best Practices

UNIT – V Mentoring the Machine

How to Train a Dragon-What Problem Are You Trying to Solve- Make it as Good Hypothesis, The Human Advantage , The Path to the Future-Machine, Train Thyself-Intellectual Capacity as a Service-Data as a Competitive Advantage-How Far Will Machines Go, Your Bot Is Your Brand, Computing Tomorrow

TEXT BOOKS:

1. Artificial Intelligence for Marketing: Practical Applications (Wiley and SAS Business Series), 2017, Jim Sterne
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", 2nd Edition, Tata McGraw-Hill, 2003.

REFERENCES:

1. Parag Kulkarni, Prachi Joshi, Artificial Intelligence –Building Intelligent Systems, PHI learning private Ltd, 2015.
2. Deepak Khemani, Artificial Intelligence, Tata Mc Graw Hill Education 2013.
3. George F. Luger, Artificial Intelligence-Structures and Strategies For Complex Problem Solving, Pearson Education / PHI, 2002.
4. Stuart Russel and Peter Norvig AI – A Modern Approach, 2nd Edition, Pearson Education 2007.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the basic concepts of AI Marketing.
2. Acquire the knowledge of real world Knowledge representation.

3. Analyze and design a real world problem for implementation and understand the dynamic behavior of a system.
4. Use different machine learning techniques to design AI machine and enveloping applications for real world problems.
5. Understand the various searching techniques, constraint satisfaction problem and example problems- game playing techniques.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	1	-	1	-	-	-	-	-	-	-
CO2	2	1	1	-	1	-	-	-	-	-	-	-
CO3	2	1	1	-	1	-	-	-	-	-	-	-
CO4	2	2	1	2	2	-	-	-	1	-	-	1
CO5	2	2	1	2	2	-	-	-	1	-	-	1

AIPESCN	**EMOTIONAL ANALYTICS IN AI**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To be Emotionally Intelligent Human Beings enabling to manage & respond to self & others' emotions.
- To develop skills of Self Awareness, Self Management, Self Motivation, Empathy & Social Relations.
- To understand Human Psychology influencing Human Behaviour.
- To develop valuable relations with other people, by understanding underlining principles of Human Relations

UNIT – I Introduction to Emotional Intelligence (EI)

Introduction – Emotional Intelligence (EI), Emotional Quotient (EQ) and Intelligence Quotient (IQ) Historical Roots of Multiple Intelligences & EI - Power of Emotions - The Emotional Brain & Amigdala Hijack - The Emotional Sentinel – Importance of Emotions – Emotions and Brain- Application of Physiology of Emotions

UNIT – II Building Blocks of Emotional Intelligence

Ability Based Model - Perception - Employment - Comprehension - Management - Trait Model of Self-Efficacy - Mixed Model - Personal Competence (Self Awareness, Self Management & Motivation) - Social Competence (Empathy & Social Skills) - Empathy - Understanding Empathy - Importance of Empathy - Application of Self-Efficacy of EI

UNIT – III Aspects & Impact of fundamental Elements of EI

Behavioral terms - Self Awareness - Emotional Resilience – Motivation - Interpersonal Sensitivity – Influence - Intuitiveness – Conscientiousness

UNIT – IV EI Elements and its Applications

Competence terms - Self Awareness - Self Management - Self Motivation - Empathy - Social Skills - Applications in Everyday Behaviour - Education - Workplace - Case Study Discussion with Role Plays

UNIT – V Measuring Emotional Intelligence & Behavioural EQ

Initial Self-Assessment on EI Elements (Internal) - 360 degree Assessment Map - EI Behavioural Test (External) - Behavioural EQ - Measuring Behaviour EQ - DISC Test - Role Play on DISC Behaviour Identification.

TEXT BOOKS:

1. The Brain and Emotional Intelligence: New Insights: Daniel Goleman HBR's 10 Must Reads on Emotional Intelligence, 2015.
2. Gil Hasson, Understanding Emotional Intelligence, Pearson, 2014,

REFERENCES:

1. Daniel Goleman, The emotionally intelligent leader, Harvard business review press, 2019.
2. Neilson Kite and Frances Kay, Understanding emotional intelligence, Koganpage, 2012.
3. The Language of Emotional Intelligence: The Five Essential Tools for Building Powerful and Effective Relationships: Jeanne Segal, 2008.
4. Marvin Minsky, The Emotion Machine, Commonsense Thinking, Artificial Intelligence, and the Future of the Human Mind" Simon & Schuster, 2006.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. To be emotionally intelligent human beings enabling to manage & respond to self & others' emotions.
2. To understand various existing models of emotional intelligence.
3. To understand behavioural intelligence and apply those in their professional life.
4. To develop skills of self awareness, self management, self motivation, empathy & social relations.
5. To understand underlying principles of behavioural test.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	1	-	1	-	-	-	-	-	-	-
CO2	3	2	1	-	1	-	-	-	-	-	-	-
CO3	3	1	1	-	1	-	-	-	-	-	-	-
CO4	3	2	1	2	2	-	-	-	1	-	-	1
CO5	2	2	1	2	2	-	-	-	1	-	-	1

AIPESCN	COGNITIVE AND COMPUTATIONAL APPROACHES TO MACHINE VISION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The course enables the students to:

- Understands cognitive computing and cognitive psychology basics..
- Develop algorithms that use AI and machine learning along with human interaction.
- Learn machine learning techniques for cognitive decision making.
- Learn various cognitive system applications.

UNIT – I Introduction to Cognitive Computing With AI

Cognitive Computing -Cognitive Psychology -The Architecture of the Mind -The Nature of Cognitive Psychology –Cognitive architecture –Cognitive processes –The Cognitive Modeling Paradigms - Declarative / Logic based Computational cognitive modeling –connectionist models –Bayesian models- Introduction to Knowledge-Based AI –Human Cognition on AI –Cognitive Architectures.

UNIT – II Different Modes of Computing

Turning machine-Lambda- Calculus,-Hyper Computing- Super Computing- Pan Computing and Interactive Computing- Computation of Cognitive Functioning in machines-Robotics, Human-Robotics Interaction- Hepatic.

UNIT – III Cognitive Computing with Inference and Decision Support Systems:

Intelligent Decision making -Fuzzy Cognitive Maps –Learning algorithms: Non linear Hebbian Learning –Data driven NHL -Hybrid learning –Fuzzy Grey cognitive maps –Dynamic Random fuzzy cognitive Maps.

UNIT – IV Cognitive Computing with Machine Learning

Machine learning Techniques for cognitive decision making –Hypothesis Generation and Scoring - Natural Language Processing -Representing Knowledge -Taxonomies and Ontologies -Deep Learning

UNIT – V Applications

Cognitive Systems in health care –Cognitive Assistant for visually impaired –AI for cancer detection- Predictive Analytics -Text Analytics -Image Analytics -Speech Analytics –IBM Watson -Introduction to IBM's PowerAI Platform -Introduction to Google's TensorFlow Development Environment.

TEXT BOOKS:

1. Vijay Raghvan, Venu Govindaraju, C.R. Rao, Cognitive Computing: Theory and Applications, Elsevier publications, 2016.
2. Jerome R. Busemeyer, Peter D. Bruza, Quantum Models of Cognition and Decision, Cambridge University Press, 2014.

REFERENCES:

1. Emmanuel M. Pothos, Andy J. Wills, Formal Approaches in Categorization, Cambridge University Press, 2011.
2. Nils J. Nilsson, The Quest for Artificial Intelligence, Cambridge University Press, 2009.

3. Hurwitz, Kaufman, and Bowles, Cognitive Computing and Big Data Analytics, Wiley, Indianapolis, 2005.
4. Neil Stillings, Steven E. Weisler, Christopher H. Chase and Mark H. Feinstein, Cognitive Science: An Introduction, MIT Press, 1995.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand and discuss what cognitive computing is, and how it differs from traditional approaches.
2. Plan and use the cognitive computing with inference and decision support systems.
3. Apply machine learning techniques in cognitive decision making.
4. Use cognitive mode of computing in machines and Robotics.
5. Develop and explore the various cognitive computing applications.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	1	-	-	-	-	-	-	-
CO2	1	1	-	-	1	-	-	-	-	-	-	-
CO3	1	1	-	-	1	-	-	-	-	-	-	-
CO4	1	1	-	-	-	1	-	-	2	-	1	-
CO5	1	-	1	-	-	-	-	-	2	-	-	-

AIPESCN	**DATA ANALYTICS AND VISUALIZATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To learn the data representation techniques.
- To understand the data analysis pipeline.
- To acquire knowledge on data mining techniques for analysis.
- To study the visualization and its various types.

UNIT – I Data Representation

Data Objects and Attribute Types: Nominal-Binary- Ordinal-Numeric- Discrete and Continuous-Types of data: Record-Temporal-Spatial Temporal-Graph-Unstructured and Semi structured data-Basic Statistical Descriptions of Data.

UNIT – II Introduction to Data Analysis

Probability and Random Variables-Correlation- Regression-Data Analysis Pipeline: Data pre-processing-Attribute values-Attribute transformation-Sampling-Dimensionality reduction: PCA-Eigen faces-Multidimensional Scaling- Non-linear Methods-Graph-based Semi-supervised Learning-Representation Learning Feature subset selection-Distance and Similarity calculation.

UNIT – III Data Mining Techniques for Analysis

Classification: Decision tree induction-Bayes classification-Rule-based classification-Support Vector Machines-Classification Using Frequent Patterns-k-Nearest-Neighbor-Fuzzy-set approach Classifier-Clustering: K-Means-k-Medoids- Agglomerative versus Divisive Hierarchical Clustering Distance in Algorithmic Methods-Mean-shift Clustering.

UNIT – IV Visualization

Traditional Visualization-Multivariate Data Visualization-Principles of Perception-Color- Design and Evaluation -Text Data Visualization- Network Data Visualization-Temporal Data Visualization and visualization Case Studies.

UNIT – V Implementation of data analytics techniques

Implementation of various data analytics techniques such as classification clustering on real world problems using R.

TEXT BOOKS:

1. Phuong Vo.T.H, Martin Czygan, Ashish Kumar, Kirthi Raman, Python: Data Analytics and Visualization, Packet Publishing Limited, 2017.
2. Andy Kirk, Data Visualization: A Handbook for Data Driven Design, 1st Education SAGE Publication, 2016.

REFERENCES:

1. Simon, P., The Visual Organization: Data Visualization, Big Data, and the Quest for Better Decisions, John Wiley & Sons, 2014.
2. Peng, D., R., R Programming for Data Science, Lulu.com, 2012.
3. Han, J., Kamber, M. and Pei, J., Data Mining Concepts and Techniques, Morgan Kaufmann 3rd Edition, 2011.
4. Hastie, T., Tibshirani, Rand Friedman, J., The Elements of Statistical Learning, 2nd Edition, Springer, 2009.

COURSE OUTCOMES:

At the end of this course the student will be able to

1. Understand data representation techniques.
2. Appreciate the data analysis pipeline.
3. Implement data mining techniques for analysis.
4. Apply multivariate data visualization on various applications.
5. Implement data analysis techniques using R.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-
CO3	3	2	3	2	-	-	-	-	-	-	-	-
CO4	3	2	-	2	-	-	-	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-

AIPESCN	VIRTUAL REALITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand geometric MODELING and Virtual environment.
- To study about Virtual Hardware and Software.
- To develop Virtual Reality applications.
- To design virtual environment.

UNIT – I Introduction to Virtual Reality

Virtual Reality & Virtual Environment : Introduction – Computer Graphics – Real Time Computer Graphics – Flight Simulation – Virtual Environments – Requirement – Benefits of Virtual Reality- Historical development of VR : Introduction – Scientific Landmark – 3D Computer Graphics: Introduction – The virtual world space – positioning the virtual observer – the perspective projection – human vision – stereo perspective projection – 3D clipping – Colour theory – Simple 3D modeling – Illumination models – Reflection models – Shading algorithms- Radiosity – Hidden Surface Removal – Realism-Stereographic image.

UNIT – II Geometric Modeling

Geometric MODELING: From 2D to 3D – 3D space curves – 3D boundary representation - Geometrical Transformations: Introduction – Frames of reference – Modeling transformations – Instances –Picking-Flying – Scaling the VE – Collision detection - A Generic VR system: Introduction – The virtual environment – the Computer environment – VR Technology – Model of interaction – VR Systems.

UNIT – III Virtual Environment

Animating the Virtual Environment: The dynamics of numbers – Linear and Non-linear interpolation - The animation of objects – linear and nonlinear translation - shape & object inbetweening – free from deformation – particle system- Physical Simulation: Introduction – Objects falling in a gravitational field – Rotating wheels – Elastic collisions – projectiles – simple pendulum – springs – Flight dynamics of an aircraft.

UNIT – IV VR Hardwares & Softwares

Human factors : eye-ear-somatic senses - VR Hardware : Introduction – sensor hardware – Head-coupled displays –Acoustic hardware – Integrated VR systems-VR Software: Introduction – modelling virtual world –Physical simulation- VR toolkits – Introduction to VRML.

UNIT – V VR Application

Virtual Reality Applications: Introduction – Engineering – Architecture – Science – Education – Medicine – Entertainment - Training – The Future: Introduction – Virtual environments – modes of interaction.

TEXT BOOKS:

1. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, 3D User Interfaces, Theory and Practice, Addison Wesley, USA, 2017.
2. William R. Sherman, Alan B. Craig, Understanding Virtual Reality: Interface, Application, and Design, Morgan Kaufmann, 2018.

REFERENCES:

1. Alan B Craig, William R Sherman and Jeffrey D Will, Developing Virtual Reality Applications: Foundations of Effective Design, Morgan Kaufmann, 2009.
2. John Vince, Virtual Reality Systems, Pearson Education Asia, 2008.
3. Grigore C. Burdea, Philippe Coiffet , Virtual Reality Technology, Wiley Interscience, 2nd Edition, 2006.
4. Oliver Bimber and Ramesh Raskar, Spatial Augmented Reality: Meging Real and Virtual Worlds, 2005.

E-BOOKS:

1. http://msl.cs.uiuc.edu/vr/
2. www.vresources.org
3. www.vrac.iastate.edu

MOOC:

1. https://www.mooc-list.com/course/making-your-first-virtual-reality-game-coursera
2. https://www.mooc-list.com/course/vr-360-video-production-coursera
3. https://nptel.ac.in/syllabus/syllabus_pdf/106106138.pdf

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Design Virtual environment.
2. Implement Virtual Hardware and software.
3. Design geometric modeling applications.
4. Understand Virtual Reality toolkits.
5. Implement Virtual Reality applications.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-
CO3	3	2	3	2	-	-	-	-	-	-	-	-
CO4	3	2	-	2	-	-	-	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-

AIPESCN	AI IN CYBER SECURITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply core knowledge of AI concepts and tools.
- To analyze a problem, identify and detect cyber security threats with AI.
- To detect network anomaly and prevent frauds with GANs.
- To evaluate AI arsenal and to prevent authentication abuse.

UNIT - I AI Core Concepts and Tools

Applying AI in cyber security: Evolution in AI-Types of machine learning-algorithm training and optimization-Know Python's libraries. Python for AI and cyber security-Python libraries for cyber security-enter Anaconda-playing with Jupyter notebooks-Installing DL libraries.

UNIT – II Detecting cyber security threats with AI

Detecting email cyber security threats with AI: Detecting spam with perceptrons-spam detection with SVM-Phishing detection with logistic regression and decision trees-spam detection with Naïve Bayes-NLP to the rescue. Malware threat detection: Malware analysis at a glance-telling different malware families apart-Decision tree malware detectors-detecting metamorphic malware with HMM-advanced malware detection with deep learning.

UNIT – III Network anomaly detection with AI and authentication abuse prevention

Network anomaly detection techniques-classifying network attacks-detecting botnet topology-ML algorithms for botnet detection. Securing user authentication: Authentication abuse prevention-account reputation scoring-user authentication with keystroke recognition-biometric authentication with facial recognition.

UNIT – IV Fraud prevention and GANs

Fraud detection algorithms-predictive analytics for credit card fraud detection-IBM Watson cloud solution-importing sample data in the cloud-evaluating quality of our predictions. GANS in a nutshell-GAN Python tools and libraries-network attack via model substitution-IDS evasion via GAN-facial recognition attacks with GAN.

UNIT – V Evaluating and testing AI Arsenal

Best practices of feature engineering-evaluating a detector's performance with ROC-split data to training and test sets-using cross validation for algorithms. Assessing AI arsenal: Evading ML detectors-challenging ML anomaly detection-testing for data and model quality-ensuring security and reliability.

TEXT BOOKS:

1. Alessandro Parisi, Hands on Artificial Intelligence for Cyber security, Packt Publishing Ltd., 2019.
2. Jack Caravelli and Nigel Jones, Cyber security-Threats and responses for government and business, Praeger security international, 2019.

REFERENCES:

1. Brij B. Gupta, Michael Sheng, Machine learning for computers and cyber security, CRC Press, 2019.
2. Clarence Chio, David freeman, Machine Learning and Security, O'Reilly, 1st edition, 2018.
3. Soma Halder and Sinan Ozademir, Machine Learning for Cyber security, Packt publishing, 2018.
4. Ted Coombs, Artificial Intelligence and Cyber security for dummies, IBM Limitec Edition, John Wiley & Sons, 2018.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the basic concepts of AI and the necessary tools for cyber security.
2. Detect cyber security threats in AI.
3. Understand the fundamentals of Network anomaly detection with AI and authentication abuse prevention.
4. Demonstrate working knowledge fraud prevention with cloud AI solutions.
5. Ability to evaluate algorithms and to test AI arsenal.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	-	-	-	-	-	-	-	-	-	1
CO2	2	1	1	-	-	-	-	-	-	-	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-
CO4	2	1	1	-	-	-	-	-	-	-	-	-
CO5	2	1	1	-	1	-	-	-	-	-	-	-

AIPESCN	**BIOMETRIC SECURITY TECHNOLOGY-AI**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

To understand the basics of Biometrics and its functionalities

- To learn the role of biometric in the organization.
- To expose the concept of IRIS and sensors.
- To expose the context of Biometric Applications.
- To learn to develop applications with biometric security.

UNIT – I Introduction

Biometrics- Introduction- benefits of biometrics over traditional authentication systems –Verification and identification – Basic working of biometric matching – Accuracy – False match rate – False non-match rate – Failure to enroll rate – Derived metrics – Layered biometric solutions -benefits of biometrics in identification systems-selecting a biometric for a system –Applications - Key biometric terms and processes - biometric matching methods -Accuracy in biometric systems.

UNIT – II Physiological Biometric Technologies

Fingerprints - Technical description –characteristics - Competing technologies - strengths – weaknesses – deployment - Facial scan - Technical description - characteristics - weaknesses-deployment - Iris scan - Technical description – characteristics - strengths – weaknesses – deployment - Retina vascular pattern – Finger scan – Features – Components – Operation (Steps) – Competing finger Scan technologies – Strength and weakness. Types of algorithms used for interpretation

UNIT – III Behavioral Biometrics

Technical description – characteristics - strengths – weaknesses – deployment - Facial Scan - Features – Components – Operation (Steps) – Competing facial Scan technologies – Strength and weakness– Hand scan - Technical description-characteristics - strengths – weaknesses deployment – DNA biometrics. Behavioral Biometric Technologies: Handprint Biometrics - DNA Biometrics.

UNIT – IV Iris and Other Traits

Signature and Handwriting technology - Technical description – classification – Iris Scan - Features – Components – Operation (Steps) – Competing iris Scan technologies – Strength and weakness –keyboard / keystroke dynamics- Voice – data acquisition - feature extraction - characteristics - strengths – weaknesses-deployment.

UNIT – V Future Trends

Multi biometrics and multi factor biometrics - two-factor authentication with passwords – Voice Scan - Features – Components – Operation (Steps) – Competing voice Scan (facial) technologies – Strength and weakness. - Tickets and tokens – executive decision - implementation plan.

TEXT BOOKS:

1. Ravindra Das, Adopting Biometric Technology: Challenges and Solutions Hardcover – Import, CRC Press, 1st Edition, 2016.
2. Ravindra Das, The Science of Biometrics: Security Technology for Identity verification, Routledge, 1st Edition 2018.

REFERENCES:

1. Larbi Boubchir, Biometric Recognition and Security: Theory, Methods and Applications, ISTE Press – Elsevier, 2019.
2. Gerardus Blokdyk, Biometric Identification A Complete Guide – 2019, 5starcooks, 2019
3. Khalid saeed with Marcin Adamski, Tapalina Bhattasali, Mohammed K. Nammous, Piotr panasiuk, mariusz Rybnik and soharab H.Sgaikh, ―New Directions in Behavioral Biometrics‖, CRC Press 2017.
4. A Ghany Kareem Kamal , An Intelligent Biometrics System, LAP Lambert Academic Publishing, 2015.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Demonstrate knowledge of the basic physical and biological science and engineering principles underlying biometric systems.
2. Understand and analyze biometric technologies in various applications and to identify the strength and weakness of the technologies.
3. Learn about the behavioral biometric technologies.
4. Identify the sociological and acceptance issues associated with the design and implementation of biometric systems such as iris, voice etc.,
5. Understand various Biometric security issues and future trends and its applications.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	1	-	-	-	-	-	-	-	-	1
CO2	2	2	1	-	1	-	-	-	-	-	-	-
CO3	2	2	1	-	-	-	-	-	-	-	-	-
CO4	2	2	1	-	-	-	-	-	-	-	-	-
CO5	2	1	1	-	1	-	-	-	-	-	-	-

AIPESCN	**INFORMATION RETRIEVAL AND WEB SEARCH**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the basics of Information Retrieval.
- To learn the basics of Web Search.
- To understand Machine Learning Techniques for text classification and clustering.
- To learn different techniques of recommender system.

UNIT – I Introduction

Information Retrieval – Early Developments – The IR Problem – The Users Task – Information versus Data Retrieval – The IR System – The Software Architecture of the IR System – The Retrieval and Ranking Processes - Goals and history of IR - The impact of the web on IR. The role of artificial intelligence (AI) in IR - The Web – The e-Publishing Era - Practical Issues on the Web – How People Search – Search Interfaces Today – Visualization in Search Interfaces.

UNIT – II Modelling and Retrieval Evaluation

Basic IR Models – Boolean Model – TF-IDF (Term Frequency / Inverse Document Frequency) Weighting – Vector Model – Probabilistic Model – Latent Semantic Indexing Model – Neural Network

Model – Retrieval Evaluation – Retrieval Metrics – Precision and Recall – Reference Collection – User-based Evaluation – Relevance Feedback and Query Expansion – Explicit Relevance Feedback.

UNIT – III Text Classification and Clustering

A Characterization of Text Classification – Unsupervised Algorithms: Clustering – Naïve Text Classification – Supervised Algorithms – Decision Tree – k-NN Classifier – SVM Classifier – Feature Selection or Dimensionality Reduction – Evaluation metrics – Accuracy and Error – Organizing the classes – Indexing and Searching – Inverted Indexes – Sequential Searching – Multi-dimensional Indexing. Categorization algorithms: naive Bayes.

UNIT – IV Web Retrieval and Web Crawling

The Web – Search Engine Architectures – Cluster based Architecture – Distributed Architectures – Search Engine Ranking – Link based Ranking – Simple Ranking Functions – Learning to Rank – Evaluations - Search Engine Ranking – Search Engine User Interaction – Browsing – Applications of a Web Crawler – Taxonomy – Architecture and Implementation – Scheduling Algorithms – Evaluation - Web search: Search engines-spidering –meta crawlers-directed spidering-link analysis (e.g. hubs and authorities, Google Page Rank)- shopping agents.

UNIT – V Recommender Systems

Recommender Systems Functions – Data and Knowledge Sources – Recommendation Techniques – Basics of Content-based Recommender Systems – High Level Architecture – Advantages and Drawbacks of Content-based Filtering – Collaborative Filtering – Matrix factorization models – Neighbourhood models.Information Extraction and Integration*:* Extracting data from text; XML; semantic web; collecting and integrating specialized information on the we.

TEXT BOOKS:

1. Ricardo Baeza-Yates and BerthierRibeiro-Neto, ―Modern Information Retrieval: The Concepts and Technology behind Search, Second Edition, ACM Press Books, 2011.
2. Ricci, F, Rokach, L. Shapira, B.Kantor, ―Recommender Systems Handbook, 1st Edition, 2011.

REFERENCES:

1. C. Manning, P. Raghavan, and H. Schütze, ―Introduction to Information Retrieval, Cambridge University Press, 2008.
2. Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, ―Information Retrieval: Implementing and Evaluating Search Engines, The MIT Press, 2010.
3. Donald Metzier, Trevor Strohman, W.Bruce Croft, Search Engines: Information Retrieval in Practice, 1st Edition, Pearson, 2009.
4. David A. Grossman, Ophir Frieder, Information Retrieval: Algorithms and Heuristics, 2nd Edition, Springer, 2004.

COURSE OUTCOMES:

1. Use an open source search engine framework and explore its capabilities
2. Apply appropriate method of classification or clustering.
3. Design and implement innovative features in a search engine.
4. Design and implement a recommender system.
5. To identify challenging problems on the Web.

Mapping Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	1	-	-	-	-	-	-	-	-
CO4	2	2	-	-	-	-	-	-	-	-	-	-
CO5	1	1	-	-	-	-	-	-	-	-	-	-

AIPESCN	**VISION SYSTEMS AND ROBOTICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To learn the basics of robotics.
- To understand the robot end effectors.
- To learn the techniques used in robot mechanics.
- To learn the fundamentals of machine vision systems and robot programming.

UNIT – I Basics of Robotics

Introduction- Basic components of robot-Laws of robotics- classification of robot-work space - accuracy-resolution –repeatability of robot. Power transmission system: Rotary to rotary motion, Rotary to linear motion, Harmonics drives.

UNIT – II Robot End Effectors

Robot End effectors: Introduction- types of End effectors- Tools as end effectors - Drive system for grippers - Mechanical gripper- types of gripper mechanism- gripper force analysis and gripper design - other types of gripper- special purpose grippers.

UNIT – III Robot Mechanics

Robot kinematics: Introduction- Matrix representation- rigid motion & homogeneous transformation- forward & inverse kinematics- trajectory planning. Robot Dynamics: Introduction - Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation.

UNIT – IV Machine Vision Fundamentals

Machine vision: image acquisition, digital images-sampling and quantization-levels of computation Feature extraction-windowing technique- segmentation- Thresholding- edge detection- binary morphology - grey morphology - Camera calibration – Stereo Reconstruction.

UNIT – V Robot Programming

Robot programming: Robot Languages- Classification of robot language-Computer control and robot software-Val system and Languages- VAL language commands- motion control, hand control, program control, pick and place applications - palletizing applications using VAL, Robot welding application using

VAL program- Rapid Language - basic commands Virtual robotics - VAL-II and AML – applications of robots.

TEXT BOOKS:

1. Carsten Steger, Markus Ulrich, Christian Wiedemann, Machine Vision Algorithms and Applications, Second edition, Weinheim, WILEY-VCH, 2018.
2. John J. Craig, Introduction to Robotics - Mechanics and Control, 3rd Edition, Pearson Education Inc, 2013.

REFERENCES:

1. Mikell P Groover, Mitchel Weiss, Roger N Nagel, Nicholas G Odrey, Ashish Dutta, Industrial Robotics Technology, Programming and Applications, Second edition, 2012.
2. S.R. DEB, S.DEB, Robotics Technology and Flexible Automation, 2nd Edition, Tata McGraw Hill Education, 2011.
3. S.K. Saha, Introduction to Robotics, 4th Edition, Tata McGraw Hill Education, 2011.
4. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis, Oxford University Press, Sixth impression, 2010.

COURSE OUTCOMES:

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

1. Able to know the basics of robotics.
2. Able to understand the concepts of robot end effectors.
3. Obtain forward, reverse kinematics and dynamics model of the industrial robot arm
4. Develop the vision algorithms.
5. Understand the robot programming and applications of robots.

Mapping Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	1	-	-	-	-	-	-	-	-
CO4	2	2	-	-	-	-	-	-	-	-	-	-
CO5	1	1	-	-	-	-	-	-	-	-	-	-

AIPESCN	**AGENT BASED MODELING AND SIMULATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To introduce the basic concepts of Agent based modeling (ABM).
- To understand agent based model design process and to present modeling methodologies.
- To describe the tools for ABM and its architecture.
- To train the students to explore model verification and validation techniques.

UNIT – I Fundamentals of Agent based Modeling

The Challenge: Agents-Why ABMS-Foundations of ABMS-Uses-Overview of ABMS-Design. ABMS Paradigm: Types of models-nondeterminism-cycle of innovation-other angles on nondeterminism-choosing behaviors to models-spectrum of model uses. Agents a close look: attributes-behaviors-simple agents-complex agents-market example-design and development.

UNIT – II Modeling and Simulation

The roots of ABMS: Context-complexity science-diffusion of ABMS. Role of ABMS: Modeling and simulation for business applications-supply chain example-survey of modeling approaches-when to use agents-blended modeling approaches. Discovering agent behaviors: Social agents-behavioral theories-agent diversity-multiagent systems-discovering agent behaviors-market example.

UNIT – III Agents and Modeling

Office ABMS: Progressive development-prototyping ABMS Environment-four model growth path-leveraging change-ABMS Architecture-ABMS Continuum-Examples. Desktop ABMS: Agent spreadsheets-Dedicated ABMS prototyping environment- Example. Participatory ABMS: Strengths and weakness-developing strong minds-market example.

UNIT – IV Large scale ABMS

Large scale ABMS: Features-current Toolkits-Large scale modeling life cycle-designing large scale models-agent patterns and antipatterns-examples. ABMS verification and validation: overview-verification-validation-related aspects of V&V. Visual approach to data collection and cleaning.

UNIT – V ABMS Management

Understanding and presenting ABMS Results: Analyzing ABMS Results-Presenting ABMS results-seven steps. ABMS Project Management: ABMS Business function-fundamentals-project goals-stopping mission creep-champions-domain skills pyramid-ABMS project structures-ABMS business process-Rising to the challenge.

TEXTBOOKS:

1. Uri Wilensky and William Rand, An Introduction to Agent-Based Modeling: Modeling Natural, Social, and Engineered Complex Systems with NetLogo, MIT Press, Cambridge, England, 2015.
2. Hiroki Sayama, Introduction to the Modeling and Analysis of Complex Systems, Open SUNY Textbooks, 2015.

REFERENCES:

1. J. Nathan Kutz, Data-Driven Modeling & Scientific Computation: Methods for Complex Systems & Big Data, Oxford University Press, 2013.
2. Jerry Banks, John S Carson, Barry L Nelson, David M Nicol and Shahabudeen P, Discrete -Event System Simulation, Pearson, New Delhi, 2011.
3. Averil M Law, Simulation Modeling and Analysis, Tata-McGraw Hill, New Delhi, 2011.
4. Narsingh Deo, System Simulation with Digital Computer, PHI Learning, New Delhi, 2011.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the agent modeling and apply to a specific domain to make a significant contribution.
2. Leverage the knowledge acquired to build novel agent models.
3. Plan and execute a project that leverages ABMS.

4. Create the business implications of ABMS.
5. Build and explore the ABMS applications that are impacting the field of AI & ML.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1		-	-	-	2	-	-	-	-	-	-	-
CO2	1	1	1	1	2	-	-	-	-	-	-	-
CO3	1	1	1	1	2	-	-	-	-	-	-	-
CO4	1	1	1	1	2	-	-	-	-	-	-	-
CO5	1	1	2	1	2	-	-	-	--	-	-	1

AIPESCN	**RECOMMENDER SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To develop state-of-the-art recommender systems that automates a variety of choice-making strategies with the goal of providing affordable, personal, and high-quality recommendations.
- To explore the algorithms, theory behind, and design of recommender systems.
- To handle attacks on collaborative recommender systems.
- To design hybrid approaches for knowledge based recommendation.

UNIT – I Introduction

Basic models of recommender systems: Collaborative filtering models-content based recommender systems-knowledge based recommender systems-demographic recommender systems-hybrid and ensemble based recommender systems-evaluation of recommender systems.
Applications of recommendation systems, Issues with recommender system.

UNIT – II Collaborative Filtering

User-based nearest neighbor recommendation, Item-based nearest neighbor recommendation, Model based and pre-processing based approaches, Attacks on collaborative recommender systems.

UNIT – III Content-based Recommendation

High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, Obtaining item features from tags, Representing item profiles, Methods for learning user profiles, Similarity based retrieval, Classification algorithms.

UNIT – IV Knowledge based Recommendation

Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders. **Hybrid approaches:** Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Meta-level, Limitations of hybridization strategies.

UNIT – V Evaluating Recommender System

Introduction, General properties of evaluation research, Evaluation designs, Evaluation on historical datasets, Error metrics, Decision-Support metrics, User-Centred metrics **Recommender Systems and communities:** Communities, collaboration and recommender systems in personalized web search, Social tagging recommender systems, Trust and recommendations, Group recommender systems

TEXT BOOKS:

1. Charu C. Agarwal, Recommender Systems: The Textbook, Springer, 2016.
2. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press, 1st Edition, 2011.

REFERENCE BOOKS:

1. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer, 1st Edition, 2013.
2. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer, 1st Edition, 2011.
3. Gerald Kembellec, Ghislaine Chartron, Imad Saleh, Recommender Systems (Information Systems, Web and Pervasive Computing), 1st Edition, ISTE Ltd, 2014.
4. Kim Falk, Practical Recommender Systems, 1st Edition, Manning Publications, 2019.

COURSE OUTCOMES:

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

1. Understand the concepts of recommender systems.
2. Utilize collaborative filtering in recommender systems.
3. Understand the design space of recommender systems.
4. Able to provide design recommendations for a particular application domain.
5. Able to critique a design to point out its strengths and weaknesses.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	-	2	-	-	-	-	-	-	-
CO2	2	1	1	1	2	-	-	-	-	-	-	-
CO3	2	1	1	1	2	-	-	-	-	-	-	-
CO4	2	1	1	1	2	-	-	-	-	-	-	-
CO5	2	1	2	1	2	-	-	-	--	-	-	1

AIPESCN	**ARTIFICIAL SUPERINTELLIGENCE**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the problem domain of superintelligent machines.
- To investigate the issues related to the development of superintelligent systems.
- To examine the singularity paradox and machine ethics.
- To build a secure confinement environment allowing humanity to benefit from superintelligence.

UNIT – I AI -Completeness

Introduction-Theory of AI-Completeness-First AI-Hard Problem-Beyond AI-compleness - Space of mind designs and human mental model: Infinitude of minds-size, complexity and properties of minds-space of mind designs-taxonomies-mind cloning.

UNIT – II Inventing Artificial Superintelligence

Motivation-Zero knowledge proof-CAPTCHA-AI-Completeness-Super CAPTCHA - Mental Illness in machines: Wireheading in Machines: Sensory Illusions-potential solutions to wire heading-perverse instantiation.

UNIT – III Forms of Superintelligence

Speed superintelligence - collective superintelligence - quality superintelligence-direct and indirect reach-sources of advantage of digital intelligence. Limits of self-improving artificially intelligent systems: Taxonomy of types of self-improvement-limits of self-improving artificially intelligent systems-analysis-RSI convergence theorem.

UNIT – IV Singularity Paradox

Singularity Paradox (SP) - Methods of SP: Prevention and development-restricted deployment-incorporation into society-self monitoring-indirect solutions-analysis-future research directions. Superintelligence safety engineering: Ethics and intelligent systems-AI safety engineering-grand challenge-artificial general intelligence research is unethical-robot rights.

UNIT – V AI Confinement Problem

AI Confinement problem-hazardous software-critique of the confinement approach-possible escape paths-critique of the AI - boxing critique - counter measures against escape-AI communication security-safety communicating with superintelligence - Unifying theory of information, computation and intelligence: Efficiency theory-Information and knowledge-intelligence and computation-time and space-compressibility and randomness-oracles and undecidability-intractable and tractable.

TEXT BOOKS:

1. Roman V. Yampolskiy, Artificial Superintelligence: A Futuristic Approach, CRC Press, Taylor & Francis Group, 2016.
2. Nick Bostrom, Superintelligence: Paths, Dangers, Strategies, Oxford University Press, 2014.

REFERENCES:

1. Artem Kovera, How to create Machine Superintelligence, Second edition, copyright Artem Kovera, 2018.
2. Amit Ray, Compassionate Artificial Superintelligence AI 5.0 – AI with blockchain, BMI, Drone, IoT and biometric technologies, Inner Light Publishers, 2018.
3. Peter J. Scott, Crisis of Control: How Artificial Super intelligences may destroy or save the human race, 2017.
4. Parag Kulkarni, Prachi Joshi, Artificial Intelligence – Building Intelligent Systems, PHI learning private Ltd, 2015.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the contribution of superintelligent machines in the theory of AI Completeness
2. Develop a superintelligent system without having to reveal the system itself.
3. Understand various forms of superintelligences and their limits.
4. Study the methods of Singularity Paradox.
5. Build intelligent systems for security safety.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	-	-	-	-	-	-		-	-	1
CO2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-
CO4	2	1	-	-	-	-	-	-	-	-	-	-
CO5	2	1	-	-	1	-	-	-	-	-	-	-

AIPESCN	**AI – CHALLENGES AND STRATEGIES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To provide both background and a motivation for the AI theory and applications.
- Introduces the concepts of Machine Learning and Data Science.
- To impart knowledge about recent trends on Blockchain Technology.
- Introduces the basics of Natural Language Processing and Robotics.

UNIT - I Introduction

AI History and Applications - The Propositional Calculus - The Predicate Calculus - Using Inference Rules to Produce Predicate Calculus Expressions - Graph Theory - Strategies for State Space Search - Using the State Space to Represent Reasoning with the Predicate Calculus.

UNIT – II Machine Learning

A Framework for Symbol-based Learning - Version Space Search - The ID3 Decision Tree Induction Algorithm - Inductive Bias and Learnability - Competitive Learning - Hebbian Coincidence Learning - Stochastic and Dynamic Models of Learning - Hidden Markov Models (HMMs) - Dynamic Bayesian Networks and Learning - Stochastic Extensions to Reinforcement Learning.

UNIT – III Data Science

Big Data and Data Science Hype – Datafication - Data Scientist - Current Landscape of Perspectives - Statistical Inference - Populations and Samples - Statistical Modeling - Probability Distributions - Modeling - Exploratory Data Analysis - Philosophy- Data Science Process - Algorithms: Linear Regression - k-NN - k-means - Spam Filters - Naive Bayes - Wrangling - Logistic Regression: Classifiers - M6D Logistic Regression.

UNIT – IV Block Chain

Currency – Contracts - Justice Applications Beyond Currency, Economics, and Markets - Efficiency and Coordination Applications Beyond Currency, Economics, and Markets - Advanced Concepts – Limitations.

UNIT – V Natural Language Processing & Robotics

Introduction to NLP - Text Analysis - Language Models - Vectorizing Text and Transformations and n-grams - Clustering and Classifying Text - Similarity Queries and Summarization.

History of Robotics – Types of Robots – Robot Mechanics – Robot Electronic Design – Robotic Sensors – Vision Systems.

TEXT BOOKS:

1. Rachel Schutt and Cathy O'Neil, Doing Data Science, Straight Talk From The Frontline, O'Reilly Media, 2013.
2. George F Luger, Artificial Intelligence - Structures and Strategies for Complex Problem Solving, Pearson Education, Inc., 2009.

REFERENCES:

1. Bhargav Srinivasa-Desikan, Natural Language Processing and Computational Linguistics, Packt Publishing, 2018.
2. Z. Falomir, K. Gibert, E. Plaza, Artificial Intelligence Research and Development: Current Challenges, New Trends and Applications, IOS Press, 2018.
3. Melanie Swan, Blockchain: Blueprint for a New Economy, O'Reilly Media, Inc., 2015.
4. Harry H. Poole, Fundamentals of Robotics Engineering, Springer Science & Business Media, 2012.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the core concepts and applications of Artificial Intelligence.
2. Handle real world problem in Machine Learning Techniques.
3. Implement the technology of Block Chain.
4. Apply the techniques in Natural Language Processing.
5. Acquire sufficient knowledge on Robotics.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	1	-	-	-	-	-		-	-	-
CO2	3	-	1	-	-	-	-	-	-	-	-	-
CO3	3	1	1	-	-	-	-	-	-	-	-	-
CO4	3	1	1	-	-	-	-	-	-	-	-	-
CO5	3	1	1	-	1	-	-	-	-	-	-	-

AIPESCN	**DEDUCTIVE AND INDUCTIVE REASONING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To study the basic concepts in reasoning.
- To acquire knowledge in deductive reasoning.
- To evaluate inductive generalizations.
- To learn the fallacies of inductive reasoning.

UNIT – I Introduction

Logic - Inferences and Arguments - Classification: Concepts and Referents, Rules of Classification, Levels of Organization - Definitions: Functions of a Definition, Rules for Definitions, Constructing Definitions - Propositions - Statements versus Propositions - Argument Analysis - Fallacies - Induction, Deduction, and Argument Strength in Human Reasoning.

UNIT – II Deductive Reasoning

Reasoning: Modus Ponens, Modus Tollens, law of syllogism - Square of Opposition - Existential Import - Venn Diagrams - Immediate Inference: Conversion, Obversion, Contraposition - Propositional Logic - Proof : Rules of inference, Constructing a Proof - Equivalence: Rules of Equivalence, Predicate Logic: Singular and Quantified Statements, Categorical Statements, Quantifier Scope and Statement Forms.

UNIT – III Reasoning with Syllogisms

Categorical Propositions - Categorical Syllogisms - Disjunctive Syllogisms - Hypothetical Syllogisms - Distilling Deductive Arguments: Identifying the Form of a Syllogism, Nonstandard Quantifiers - Extended Arguments: Categorical and Hypothetical Syllogisms in Extended Arguments, Compound Components, Distilling an Extended Argument.

UNIT – IV Inductive Reasoning

Development of Inductive Reasoning - Inductive Generalizations - Evaluating Inductive Generalizations - Argument by Analogy - Statistical Reasoning: Logic and Statistics, Using Statistics in Argument, Statistical Evidence of Causality - Casual Arguments - Adequacy of Hypotheses, Truth of Hypotheses - Probability: Probability Measures, Probability Calculus.

UNIT – V Fallacies of Inductive Reasoning

Fallacies of Generalization – Fallacies of Non-observation – False Analogy –Interpreting Asymmetries of Projection in Children's Inductive Reasoning - Use of Single or Multiple Categories in Category based Induction – Abductive Inference from Philosophical Analysis to Neural Mechanisms.

TEXT BOOKS:

1. Carveth Read, Logic Deductive and Inductive, Createspace, 2016.
2. David Kelley, The Art of Reasoning: An Introduction to Logic and Critical Thinking, 4th Edition, W. W. Norton & Company, 2014.

REFERENCES:

1. Ruth M.J. Byrne, Jonathan St.B.T. Evans, Stephen E. Newstead, Human Reasoning: The Psychology of Deduction, Psychology Press, 2019.
2. Dr. Treat Preston, How To Figure Things Out: Inductive Reasoning versus Deductive Reasoning, Ceatespace, 2014.
3. William Minto, Logic: Inductive and Deductive, Pantianos Classics, 2010.
4. Walter Schaeken, Gino De Vooght, Andre Vandierendonck, Gery d'Ydewalle, Deductive Reasoning and Strategies, Lawrence Erlbaum Associates, 2000.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Gain basic knowledge in deduction and induction.
2. Apply deductive reasoning techniques in real world problems.
3. Use different types of syllogisms for reasoning.
4. Develop reasoning skills using statistics and probability.
5. Use single or multiple categories in inductive reasoning.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	-	-	-	-	-	-	-	-	-
CO3	2	-	1	-	2	-	-	-	-	-	-	-
CO4	1	-	-	-	-	-	-	-	-	-	-	-
CO5	1	1	1	1	-	-	-	-	-	-	-	-

OPEN ELECTIVES

AIOESCN	ARTIFICIAL INTELLIGENCE AND KNOWLEDGE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To expose students to the basic concepts and problem solving process in AI.
- To evaluate uninformed and informed search techniques.
- To represent knowledge and to make decisions.
- To develop AI applications.

UNIT – I Introduction to AI

Introduction - History of AI - AI Techniques - Problem Solving with AI - AI models - Data Acquisition and Learning Aspects in AI - Problem Solving Process - Formulating Problems - Problem Types and Characteristics - Problem Analysis and Representation - Performance Measuring - Problem Space and Search - Toy problems – Real world problems - Problem Reduction Methods.

UNIT – II Heuristic Search Techniques

General Search Algorithm - Uninformed Search Methods: Breadth First Search, Uniform Cost Search, Depth First Search, Depth Limited Search, Iterative Deepening - Informed Search: Generate and Test, Best First Search, A* Search, Memory Bounded Heuristic Search - Local Search Algorithms and Optimization Problems - Hill Climbing and Stimulated Annealing - Intelligent Agents: Agents and Environment, Agent Function, Representation, Types.

UNIT – III Knowledge Representation

Knowledge Management - Types of Knowledge - Approaches and issues of Knowledge Representation - Knowledge representation using Predicate logic: Basic Predicate Representations, Conversion of WFF to Clause Form, Resolution, Issues with Resolution - Knowledge representation using other logic - Structured representation of knowledge, Semantic Networks, Frames.

UNIT – IV Uncertain Knowledge and Reasoning

Uncertainty and Methods - Bayesian Probability and Belief Network - Probabilistic Reasoning - Probabilistic Reasoning over time - Forward and Backward Reasoning - Perceptron - Making Simple Decisions - Making Complex Decisions - Other Techniques: Non_monotonic Reasoning, Fuzzy Logic, Ontological Engineering, Dempster_Shafer Theory.

UNIT – V Advanced Topics

Game Playing: Minimax search procedure, Adding alpha-beta cutoffs - Expert System: Architecture-Knowledge acquisition, Rule based Expert System, Frame based and Fuzzy based expert system - Robotics: Hardware, Robotic Perception, Planning, Application domains - Future Trends in Knowledge Engineering: Tactical and Strategic Considerations, Anticipation Technologies, Beyond the Information Age.

TEXT BOOKS:

1. Parag Kulkarni, Prachi Joshi, Artificial Intelligence – Building Intelligent Systems, PHI learning private Ltd, 2015.
2. Vinod Chandra S.S., Anand Hareendran S, Artificial Intelligence and Machine Learning, 2014.

REFERENCES:

1. Thomas B. Cross, Knowledge Engineering: The Uses of Artificial Intelligence in Business, 2017.
2. Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum, Knowledge Engineering: Building Cognitive Assistants for Evidence-based Reasoning, Cambridge University Press, 2016.
3. H. Elaine Rich, Kevin Knight, Shivashankar B Nair, Artificial Intelligence, Mc Graw Hill, 2009.
4. S.L. Kendal, M. Creen, An Introduction to Knowledge Engineering, Springer, 2007.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Identify problem types and appropriate AI methods to solve a problem.
2. Analyze various search strategies.
3. Manage and represent knowledge.
4. Handle uncertain knowledge.
5. Apply AI techniques in the development of problem-solving and learning systems.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	-	-	-	-	-	-	-	-	-
CO3	2	1	1	-	2	-	-	-	-	-	-	-
CO4	1	1	1	-	-	-	-	-	-	-	-	-
CO5	1	1	1	1	-	-	-	-	-	-	-	-

AIOESCN	**MACHINE LEARNING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To introduce the fundamental concepts of machine learning and its applications.
- To learn the classification, clustering and regression machine learning algorithms.
- To introduce the methods of combining the classifiers.
- To understand the methods of solving real life problems using the machine learning techniques.

UNIT – I Bayesian Decision Theory and Normal Densities

Machine perception - feature extraction - classification, clustering and regression - design cycle - types of learning. Bayesian decision theory - classifiers, discriminant functions, and decision surfaces - univariate and multivariate normal densities - Bayesian belief networks.

UNIT – II Component Analysis and Markov Model

Principal component analysis - Linear discriminant analysis. Markov model - Introduction to hidden Markov model.

UNIT – III Classification Algorithms

Perceptron and backpropagation neural network - radial basis function neural network - probabilistic neural network - k-nearest-neighbor rule. Support vector machine: Training - multicategory generalizations. Decision trees: classification and regression tree - random forest.

UNIT – IV Clustering and Regression Algorithms

k-means clustering - fuzzy k-means clustering - Gaussian mixture models - autoassociative neural network. Regression analysis - support vector regression.

UNIT – V Combining Multiple Learners

Generating diverse learners - model combination schemes - voting - error-correcting output codes - bagging - boosting - mixture of experts revisited - stacked generalization – fine - tuning an ensemble - cascading.

TEXT BOOKS:

1. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, Third Edition, 2014.
2. R. O. Duda, E. Hart, and D.G. Stork, Pattern classification, Second edition, John Wiley & Sons, Singapore, 2003.

REFERENCES:

1. Tom M. Mitchell, Machine Learning, 1st Edition, McGraw Hill Education, 2017.
2. M. Mohri, A. Rostamizadeh, and A. Talwalkar, Foundations of Machine Learning, MIT Press, 2012.
3. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
4. C. M. Bishop, Pattern Recogniti on and Machine Learning, Springer, 2006.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the basic concepts of machine learning.
2. Understand the classification, clustering and regression algorithms.
3. Implement the classification, clustering and regression algorithms.
4. Combine the evidence from two or more models/methods for designing a system.
5. Design and implement a method for solving real life problem using a suitable machine learning technique.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	1	1	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-
CO3	2	2	1	1	-	-	-	-	-	-	-	-
CO4	2	2	1	-	-	-	-	-	-	-	-	-
CO5	2	2	1	1	1	-	-	-	-	-	-	-

AIOESCN	**NATURAL LANGUAGE PROCESSING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To familiarize the students with the basic concepts of Natural Language Processing and Information Retrieval.
- To study the concepts related to the processing of words.
- To study the various level of analysis involved in Natural Language Processing.
- To gain knowledge on natural language generation and machine translation.

UNIT – I Introduction

Origin of Natural Language processing – Language and Knowledge– Processing Indian Languages – NLP applications–Introduction to language modelling – Various grammar-based Language Models – Statistical language model – Introduction to Information Retrieval-Information Retrieval Models.

UNIT – II Words

Regular expressions – Finite state Automata – Survey of English Morphology - Finite State Morphological parsing-Speech Sounds and Phonetic Transcription-Phoneme and Phonological Rules-Dealing with Spelling Errors-Spelling Error Patterns-Probabilistic Models-Ngram models of syntax – Counting words – Unsmoothed N-grams – Smoothing –Speech Recognition architecture – Hidden Markov models.

UNIT – III Syntax

English Word classes – Tagsets – Part of Speech Tagging – Transformation based tagging – Context free rules and trees – The noun phrase – Verb phrase – Finite state and context free grammars – Top down parsing – Bottom up parsing – Feature structures – Unification of Feature Structures-Feature Structure in the Grammer - Implementing Unification –Constraints – Probabilistic context free grammars – Probabilistic Lexicalized context free grammars .

UNIT – IV Semantic

Computational Desiderata of for Representations- Meaning Structure of Language-First order predicate calculus- Syntax Driven Semantic analysis – Attachments – Idioms and Compositionality – Relations among Lexemes and their Senses-WordNet-Internal Structure of Words.

UNIT – V Pragmatics

Introduction to Discourse Processing- Cohesion- Reference Resolution – Discourse Coherence and Structure- Introduction to Natural Language Generation – Architecture of NLG Systems-Generation tasks and Representations- Introduction to Machine Translation-Machine Translation Approaches.

TEXT BOOKS:

1. Samuel Burns, Natural Language Processing: A Quick Introduction to NLP with Python and NLTK, 1st Edition, 2019.
2. Yoav Goldberg, Graeme Hirst, Neural Network Methods for Natural Language Processing, Morgan and Claypool Life Sciences, 2017.

REFERENCES:

1. Daniel Jurafsky and James H Martin, Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Pearson Education, 6th Edition, 2011.
2. Nitin Indurkhya and Fred J. Damerau, Handbook of Natural Language Processing, 2nd edition, Chapman & Hall/Crc: Machine Learning & Pattern Recognition, CRC press, Feb 2010.
3. Tanveer Siddiqui, U.S. Tiwary, Natural Language Processing and Information Retrieval, Oxford University Press, 2008.
4. Ehud Reiter, Robert Dale, Building Natural Language Generation Systems, Cambridge University Press, 2006.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the basic concept of Natural Language Processing, NLP applications and Language modeling.
2. Understand the processing of words and algorithms used to process the words.
3. Understand the parts of speech and phrase structure grammars for English.
4. Understand the semantic analysis and internal structure of words.
5. Understand various methods of machine translation.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-
CO3	2	1	2	1	1	-	-	-	-	-	-	-
CO4	2	-	2	-	2	-	-	-	-	-	-	-
CO5	3	-	-	-	2	-	-	-	-	-	-	-

AIOESCN	**EXPERT SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the basic concepts of Expert systems.
- To gain knowledge in both theory and applications.
- To integrate theory with real-world situations.
- To appreciate the role played by expert systems in today's world.

UNIT – I Introduction

Expert Systems: Features of Expert systems-ES Building. Real Experts-Keep human in loop. Organization of ES: Organizing knowledge-Representing knowledge-Expert systems vs conventional programs: Characteristics of ES-Activities of ES-Types of problems that ES solve

UNIT – II Expert System Tools

Knowledge Representation in Expert Systems: Using rules-using semantic nets-using frames. Nature of expert system tools: Programming languages-knowledge engineering languages-system building aids-support facilities. ES building process. Stages in the development of ES Tools.

UNIT – III Building an Expert System

Expert system for a problem: ES development-possible, justified, appropriate. Building ES: Tasks-Stages. Choosing tools-Acquiring knowledge from Experts-knowledge acquisition process-interviewing the expert.

UNIT – IV Difficulties with ES Development

Difficulties in developing an ES: Lack of resources-Limitations-Long time. Common Pitfalls in planning an ES: Choosing problem-Resources for building an ES-choosing the ES tool. Dealing with Domain Expert: Choosing domain expert-interacting with expert. ES Development Process: Implementation-Testing and Evaluation.

UNIT – V Expert systems in Marketplace

ES at Universities-Research organizations-knowledge engineering companies. High performance Expert Systems used in Research-Business-Computer Systems-Expert systems to Intelligent systems.

TEXT BOOKS:

1. Patterson, Introduction to Artificial Intelligence and Expert Systems, Pearson Education India, 2015.
2. Spyros Tzafestas, Expert Systems in Engineering Applications, Springer, 2011.

REFERENCES:

1. Donald. A. Waterman, A Guide To Expert Systems, 3rd Edition, Pearson Education, 2009.
2. J. Giarratano and G. Riley, Expert Systems -- Principles and Programming, 4th Edition, PWS Publishing Company, 2004.
3. Peter Jackson, Introduction to Expert Systems, Addison Wesley Longman, 1999.
4. Nikolopoulos, Expert Systems, Marcel Dekker Inc. 1997.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the features and characteristics of Expert systems.
2. Be acquainted with various tools and the development process of Expert systems.
3. Be familiar in building an Expert system.
4. Demonstrate awareness in the Expert system development.
5. Exhibit knowledge in the role of Expert system in various applications.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-
CO3	2	1	2	1	1	-	-	-	-	-	-	-
CO4	2	-	2	-	2	-	-	-	-	-	-	-
CO5	3	-	-	-	2	-	-	-	-	-	-	-

AIOESCN	**COMPUTER VISION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the basic concepts of computer vision and segmentation.
- To gain knowledge in foundation of image formation and image analysis.
- To understand the Basic concepts of Recognition.
- To learn the various concepts of Computer Vision in other application areas.

UNIT – I Introduction

Image formation - Geometric primitives and transformations - Geometric primitives - 2D transformations - 3D transformations - 3D rotations - 3D to 2D projections - Lens distortions – Photometric image formation - Lighting - Reflectance and shading – Optics - The digital camera - Sampling and aliasing – Color – Compression.

UNIT – II Feature Detection and Matching

Points and patches - Feature detectors - Feature descriptors - Feature matching - Feature tracking - Application: Performance driven animation - Edges - Edge detection - Edge linking - Application: Edge editing and enhancement – Lines - Successive approximation - Hough transforms - Vanishing points - Application: Rectangle detection.

UNIT – III Segmentation

Active contours - Snakes - Dynamic snakes and CONDENSATION – Scissors - Level Sets - Application: Contour tracking and rotoscoping – Split and merge - Watershed - Region splitting - Region merging - Graph-based segmentation - Probabilistic aggregation – Mean shift and mode finding - K-means and mixtures of Gaussians - Mean shift – Normalized cuts - Graph cuts and energy-based methods - Application: Medical image segmentation.

UNIT – IV Structure from Motion

Triangulation - Two-frame structure from motion – Factorization - Bundle adjustment - Constrained structure and motion. Dense motion estimation - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.

UNIT – V Image Stitching and Recognition

Motion models - Global alignment – Compositing - Recognition - Object detection - Face detection - Pedestrian detection - Face recognition – Eigenfaces - Active appearance and 3D shape models - Instance recognition - Geometric alignment - Large databases - Category recognition - Bag of words - Part-based models - Recognition with segmentation - Context and scene understanding - Learning and large image collections - Recognition databases and test sets.

TEXT BOOKS:

1. Forsyth, A., D. and Ponce, J., Computer Vision: A Modern Approach, Pearson Education, 2nd Edition, 2012.
2. Szeliski, R., Computer Vision: Algorithms and Applications, Springer-Verlag London Limited, 1st Edition, 2011.

REFERENCES:

1. Gonzalez C. R., and Woods E. R., Digital Image Processing, Addison-Wesley, 4th Edition, 2018.
2. Hartley, R. and Zisserman, A., Multiple View Geometry in Computer Vision, Cambridge University Press, 2nd Edition, 2003.
3. Fukunaga, K., Introduction to Statistical Pattern Recognition, Academic Press, Morgan Kaufmann, 2nd Edition, 1990.
4. Trucco and Verri, Introductory Techniques for 3D Computer Vision, Prentice Hall, 1998.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the fundamental problems of computer vision.
2. Implement various techniques and algorithms used in computer vision.
3. Acquire knowledge and understanding of Feature detection and matching.
4. Demonstrate awareness of the current key research issues in computer vision.
5. Exhibit knowledge in Image stitching and Recognition.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	-	1	-	-	-	-	-	-	2
CO2	2	2	1	-	1	-	-	-	-	-	-	-
CO3	-	2	-	-	-	1	-	-	-	-	-	-
CO4	-	1	-	-	1	2	-	-	-	-	-	-
CO5	2	2	-	-	1	-	-	-	-	-	-	2

AIOESCN	**ROBOTICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To enlighten the students about the fundamentals of robotic systems.
- To impart basic knowledge of Robots and its roles in Automation.
- Ability to understand the features and operation of automation products.
- Ability to understand ethical and professional responsibilities.

UNIT - I Introduction

Classification of Robots-Industrial Robots- Autonomous Mobile -Humanoid Robots - Educational Robots-The Generic -Differential Drive-Proximity -Ground -Embedded -The Algorithmic Formalism-Sensors: Classification of Sensors-Distance Sensors-Cameras and onther sensors-Range, Resolution, Precision, Accuracy- Nonlinearity.

UNIT – II Reactive Behavior

Braitenberg Vehicles- Reacting to the Detection of an Object- Reacting and Turning- Line Following-Braitenberg's Presentation of the Vehicles- Finite State Machines: State Machines- Reactive Behavior with State- Search and Approach- Implementation of Finite State Machines.

UNIT – III Robotic Motion and Odometry

Distance, Velocity and Time- Acceleration as Change in Velocity- From Segments to Continuous Motion- Navigation by Odometry- Linear Odometry- Odometry with Turns- Errors in Odometry- Wheel Encoders- Inertial Navigation Systems- Degrees of Freedom and Numbers of Actuators- The Relative Number of Actuators and DOF.

UNIT – IV Control

Control Models- On-Off Control- Proportional (P) Controller- Proportional-Integral (PI) Controller- Proportional-Integral-Derivative (PID) Controller- Local Navigation: Obstacle Avoidance- Wall Following- Wall Following with Direction- The Pledge Algorithm- Following a Line with a Code- Ants Searching for a Food Source- A Probabilistic Model of the Ants' Behavior- A Finite State Machine for the Path Finding Algorithm.

UNIT – V Localization

Determining Position from Objects whose Position is Known - Global Positioning System- Probabilistic Localization- Uncertainty in Motion- Fuzzy Logic Control: Fuzzify- Apply Rules- Defuzzify- Image Processing: Obtaining Images- Image Enhancement- Edge Detection- corner detection-Recognizing Blobs.

TEXT BOOKS:

1. Mordechai Ben-Ari, Francesco Mondada, Elements of Robotics, Springer, 2018.
2. Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, Technology programming and Applications, McGraw Hill, 2012.

REFERENCES:

1. S.R. Deb, Sankha Deb, Robotics Technology and Flexible Automation, 2nd edition, Tata McGraw Hill Education, 2010.
2. Richard D. Klafter, Thomas .A, Chri Elewski, Michael Negin, Robotics Engineering an Integrated approach, Phi Learning., 2009.
3. Carl D. Crane and Joseph Duffy, Kinematic Analysis of Robot manipulators, Cambridge University press, 2008.
4. Bharat Bhushan., Springer Handbook of Nanotechnology, Springer, 2004.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Know the basics of robot.
2. Understand the reactive behavior of robotics.
3. Get an idea about robot motion and sensors.
4. Develop path finding algorithms to control the motion of robot.
5. Apply fuzzy logic in robotic systems.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	2	-	-	-	-	-	-	-	-
CO3	2	1	-	2	1	-	-	-	-	-	-	-
CO4	1	-	-	2	-	-	-	-	-	-	-	-
CO5	-	-	-	-	2	-	-	-	-	-	-	-

AIOESCN	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of Internet of Things.
- To gain knowledge on IoT Architecture and Data Analytics for IoT.
- To build a small low cost embedded system using Raspberry Pi and Arduino.
- To apply the concept of Internet of Things in the real world scenario.

UNIT - I Introduction

Introduction to IoT– Characteristics –Various Things in IoT – IoT Protocols – IoT Functional Blocks – IoT Communication Models – IoT Communication APIs – Enabling technologies – IoT Levels – Domain Specific IoTs – IoT and M2M.

UNIT – II Design Methodology

Need for IoT Systems Management – Simple Network Management Protocol and its Limitations – Network Operator Requirements – NETCONF – YANG – IoT Systems Management with NETCONF-YANG – IoT Design Methodology – IoT System for Weather Monitoring – Logical Design of IoT System using Python – Python Packages for IoT.

UNIT – III Data Analytics for IoT

Apache Hadoop – MapReduce Programming Model – Hadoop MapReduce Job Execution – MapReduce Job Execution Workflow – Hadoop Cluster Setup – Hadoop YARN for Batch Data Analysis – Setting up Oozie – Oozie Workflows for IoT Data Analysis – Apache Spark – Setting up a Storm Cluster – Apache Storm for Real-time Data Analysis.

UNIT –IV Raspberry Pi & Arduino

Physical device – Linux on Raspberry Pi – Raspberry Pi Interfaces – Programming: Controlling LED with Raspberry Pi – Interfacing an LED and Switch with Raspberry Pi – Interfacing a Light Sensor (LDR) with Raspberry P – Other IoT Devices – Intel Galileo Gen2 with Arduino – Interfaces – Arduino IDE – Programming – APIs and Hacks.

UNIT – V Tools and Applications

Chef – Puppet – IoT Code Generator – Various Real time applications of IoT: Home Automation – Smart Parking – Air Pollution Monitoring – Forest Fire Detection – Smart Irrigation – Connecting IoT to cloud – Cloud Storage for IoT – IoT Printer.

TEXT BOOKS:

1. Arshdeep Bahga, Vijay Madisetti, Internet of Things – A hands-on approach, Universities Press, 2015.
2. Manoel Carlos Ramon, Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers, Apress, 2014.

REFERENCES:

1. Qusay F. Hassan, Internet of Things A to Z: Technologies and Applications, John Wiley & Sons, 2018.
2. Peter Waher, Learning Internet of Things, Packt Publishing, 2015.

3. Marco Schwartz, Internet of Things with the Arduino Yun, Packt Publishing, 2014.
4. Francis daCosta, Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, 1st Edition, Apress Publications, 2014.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Expertise with IoT Architecture.
2. Do Data Analytics for IoT in Industrial Environment.
3. Design IoT devices using Rasperry Pi and Arduino.
4. Develop web services to access/control IoT devices.
5. Analyze applications of IoT in real time scenario.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	2	-	-	-	-	-	-	-	-
CO3	2	1	1	2	1	-	-	-	-	-	-	-
CO4	1	1	-	2	-	-	-	-	-	-	-	-
CO5	1	1	-	-	2	-	-	-	-	-	-	-

AIOESCN	**BIG DATA ANALYTICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To train students to use Big data analytics, applications and Map reducing Algorithms.
- To learn tips and tricks for Big Data use cases and solutions.
- To build and maintain reliable, scalable, distributed systems with Apache Hadoop.
- To get knowledge about Hive Architecture and Installation.

UNIT I – Introduction to Big Data

Introduction – distributed file system – Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications. Algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce.

UNIT II – Introduction to Hadoop

Big Data – Apache Hadoop & Hadoop EcoSystem – Moving Data in and out of Hadoop – Understanding inputs and outputs of MapReduce - Data Serialization.

UNIT – III Hadoop Architecture

Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands , Anatomy of File Write and Read., NameNode, Secondary NameNode, and DataNode, Hadoop MapReduce paradigm, Map

and Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering –Monitoring & Maintenance.

UNIT – IV Hadoop Ecosystem and Yarn

Hadoop ecosystem components - Schedulers - Fair and Capacity, Hadoop 2.0 New Features NameNode, High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN.

UNIT – V Hive and HiveQL, HBase

Hive Architecture and Installation, Comparison with Traditional Database, HiveQL – Querying Data - Sorting And Aggregating, Map Reduce Scripts, Joins & Subqueries, HBase concepts Advanced Usage, Schema Design, Advance Indexing - PIG, Zookeeper - how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper.

TEXT BOOKS:

1. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, Professional Hadoop Solutions, Wiley, 2015.
2. Chris Eaton, Dirk deroos et al. Understanding Big data, McGraw Hill, 2012.

REFERENCES:

1. Tom Plunkett, Brian Macdonald et al, Oracle Big Data Handbook, Oracle Press, 2014.
2. Vignesh Prajapati, Big Data Analytics with R and Haoop, Packet Publishing 2013.
3. Jy Liebowitz, Big Data and Business analytics, CRC press, 2013.
4. Tom White, HADOOP: The definitive Guide, O Reilly 2012.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Gain knowledge in map reduce algorithm.
2. Acquire knowledge and understanding of Hadoop Data Serialization.
3. Exhibit the knowledge in Hadoop architecture and storage**.**
4. Understand the Hadoop ecosystem and yarn.
5. Acquire Knowledge in Hive, Pig and Zookeeper.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	-	-	-	-	-	-	-	-	-
CO3	2	-	1	-	2	-	-	-	-	-	-	-
CO4	1	-	-	-	-	-	-	-	-	-	-	-
CO5	1	1	1	1	-	-	-	-	-	-	-	-

AIOESCN	MINING MASSIVE DATASETS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the design of good MapReduce algorithms and parallel algorithm.
- To explore the notions of similarity in finding similar items of sets.
- To understand the fundamental problem of maintaining of Data Stream.
- To establish the problem of finding frequent Itemsets differs from the similarity search.

UNIT – I Data Mining and MapReduce

Introduction to Data Mining – Statistical Limits on Data Mining - MapReduce : Distributed File Systems - Details of MapReduce Execution - Algorithms Using MapReduce - Extensions to MapReduce - Communication Cost Model - Complexity Theory for MapReduce - Applications of Near-Neighbor Search - Distance Measures - LSH Families for Other Distance Measures

UNIT –II Finding Similar Items and Mining Data Streams

Applications of Near-Neighbor Search - Shingling of Documents - Similarity-Preserving Summaries of Sets - Locality-Sensitive Hashing for Documents - Distance Measures - The Theory of Locality-Sensitive Functions - LSH Families for Other Distance Measures - Applications of Locality-Sensitive Hashing - Methods for High Degrees of Similarity - The Stream Data Model - Sampling Data in a Stream - Filtering Streams - Counting Distinct Elements in a Stream - Estimating Moments - Counting Ones in a Window - Decaying Windows.

UNIT – III Link Analysis and Frequent Itemsets

PageRank - Efficient Computation of PageRank - Topic-Sensitive PageRank - Link Spam - Hubs and Authorities - The Market-Basket Model - Market Baskets and the A-Priori Algorithm - Handling Larger Datasets in Main Memory - Limited-Pass Algorithms - Counting Frequent Items in a Stream.

UNIT – IV Clustering and Advertising on the Web

Introduction to Clustering Techniques - Clustering in Non-Euclidean Spaces - Clustering for Streams and Parallelism –. Issues in On-Line Advertising - On-Line Algorithms - The Matching Problem - The Adwords Problem - Adwords Implementation.

UNIT – V Recommendation Systems and Mining Social-Network Graphs

A Model for Recommendation Systems - Content-Based Recommendations - Collaborative Filtering - Dimensionality Reduction - The Netflix Challenge - Social Networks as Graphs - Clustering of Social-Network Graphs - Direct Discovery of Communities - Partitioning of Graphs - Finding Overlapping Communities – Simrank - Counting Triangles - Neighborhood Properties of Graphs.

TEXT BOOKS:

1. Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman, Mining of Massive Datasets, Cambridge University Press, 2014.
2. Nina Zumel, John Mount, Practical Data Science with R, Manning Publications, 2014.

REFERENCES:

1. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, Practical Data Science Cookbook, Packt Publishing Ltd., 2014.
2. W. N. Venables, D. M. Smith and the R Core Team, An Introduction to R, 2013.

3. Mark Gardener, Beginning R - The Statistical Programming Language, John Wiley & Sons, Inc., 2012.
4. Nathan Yau, Visualize This: The FlowingData Guide to Design, Visualization, and Statistics, Wiley, 2011.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the data-mining concepts and design of good MapReduce algorithms.
2. Describe a Similarity of data sets and Stream Data Model.
3. Recognize the PageRank and other approaches for detecting link spam.
4. Describe the concepts of Clustering in Non-Euclidean Spaces.
5. Determine an appropriate Clustering of Social-Network Graphs.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	-	-	-	-	-	-	-	-	-
CO3	2	1	1	-	2	-	-	-	-	-	-	-
CO4	1	1	-	-	-	-	-	-	-	-	-	-
CO5	1	1	1	1	-	-	-	-	-	-	-	-

AIOESCN	**DEEP GENERATIVE MODELS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the machine learning basics.
- To gain knowledge in deep learning architecture.
- To learn and understand the challenges in deep models and convolutional networks.
- To appreciate the role played by deep generative models.

UNIT - I Introduction

Machine learning basics: Learning algorithms-overfitting and underfitting-estimators, bias and variance-bayesian statistics-supervised learning algorithms-unsupervised learning algorithms-stochastic gradiant descent.

UNIT – II Deep Learning

Gradient based learning-hidden units-architecture design-back propagation algorithms. Parameter norm penalties-norm penalties-under constrained problems-dataset augmentation-noise robustness-semi supervised and multitask learning-early stopping-parameter tying and sharing-sparse representations-bagging and ensemble methods-dropout-adversarial training

UNIT – III Optimization for training deep models and convolutional networks

Learning vs optimization-challenges-basic algorithms-parameter initialization strategies-adaptive learning-second order methods-optimization strategies. Convolutiional networks: Convolution operation-motivation-pooling-convolution and pooling as an infinitely strong prior-variants of convolution function-structured outputs-data types-efficient convolution algorithms.

UNIT – IV Recurrent & recursive nets and Autoencoders

Recurrent neural networks-Bidirectional RNNs-Encoder decoder architecture-Deep RN-Recursive NN-long term dependencies. Autoencoders: Undercomplete, regularized autoencoders-representational power, layer size and depth-stochastic encoders and decoders-denoising autoencoders-learning manifolds-contractive autoencoders-predictive sparse decomposition.

UNIT – V Deep Generative Models

Boltzmann machines-Restricted Boltzmann machines-deep belief networks-deep Boltzmann machines-Boltzmann machines for real valued data-convolutional Boltzmann machines-Boltzmann machines for structured or sequential outputs-back propagation through random operations-directed generative nets-drawing samples from autoencoders-generative stochastic networks-evaluating generative models.

TEXT BOOKS:

1. David Foster, Generative Deep Learning, O'Reilly, 2019.
2. Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2016.

REFERENCES:

1. Sudharsan Ravichandiran, Hands-on Deep Learning Algorithms with Python, Packt Publishing, 2019.
2. Rajalingappa Shanmugamani, Deep Learning for Computer Vision, Packt Publishing, 2017.
3. K. P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
4. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the basics of machine learning.
2. Be acquainted with deep learning basics.
3. Be familiar with various techniques in Optimization for training deep models and convolutional networks.
4. Demonstrate knowledge in Recurrent & recursive nets and Autoencoders.
5. Exhibit knowledge in deep generative models.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	-	-	-	-	-	-	-	-	-
CO3	2	-	1	-	2	-	-	-	-	-	-	-
CO4	1	-	-	-	-	-	-	-	-	-	-	-
CO5	1	1	1	1	-	-	-	-	-	-	-	-

HONOURS SUBJECTS

AIHESCN	COMPUTATIONAL NEUROSCIENCE	L	T	P	C
		3	0	0	4

COURSE OBJECTIVES:

- To Learn about Single Neuron and Signaling Components in a neuron.
- To get the knowledge of Neuroanatomy and Neurobiology.
- To understand the basic of Neural Network Models and Reinforcement Learning Models.
- To get knowledge about Dendritic Processing, Axonal Propagation and Synaptic Transmission.

UNIT - I Introduction

History of neuroscience.- History of computational neuroscience - Linear algebra - Eigenvalues and eigenvectors for symmetric matrices - Quadratic forms, solving a system of linear equations (3 cases) - Dynamical systems - Types of fixed pts, bifurcation map in terms of trace and determinant - Phase plane analysis - null clines - Hopf bifurcation and limit cycles.

UNIT – II Organization of Nervous System and Neuroanatomy

Neuron – axons – Dendrites - The four components of Neural Signaling - Neurotransmission: Neurotrasmitter, Receptor, Ion channel, Channel gating - Electrophysiology - Nernst potential - Resting potential - Goldman-Hodgkin-Katz voltage equation - Outline of the Hodgkin-Huxley model - Modeling ion channel kinetics - Activation and inactivation gates - Complete formulation of Hodgkin-Huxley model - Relation between output firing and constant input current.

UNIT – III Biophysical Models of Single Neuron

Derivation of the cable equation - Defining axial - Radial resistance and membrane capacitance - Defining quantities in terms of per unit length - Steady state Solution for Infinite cable and semi-infinite cable - Solution for Finite cable: sealed end, killed end and arbitrary boundary conditions - Time-dependent solution for impulse input. Propagation delay, pseudo-velocity - Relation between cable diameter and conduction velocity - Branched cables and Rall's condition - Modeling synaptic transmission.

UNIT – IV Simplified Neuron Models and Learning Mechanisms

Fitzhugh-Nagumo neuron model - Phase-plane analysis, showing excitability - Bistability and oscillations - Integrate and fire neuron - Resonate and fire neuron - Izhikevich models - Classical conditioning and instrumental condition - Sensitization, habituation and priming -Cellular correlates of learning - Hebbian learning, Long-term Potentiation (LTP) and Long-term Depression (LTD) – Perceptron – MLP - Backpropagation algorithm - Case studies: Past tense learning, NetTalk, biological plausibility of backpropagation algorithm.

UNIT – V Unsupervised Learning, Hopfield Network and Hebbian Learning

Discrete model formulation - Lyapunov or Energy function - The concept of memory capacity - Continuous models of associative memory - bi-directional associative memory - Case study: memory storage in hippocampus - Competitive learning and Self-organizing map - Case studies: somatosensory map adaptation, auditory cortex of bats, orientation maps in mammalian visual cortex - Introduction to Hebbian learning - Hebbian learning and PCA - Variations of Hebbian learning - Linsker's model of the visual system - Reinforcement Learning - Spiking neuron networks.

TEXT BOOKS:

1. Paul Miller, Terrence J. Sejnowski, Tomaso A. Poggio, An introductory Course in Computational Neuroscience, 1st Edition, MIT Press, 2018.
2. Jianfeng Feng, Computational neuroscience: a comprehensive approach, Chapman & Hall/CRC, 2010.

REFERENCES:

1. Peter Dayan & LF Abbot, Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems, MIT Press, 2005.
2. Patricia Churcland & Terence Sejnowski, Computational Brain, MIT Press, 2017.
3. Randall C. O'Reilly, Yuko Munakata, Computational explorations in cognitive neuroscience: understanding the mind by Simulating the Brain, MIT Press, 2005.
4. Christof Koch, Biophysics of computation: information processing in single neurons, Oxford University Press, 2005.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Know about computational neuroscience Basics.
2. Understand nervous system and Neuroanatomy.
3. Study about Modeling synaptic transmission.
4. Develop Simple neuron models.
5. Understand the principles of Hopfield network and Hebbian Learning.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	2	-	-	-	-	-	-	-	-	-
CO2	2	1	1	2	-	-	-	-	-	-	-	-
CO3	2	1	1	1	2	-	-	-	-	-	-	-
CO4	1	1	1	-	-	-	-	-	-	-	-	1
CO5	1	1	1	1	-	-	-	-	-	-	-	-

AIHESCN	**ROBOT LEARNING AND SENSORIMOTOR CONTROL**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**4**

COURSE OBJECTIVES:

- To establish understanding of sensorimotor systems like humanoid robots/autonomous vehicles.
- To introduce various aspects involved in motor planning, control, estimation and prediction with an emphasis on computational perspective.
- To understand the approaches of planning under uncertainty, sensorimotor transformations.

- To make the students understand topics in human motor control, experimental paradigms and the use of computational methods in understanding biological sensorimotor mechanisms.

UNIT - I Introduction

Robotics-Components and structure of robots: Symbolic representation-degrees of freedom and workspace-classification of robots-common kinematic arrangements-robotic systems-accuracy and repeatability-wrists and end effectors.

UNIT - II Rigid Motions and Homogeneous Transformations

Representing positions-representing rotations-in plane-in 3D-rotational transformations-composition of rotations-current coordinate frame-fixed frame-parameterizations of rotations-Euler Angles-Roll, pitch, yaw angles-axis/angle representation-homogeneous transformations.

UNIT – III Computer Vision

Geometry of image formation-camera coordinate frame-perspective projection-image plane and the sensor array-camera caliberation-extrinsic camera parameters-intrinsic camera parameters-determining the camera parameters-segmentation and thresholding-connected components-position and orientation.

UNIT – IV Planning and Optimization

Path planning and collision avoidance: The configuration space-path planning using configuration space potential fields-planning using workspace potential fields-using random motions to escape local minima-probabilistic roadmap methods. Trajectory planning: Trajectories for point to point motion-tranjectories for paths specified via points.

UNIT – V Cue Integration and Sensorimotor Adaptation

Independent Joint Control: Actuator dynamics-set point tracking-Feedforward control and computed torque-drive train dynamics. Force Control: Constrained dynamics-static force/torque relationships - constraint surfaces-natural and artificial constraints-network models and impedance-force control strategies.

TEXT BOOKS:

1. Elements of Robotics, Mordechai Ben-Ari, Francesco Mondada, Springer, 2018.
2. Principles of robot motion: Theory, algorithms and implementations, Howie Choset, Kevin Lynch, seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki and Sebastian Thrun, MIT Press, 2005.

REFERENCES:

1. Human and robot hands: Sensorimotor synergies to bridge the gap between neuroscience and robotics, Bilanchi, Matteo, Moscatelli, Alessandro (Eds.) Springer series in Touch and Haptic systems, Springer, 2016.
2. Industrial Robotics: Technology programming and Applications, Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, McGraw Hill, 2012.
3. Kinematic Analysis of Robot manipulators, Carl D. Crane and Joseph Duffy Cambridge University press, 2008.
4. Robot dynamics and control, Mark W. Spong, Seth Hutchinson, M. Vidyasagar, Second edition, John Wiley & Sons, 2004.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the important concepts in robotics as applied to industrial robot manipulators.
2. Establish various coordinate systems related to robot kinematics.
3. Realize computer vision, the most powerful sensing modality that a robot used to interact with the environment.
4. Describe the path planning problem and to handle its computational complexity.
5. Apply the control techniques and methodologies to the control problem for robot manipulators.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	1	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-
CO3	2	2	1	-	-	-	-	-	-	-	-	-
CO4	2	2	1	-	-	-	-	-	-	-	-	-
CO5	2	2	1	1	1	-	-	-	-	-	-	-

AIHESCN	**HUMAN COMPUTER INTERACTION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

The students should be made to

- Learn the history of evolution of Human Computer Interaction.
- Study and design HCI experiments.
- Become familiar with various interaction models of HCI.
- Be skilled at searching and visualizing information.

UNIT – I Historical Context and Interaction Elements

Introduction - Memex – Sketchpad – Mouse - Xerox star - Birth of HCI -Growth of HCI and GUIs – Human factor : Sensors – Responders - The brain –Language - Human performance - Interaction Elements : Hard controls and soft controls – Control-display relationships - Natural versus learned relationships - Mental models and metaphor – Modes -Mobile context - Interaction errors.

UNIT – II Designing HCI Experiments

Ethics – Experiment design – Variables – independent, dependent, control, random, confounding - Task and procedure – Participants – Hypothesis testing : Analysis of variance – Chi-square test - Parametric tests - Non-parametric tests.

UNIT – III Interaction Models and Design Issues

Interaction models : Descriptive models - Predictive models - Design issues - Quality of Service : Introduction, Models of response, Time impacts, Expectations and attitudes, User productivity, Variability in response time, Frustrating experiences - Balancing function and fashion, Error messages, Design -Information search and Visualization : Searching in textual documents and Database querying, Multimedia document searches, Advanced filtering and search interfaces, Information visualization.

UNIT – IV Mobile Interfaces

Mobile ecosystem - Application frameworks - Types of mobile applications- Mobile information architecture - Mobile design – Elements - Mobile web Apps - Mobile 2.0 – Mobile web development- WebKit.

UNIT – V Web Interfaces

In-Page Editing - Drag and Drop - Direct selection - Contextual tools – Overlays - Inlays - Virtual pages - Process flow – Use transitions – Patterns.

TEXT BOOKS:

1. Kent L. Norman and Jurek Kirakowski, The Wiley Handbook of Human Computer Interaction Volume 1, John Wiley and Sons Ltd, 2018.
2. I. Scott Mackenzie, Human-Computer Interaction – An Empirical Research Perspective, Elsevier, 2013.

REFERENCES:

1. Alan Dix, Janet Finlay, Gregory D. Abowd and Russell Beale, Human Computer Interaction, Pearson Education, Third Edition, 2004.
2. Meena, K and Sivakumar, R, Human-Computer Interaction, PHI Learning, First Edition, 2014.
3. Gerard Jounghyun Kim, Human-Computer Interaction - Fundamentals and Practice, Auerbach Publications, First Edition, 2015.
4. Ben Shneiderman and Catherine Plaisant, Designing the User Interface: Strategies for Effective Human-Computer Interaction, Addison-Wesley, 2010.

COURSE OUTCOMES:

Upon completion of the course, the students should be able to

1. Realize the evolution and importance of HCI.
2. Design effective experiments for HCI.
3. Learn and employ different models of interaction and understand design issues of HCI.
4. Develop mobile interfaces.
5. Implement web interfaces.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	1	1	-	1	-	-	-	-	-	-	-	-
CO3	2	1	1	1	-	-	-	-	-	-	-	2
CO4	1	1	1	-	2	-	-	-	-	-	-	-
CO5	1	1	-	-	-	-	-	-	-	-	-	-

AIHESCN	**ENTERPRISE DEEP LEARNING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To get knowledge about Machine learning, Deep learning and AI.
- To Understand the knowledge of Neural network, Convolution networks and RNN.
- To know the various Deep Generative models.
- To learn about the concept of Recommendation engines in business and various Deep learning business application.

UNIT - I Introduction

Introduction to Machine learning, Deep learning and AI – Historical trends in Deep learning – Significance of Deep learning – Learning algorithms – Supervised, Unsupervised and semi-supervised learning algorithms – Stochastic Gradient descent – building a machine learning algorithm – challenges motivating Deep learning – Deep learning drives AI.

UNIT – II Deep Learning and Neural Networks

Perceptrons –Single-layer and Multi-layer Perceptron – Cross-entropy loss functions for Neural net – Matrix representation of Neural nets – Convolutional networks – variants of the basic convolution function – efficient convolution algorithms – Recurrent Neural networks – Bidirectional RNNs – Deep recurrent networks – recursive neural networks – The Long short-term memory and other gated RNNs.

UNIT – III Deep Generative Models

Boltzmann machines – Deep belief networks – Convolutional Boltzmann machines – Boltzmann machines for structured or sequential outputs – Back-propagation through random operations – Directed generative nets – Generative stochastic networks – other generation schemes – evaluating generative models

UNIT – IV Deep Learning: Business Application

Games and Art– Anomaly detection and fraud – security and prevention – Forecasting – Medicine and Biomedical – applications of Deep learning in business – Business use case example.

UNIT – V Recommendation Engines

Introduction – Recommendation system techniques – content-based recommendation – collaborative recommendation – Hybrid approaches – Applications of recommendation engines in business – Applications of NLP in business – employing AI in business – embedding AI into business processes.

TEXT BOOKS:

1. RajendraAkerkar, Artificial Intelligence for Business, Springer briefs in business, 2019.
2. Ian Goodfellow, YoshuaBengio and Aaron Courville, Deep Learning: Adaptive Computation and Machine Learning, The MIT Press, Cambridge, London, England, 2016.

REFERENCES:

1. EugeneCharniak, Introduction to Deep Learning, The MIT Press, 2019.
2. Armando Vieira and BernardeteRibeiro, Introduction to Deep Learning Business applications for Developers, Apress publication, 2018.
3. Sandro Skansi, Introduction to Deep Learning: From Logical Calculus to Artificial Intelligence, 1st Edition, Springer, 2018.
4. Josh Patterson and Adam Gibson, Deep Learning: A Practioners Approach, 2017.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Gain knowledge in Machine learning, Deep learning and AI.
2. Acquire knowledge and understanding neural network, Convolution network and RNN.
3. Exhibit the knowledge in Deep Generative models**.**
4. Analyze the various Deep learning business applications.
5. Knowledge in Recommendation engines and employing AI in business.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	2	-	-	-	-	-	-	-	-	-	-
CO2	1	2	-	1	-	-	-	-	-	-	-	-
CO3	2	2	1	1	-	-	-	-	-	-	-	2
CO4	1	1	1	-	2	-	-	-	-	-	-	-
CO5	1	1	-	-	-	-	-	-	-	-	-	-

AIHESCN	**STOCHASTIC PROCESS AND QUEUEING THEORY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To understand the basic concepts of random processes which are widely used in IT fields.
- To understand the concept of queueing models and apply in engineering.
- To understand the significance of advanced queueing models.
- To provide the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering.

UNIT – I Random Processes
Classification – Stationary process – Markov process – Poisson process – Random telegraph process.

UNIT – II Correlation and Spectral Densities
Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties.

UNIT – III Linear Systems with Random Inputs
Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and Cross correlation functions of input and output.

UNIT – IV Queueing Models
Markovian queues – Birth and death processes – Single and multiple server queueing models –Little's formula – Queues with finite waiting rooms – Queues with impatient customers : Balkingand reneging.

UNIT – V Advanced Queueing Models
Finite source models – M/G/1 queue – Pollaczek Khinchin formula – M/D/1 and M/EK/1 as special cases – Series queues – Open Jackson networks.

TEXTBOOKS:

1. Moorthy,M.B.K., Subramani,K and Santha.A., Probability and Random Processes, Sci tech Publications(India) Pvt. Ltd 7th Edition , 2015.
2. Gross, D., Shortle, J.F, Thompson, J.M and Harris. C.M., Fundamentals of Queueing Theory, Wiley Student 4th Edition, 2014.

REFERENCES:

1. U. Narayan Bhat, An Introduction to Queueing Theory: Modeling and Analysis in Applications, Birkhauser, 2015.
2. Robert G. Gallager, Stochastic Processes: Theory for Applications, Cambridge University, 2013.
3. Medhi, J., Stochastic Models in Queuing Theory, Academic press, second Edition, 2003.
4. Trivedi, K.S., Probability and Statistics with Reliability, Queuing and Computer Science Applications, 2nd Edition, John Wiley and Sons, 2002.

COURSE OUTCOMES:

1. Upon successful completion of the course, students should be able to:
2. Apply the concept of random processes in engineering disciplines.
3. Understand the tool to represent signals i.e. noise.
4. Acquire the right methodology to quantify the randomness associated with the image processing and neural networks.
5. Acquire skills in analyzing queueing models.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-
CO3	1	2	2	2	-	-	-	-	-	-	-	-
CO4	2	1	1	1	3	-	-	-	-	-	-	-
CO5	2	2	3	3	-	-	-	-	-	-	-	-

AIHESCN	**CNN FOR VISUAL RECOGNITION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To gain basic knowledge of deep learning principles.
- To understand CNNs, their fundamental processes and their applications.
- To recognize, identify and understand visual information from single image or video sequence.
- To explore CNN for visual recognition.

UNIT – I Machine Learning for Computer Vision

A brief history of computer vision- Challenges in Computer Vision - Machine Learning for Vision- Machine Learning Basics - Learning Algorithms - Capacity, Overfitting and Underfitting- Hyperparameters and Validation - Estimators, Bias and Variance - Maximum Likelihood Estimation - Bayesian Statistics - Supervised Learning Algorithms - Unsupervised Learning Algorithms - Stochastic Gradient Descent - Building a Machine Learning Algorithm - Challenges Motivating Deep Learning.

UNIT – II Deep Learning and Convolutional Networks

Deep Feedforward Networks -Example: Learning XOR - - Gradient-Based Learning - Hidden Units Architecture Design Back-Propagation and Other Differentiation Algorithms Convolutional Networks - The Convolution Operation -Motivation - Pooling -Convolution and Pooling as an Infinitely Strong Prior -Variants of the Basic Convolution Function -Structured Outputs-Data Types-Efficient Convolution Algorithms -Random or Unsupervised Features -The Neuroscientific Basis for Convolutional Networks.

UNIT – III Convolutional Neural Networks Architectures

Popular CNN Model Architectures -Introduction to ImageNet-LeNet-AlexNet architecture- VGGNet architecture-GoogLeNet architecture-Architecture insights-Inception module-ResNet architecture-Convolutional Networks for Detection and Segmentation.

UNIT – IV Recurrent Neural networks and Reinforcement Learning

Recurrent Neural Networks-Recurrent Neurons-Training RNNs-Deep RNNs-LSTM Cell-GRU Cell-Reinforcement Learning- Deep Reinforcement Learning

UNIT – IV Autoencoders,Generative Models with Adversarial Learning

Generative Models- Taxonomy of Generative models - PixelRNN - PixelCNN- variational auto encoders (VAE) - generative adversarial network(GAN)- Visualizing and Understanding - Feature visualization and inversion -Adversarial examples -DeepDream and style transfer.

TEXT BOOKS:

1. Ragav Venkatesan, Baoxin Li, Convolutional Neural Networks in Visual Computing: A Concise Guide", CRC Press, 2018.
2. Ian Goodfellow and YoshuaBengio and Aaron Courville, Deep Learning, MIT press, http://www.deeplearningbook.org, 2016.

REFERENCES:

1. Pradeep Pujari, Md. Rezaul Karim, Mohit Sewak, Practical Convolutional Neural Networks, Packt Publishing, February 2018.
2. Charu C. Aggarwal, Neural Networks and Deep Learning: A Textbook, Springer, September 2018.
3. Salman Khan; Hossein Rahmani; Syed Afaq Ali Shah; Mohammed Bennamoun; Gerard Medioni; Sven Dickinson, A Guide to Convolutional Neural Networks for Computer Vision, Morgan & Claypool, 2018.
4. Xavier Alameda, Elisa Ricci, Multimodal Behaviour Analysis in the wild: Advances and challenges, 1st Edition, Academic Press, 2018

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the challenges in computer vision.
2. Gain knowledge of how deep learning algorithms could be used in computer vision.
3. Understand the advantages and trade-offs of various CNN and RNN architectures.
4. Apply CNN for object detection and segmentation.
5. Apply generative adversarial networks (GANs) for Visual Recognition.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	2	-	-	-	-	-	-	-	-	-	-
CO2	1	2	1	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	3	-	-	-	-	-	-	-
CO4	1	2	2	1	1	-	-	-	-	-	-	-
CO5	1	1	2	1	-	-	-	-	-	-	-	-

AIHESCN	MACHINE LEARNING FOR PREDICTIVE DATA ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce most important machine learning approaches used in predictive data analytics.
- To learn four approaches to machine learning: information-based learning, similarity-based learning, probability-based learning, and error-based learning.
- To learn the techniques for evaluating prediction models.
- To learn statistics and data visualization for Machine Learning.

UNIT – I Introduction

Machine Learning for Predictive Data Analytics - Is Predictive Data Analytics - Is Machine Learning - Machine Learning Work- Can Go Wrong with Machine Learning - The Predictive Data Analytics Project Lifecycle - Predictive Data Analytics Tools - Data to Insights to Decisions-Converting Business Problems into Analytics Solutions - Assessing Feasibility-Designing the Analytics Base Table- Designing & Implementing Features.

UNIT – II Data Exploration

The Data Quality Report-Getting to Know the Data-The Normal Distribution-Identifying Data Quality Issues - Missing Values - Irregular - Handling Data Quality Issues - Handling Missing Values- Handling Outliers - Advanced Data Exploration - Visualizing Relationships Between Features-Measuring Covariance & Correlation - Data Preparation – Normalization - Binning- Sampling – Information - Based Learning - Big Idea – Fundamentals - Decision Trees-Shannon's Entropy Model-Information Gain - Standard Approach: The ID3 Algorithm - Example: Predicting Vegetation Distribution-Alternative Feature Selection & Impurity Metrics.

UNIT – III Handling Continuous Descriptive Features

Predicting Continuous Targets - Tree Pruning - Model Ensembles - Similarity-based Learning- Feature Space-Measuring Similarity Using Distance Metrics - The Nearest Neighbor Algorithm- Data Normalization - Predicting Continuous Targets - Probability-based Learning- Bayes' Theorem-Bayesian Prediction - Handling Continuous Features: Probability Density Functions- Handling Continuous Features: Binning - Bayesian Networks- Simple Linear Regression- Measuring Error-Error Surfaces-Multivariable Linear Regression with Gradient Descent- Multivariable Linear Regression- Choosing Learning Rates & Initial Weights- Interpreting Multivariable Linear Regression Models-Setting the Learning Rate Using Weight.

UNIT – IV Designing Evaluation Experiments

Performance Measures: Categorical Targets- Performance Measures: Prediction Scores-Performance Measures: Multinomial Targets-Performance Measures: Continuous Targets-Evaluating Models after Deployment-Case Study: Customer Churn-Business Understanding-Data Understanding - Data Preparation - Modeling-Evaluation-Deployment -The Art of Machine Learning for Predictive Data Analytics- Different Perspectives on Prediction Models- Choosing a Machine Learning Approach-Matching Machine Learning Approaches to Projects-Matching Machine Learning Approaches to Data.

UNIT – V Statistics & Data Visualization for Machine Learning

Descriptive Statistics for Continuous Features-Central Tendency- Variation-Descriptive Statistics for Categorical Features- Populations & Samples-Data Visualization-Bar Plots- Histograms-Box Plots-

Introduction to Probability for Machine Learning-Probability Basics- Probability Distributions & Summing Out-Some Useful Probability Rules-Differentiation Techniques for Machine Learning-Derivatives of Continuous Functions-The Chain Rule-Partial Derivatives.

TEXT BOOKS:

1. John D. Kelleher, Brian Mac Namee, Aoife D'Arcy, Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies , 1st Edition, The MIT Press, Kindle Edition, 2014.
2. Statistical and Machine-Learning Data Mining: Techniques for Better Predictive Modeling and Analysis of Big Data, Bruce Ratner, Second Edition, CRC Press, 2012.

REFERENCES:

1. Tom M. Mitchell, Machine Learning, 1st Edition, McGraw Hill Education, 2017.
2. Thomas W. Miller, Modeling Techniques in Predictive Analytics with Python and R: A Guide to Data Science, FT Press Analytics, Pearson Education, 2015.
3. Witten, I. H., E. Frank, and M. A. Hall, Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufmann, 2011.
4. Hastie, T., R. T. Jerome, and H. Friedman, The Elements of Statistical Learning: Data Mining, Inference and Prediction, Springer, 2009.

COURSE OUTCOMES:

At the end of this course, the students will be able to

1. Understand the machine learning approaches for predictive data analytics.
2. Understand the various machine approaches.
3. Apply machine learning techniques and evaluate predictive modeling.
4. Choose and implement appropriate performance measures for predictive models.
5. Document and transfer the results, and effectively communicate the findings using visualization techniques.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	2	1	1	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	1	1	-	-	-	-	-	-	-	-
CO4	2	1	2	2	2	-	-	-	-	-	-	-
CO5	1	2	2	2	3	-	-	-	-	-	-	-