PONDICHERRY UNIVERSITY

A Central University under Ministry of Education, Govt. of India

Proposed Curriculum & Syllabus

for

B.Tech.
Artificial Intelligence and Machine Learning

(Affiliated Engineering Colleges)

2023-24

PONDICHERRY UNIVERSITY

BACHELOR OF TECHNOLOGY PROGRAMMES

(For Affiliated Colleges)

REGULATIONS 2023-24

1. Conditions for Admission:

a) Candidates for admission to the first semester of the 8 semester B.Tech. degree programme should be required to have passed:

The Higher Secondary Examination of the (10+2) curriculum (Academic Stream) prescribed by the different State Boards/ Central Boards or any other examination equivalent there to with minimum of 45% marks (40% marks in case of candidates belonging to reserved category) in aggregate of subjects – Mathematics, Physics and any one of the following optional subjects: Chemistry / Biotechnology/ Computer Science / IT and equivalent/ Electronics/ Biology (Botany & Zoology) or Passed D.Voc Stream in the same or allied sector or an Examination of any University or Authority recognized by the Executive Council of the Pondicherry University as equivalent thereto.

b) Candidates for admission through Lateral entry into second year (third semester)of the 8 semester B.Tech. degree programme should be required to have passed :

Passed Minimum THREE years / TWO years (Lateral Entry) Diploma examination with at least 45% marks (40% marks in case of candidates belonging to reserved category) in ANY branch of Engineering and Technology.

OR

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

OR

Passed D.Voc. Stream in the same or allied sector.

(The Universities/colleges will offer suitable bridge courses such as Mathematics, Physics, Engineering drawing, etc., for the students coming from diverse backgrounds to achieve desired learning outcomes of the programme)

2. AgeLimit:

As per applicable AICTE norms.

3. Duration of Programme:

The Bachelor of Technology degree programme shall extend over a period of 8 semesters spread over 4 academic years – two semesters constituting one academic year. The duration

of each semester shall normally be 15 weeks excluding examinations.

4. Program Structure

The medium of instruction is English.

A student admitted to the B.Tech. programme in a particular branch of engineering will earn the degree in that branch by fulfilling all the requirements prescribed in the regulations during the course of study.

The student is also permitted to opt for earning an **Honors degree in the same discipline of Engineering or a Minor degree** in another discipline of engineering in addition to the degree in his own discipline of engineering. The student will be allowed to exercise this option at the end of first year based on his academic performance in the first year. The students admitted through lateral entry can exercise this option at the end of third semester, based on the GPA scored in the third semester examination.

The student opting for B.Tech. degree with **Honors or B.Tech. degree with Minor** is required to earn additional 20 credits starting from the third semester. The students admitted in the second year through lateral entry and opting for Honors / Minor degree will earn the additional 20 credits starting from the fourth semester.

5. Eligibility for the award of B.Tech. Degree:

No candidate shall be eligible for the award of the degree of Bachelor of Technology, unless he/she has undergone the course for a period of 8 semesters (4 academic years) / 6 semesters (3 academic years for Lateral Entry candidates) in the Faculty of Engineering and has passed the prescribed examinations in all the semesters. Details regarding the possible exit for a B.Tech. Student – in line with one of the goals of the National Education Policy (NEP) 2020 are provided in section 13.

6. Branches of Study:

Branch I - Civil Engineering

Branch II – Mechanical Engineering

Branch III - Electronics & Communication Engineering

BranchIV - ComputerScience&Engineering

Branch V – Electrical & Electronics Engineering

Branch VI – Chemical Engineering

Branch VII - Electronics & Instrumentation Engineering

Branch VIII –Information Technology

Branch IX - Instrumentation & Control Engineering

Branch X– Biomedical Engineering

Branch XI - Robotics and Automation

Branch XII – Food Technology

Branch XIII - CSE (Internet of Things & Cyber security including Block chain Technology)

Branch XIV – Artificial Intelligence and Machine Learning

Branch XV – Artificial Intelligence and Data Science

or any other branch of study as and when offered. The branch allocation shall be ordinarily done at the time of admission of the candidate to the first semester.

7. Course Structure and Subjects of Study:

Definition of Credit:

1 Hour Lecture (L) per week	1 Credit
1 Hour Tutorial (T) per week	1 Credit
2 Hours Practical (P) per week	1 Credit

Range of Credits: The total credits of all the branches for the four-year B. Tech. degree Programme shall be in the range of160 to 172 (Minor variation is allowed as per AICTE guidelines). ″Minor Degree or Honors will cumulatively require additional 20 credits in the specified area in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline".

The subjects of study shall include theory, practical courses and project work/internships as given in the curriculum and shall be in accordance with the prescribed syllabus.

The curriculum of every programme will have courses that are categorized as follows:

(i) Humanities, Social Sciences and Management Courses (HSM)

(ii) Basic Science Courses (BSC)

(iii) Engineering Science Courses (ESC)

(iv) Professional Core Courses (PCC)

(v) Professional Elective Courses (PEC)

(vi) Open Elective Courses (OEC)

(vii) Professional Activity Courses (PAC)

(viii) Mandatory non-Credit Courses (MCC)

Each course will have either one or more of three components namely Lecture (L), Tutorial (T) and Practice (P). Each course is assigned credits as detailed below:

(i) Theory courses will carry either 3 or 4 credits - 3 credits for courses with 3 lecture periods per week and 4 credits for courses with 3 lecture periods and 1 tutorial period per week.

(ii) All Elective courses including online courses will carry maximum 3 credits. The student can earn the credits towards the Open Elective Courses (OEC) by completing the online courses offered in NPTEL anytime between third and seventh semester on prior approval of the courses by the Academic Courses Committee of the Institute. Credits earned through the NPTEL courses will be confined to 2 or 3 credits and subject to a maximum of 9 credits during the entire programme of study.

(iii) Practical courses will normally carry either 1 or 1.5 credits – 1.5 credits for courses with 3 practice periods per week and 1 credit for courses with 2 practice periods per week.

(iv) Out of total credits required for successful completion of the degree, 14 to 22 credits can be assigned for Project work and/or Internship.

(v) Mandatory non-credit courses carry zero credit.

8. Examinations:

The theory and practical examinations shall comprise continuous internal assessment throughout the semester in all subjects as well as university examinations conducted by Pondicherry University at the end of the semester (November / December or April /May).

8.1. Evaluation Scheme

All Credit courses are evaluated for 100 marks comprising of Internal assessment and end-semester exam.

For Theory Course, the weightage of internal assessment is 40% and end semester examination is 60%

For Practical course, the weightage of internal assessment is 60% and end semester examination is 40%

For Project, the weightage of internal assessment is 60% and end semester examination is 40%

8.2. Internal Assessment (Theory)

Total Internal Assessment mark for a theory course is 40 marks. The breakup is as follows:

Criteria	Maximum Marks
a) Internal Assessment Tests	30
b) Percentage of Attendance	5
c) Assignment(s)	5
Total	**40**

Marks for Attendance are as follows:

Below 75%	0
75% - 80%	1
81% - 85%	2
86% - 90%	3
91% - 95%	4
96% - 100%	5

The Principal of the College/Institute schedules the Internal Assessment tests for all courses. All faculty members are expected to conduct this Internal Assessment tests for 1.30 hours duration and evaluate and required to upload the marks to the Controller of Examinations of University. Colleges are also requested to preserve the answer sheets of Internal Assessment tests until declaration of results by the University.

8.3. Internal Assessment (Practical's)

Faculty in-charge of Lab courses shall evaluate the practical course for 60 marks. The break up is as follows:

Criteria	Maximum Marks
a) Laboratory exercises and Record	30
c) Mid Semester exam (Average of 2 exams)	15
c) Internal Viva voce	5
d) Percentage of Attendance	10
Total	**60**

Marks for Attendance is as follows:

Below 75%	0
75% - 80%	2
81% - 85%	4
86% - 90%	6
91% - 95%	8
96% - 100%	10

8.4. Internal Assessment (Project)

The Project work carried out in the eighth semester shall be assessed as follows:

Criteria	Marks
a) Continuous assessment (Guide)	25
b) Project Evaluation Committee	35
Total	**60**

8.5 Requirement for appearing for University Examination

The Controller of Examinations (COE) of Pondicherry University schedules the End-Semester exams for all theory and practical courses based on the University academic calendar.

A detailed Exam Time Table shall be circulated to all Colleges at least 15 days before the start of exams. Question Papers shall be set externally based on BOS approved syllabus.

A candidate shall be permitted to appear for university examinations at the end of any semester only if:

i) He / She secures not less than 75% overall attendance arrived at by taking into account the total number of periods in all subjects put together offered by the institution for the semester under consideration.
(*Candidates who secure overall attendance greater than 60% and less than 75% have to pay a condonation fee as prescribed by University along with a medical certificate obtained from a medical officer not below the rank of Assistant Director*)

ii) He / She earns a progress certificate from the Head of the institution for having satisfactorily completed the course of study in all the subjects pertaining to that semester

iii) His / Her conduct is found to be satisfactory as certified by the Head of the institution.
A candidate who has satisfied the requirement (i) to (iii) shall be deemed to have satisfied the course requirements for the semester.

8.6 End Semester Exam Evaluation Pattern

Course	**Maximum marks**
a) Theory course (Sec A, Sec B and Sec C) Questions from all units of syllabus	60 marks
b) Practical course (Based on Lab exercises/Record/ Practicals /Viva)	40 marks
c) Internship /Project Work (Based on Seminar/Project Work/Project report/Presentation and viva voce)	40 marks

8.7 Consolidation of Marks and PassingMinimum

The Controller of Examinations of the University consolidates the Internal Assessment marks uploaded by the Colleges and marks secured by students in the end-semester examination.

A student shall be declared to have passed the examination in a subject of study only if he/she secures not less than **40% marks individually both in internal assessment and end-semester examination or an aggregate of 40%.**

A candidate who has been declared "Fail" in a particular subject may reappear for that subject during the subsequent semesters and secure pass marks. However, there is a provision for revaluation of failed or passed subjects provided he/she fulfills the following norms for revaluation.

a) Applications for revaluation should be filed within 15 days from the date of declaration of resultsor 7days from the date of receipt of grade sheet whichever is earlier.
b) The candidate should have attended all the internal assessments conducted by the college as well as all the end semester examinations conducted by the University.
c) If a candidate has failed in more than two papers in the end semester examinations, his/her representation for revaluation will not be considered.
d) The request for revaluation must be made in the prescribed format duly recommended by the Head of the Institution along with the revaluation fee prescribed by theUniversity.

A student shall be declared to have passed the examination in a subject of study only **if he/she secures not less than 40% marks in the end-semester examination and secures an overall aggregate of 40%.**

8.8. Arrear Exams

A student who failed to secure 40% marks in aggregate is declared as "Fail" and he is eligible to take up a supplementary examination by registering to the said course in the following semester. All other candidates who failed due to shortage of attendance and those seeking to improve the grade shall repeat the course.

8.9. Letter Grades and Calculation of CGPA

Total Marks Secured by a student in each course shall be converted into a letter grade. The following Table shows the seven letter grades and corresponding meaning and the grade points for the calculation of Cumulative Grade Point Average (CGPA).

Each course(Theory/Practical)is to be assigned 100 marks, irrespective of the number of credits, and the mapping of marks to grades may be done as per the following table:

Range of Marks	Assigned Grade	Grade Points
91-100	A^+	10
81-90	A	9
71-80	B^+	8
61-70	B	7
51-60	C^+	6
46-50	C	5
40-45	D	4
<40	F	0
Not Applicable	F^R (Fail due to shortage of attendance and therefore, to repeat the course)	0

Note: -F- denotes failure in the course; - F^R - denotes absent / detainedas per AICTE norms. After the results are declared, grade sheets will be issued to the students.The grade sheets will contain the following details:

a) The college in which the candidate has studied.
b) The list of courses enrolled during the semester and the grades scored.
c) The Grade Point Average (GPA) for the semester and t he Cumulative Grade Point Average (CGPA)of all enrolled subjects from first semester onwards.
d) GPA is the ratio of sum of the products of the number of credits (C) of courses registered and the corresponding Grades Points (GP) scored in those courses, taken for all the courses and sum of the number of credits of all the courses.

$$\mathbf{GPA = \sum(C \times GP) / \sum C}$$

CGPA will be calculated in a similar manner, considering all the courses enrolled from first semester. F^R grades are to be excluded for calculating GPA and CGPA.

e) The conversion of CGPA into percentage marks is as follows

$$\% \text{ Mark} = (\text{CGPA} - 0.5) \times 10$$

9. Procedure for completing the B.Tech. course:

A candidate can join/rejoin the course of study of any semester only at the time of its normal

commencement and only if he/she has satisfied the course requirements for the previous semester and further has registered for the university examinations of the previous semester in all the subjects as well as all arrear subjects if any.

However, the entire B.Tech. course should be completed within 7 years (14 semesters) and six years (12 semesters) for students admitted under lateral entry.

10. Award of Class and Rank in B.Tech. degree:

i) A candidate who satisfies the course requirements for all semesters and who passes all the examinations prescribed for all the eight semesters (six semesters for lateral entry candidates) within a maximum period of 7 years (6 years for lateral entry candidates) reckoned from the commencement of the first semester to which the candidate was admitted shall be declared to have qualified for the award of B.Tech. degree.

ii) A candidate who qualifies for the award of the B.Tech. degree passing in all subjects pertaining to the semesters 3 to 8 in his/her first appearance within 6 consecutive semesters (3 academic years) and in addition secures a CGPA of 8.50 and above for the semesters 3 to 8 shall be declared to have passed the examination in **FIRST CLASS** with **DISTINCTION**.

iii) A candidate who qualifies for the award of the B.Tech. degree by passing in all subjects relating to semesters 3 to 8 within a maximum period of eight semesters after his/her commencement of study in the third semester and in addition secures CGPA not less than 6.5 shall declared to have passed the examination in **FIRST CLASS**.

iv) All other candidates who qualify for the award of B.Tech. degree shall be declared to have passed the examination in **SECOND CLASS**.

v) For the Award of University ranks and Gold Medal for each branch of study, the CGPA secured from the 1st to 8th semester alone should be considered and it is mandatory that the candidate should have passed all the subjects from the1st to 8th semester in the first attempt. Rank certificates would be issued to the first ten candidates in each branch of study.

11. Provisions for Honors/Minor degree along with B.Tech. degree:

1. <u>B.Tech. with Honors Degree in the same Engineering discipline</u>

a. The student shall be given an option to earn a Honors degree in the same discipline of engineering at the end of first year based on his academic performance in the first year.

b. A student is eligible to exercise this option if he has passed all the subjects offered in

the first year in the first attempt itself and has earned a CGPA of not less than 7.5.

c. Honors degree in a particular discipline of engineering shall be offered for a batch of students if and only if a minimum of 5 eligible students opt for it.

d. The student is required to earn an additional 20 credits (over and above the prescribed maximum credits in the curriculum) starting from the third semester onwards to become eligible for the award of Honors degree. 20 credits shall be earned by the student by completing 5 additional courses of 4 credits each, one in each of the 5 semesters starting from the third to seventh semester. The syllabus of these 5 courses are framed so as to cover advanced topics in that discipline of engineering.

e. The students admitted in the second year through Lateral Entry Scheme will also be given a chance to opt for Honors degree. Eligibility to avail this option is CGPA of 7.5 and above with no arrears in the third Semester. The student will join the existing batch of students in the fourth semester and earn 16 credits by registering the prescribed courses offered up to the seventh semester. The respective BoS will decide on a suitable course in lieu of the course offered in the third semester to facilitate the student to earn the remaining 4 credits.

f. A student is eligible to get the Honors degree only on completing the programme in 'First Class with Distinction' class.

g. A student can exercise the option to withdraw from the Honors degree at any time after entry.

h. Details about the courses completed and credits earned for Honors degree will appear only in the 'Eighth Semester Grade Sheet' and 'Consolidated Grade Sheet'. These details will be listed under the heading 'Credits Earned for Honors degree'. In the case of students who have either withdrawn from Honors degree or become ineligible for Honors degree by not securing 'First Class with Distinction', the credits earned for the courses registered and successfully completed for Honors degree will be listed under the heading 'Additional Credits Earned'.

i. The CGPA will be calculated for all the courses credited by the students inclusive of major and honors courses

j. Nomenclature of Honors Degree is 'B.Tech.(Honors) in XXX ', where XXX is Discipline in which the student has enrolled.

2. <u>B.Tech. with Minor degree in another Engineering discipline</u>

a) The student shall be given an option to earn a minor degree in another discipline of engineering of his choice at the end of first year based on his academic performance in the first year.

b) A student is eligible to exercise this option if he has passed all the subjects offered in the first year in the first attempt itself and has earned a CGPA of not less than 7.5.

c) Minor degree in a particular discipline of engineering shall be offered for a batch of students if and only if a minimum of 5 eligible students opt for it.

d) The student is required to earn an additional 20 credits (over and above the prescribed maximum credits in the curriculum) starting from the third semester onwards to become eligible for the award of minor degree. 20 credits shall be earned by the student by completing 5 additional courses of 4 credits each, one in each of the 5 semesters starting from the third to seventh semester. The curricular content of these 5 courses are framed in such a way that that these courses will essentially cover the core minimum knowledge required to be fulfilled for award of degree in the discipline of engineering in which the student chooses to earn the minor degree.

e) The students admitted in the second year through Lateral Entry Scheme will also be given a chance to opt for Minor degree. Students with a CGPA of 7.5 and with no arrears in the third semester are eligible to avail this option. The student will join the existing batch of students in the fourth semester and earn 16 credits by registering for prescribed courses offered up to seventh semester. The respective BoS will decide on a suitable course in lieu of the course offered in the third semester to facilitate the student to earn the remaining 4 credits.

f) A student can exercise the option to withdraw from the Minor degree at any time after entry.

g) Details about the courses completed and credits earned for Minor degree will appear only in the 'Eighth Semester Grade Sheet' and 'Consolidated Grade Sheet'. These details will be listed under the heading 'Credits Earned for Minor degree'. In the case of students who have withdrawn from Minor degree, the credits earned for the courses registered and successfully completed for Minor degree will be listed under the heading 'Additional Credits Earned'.

h) Nomenclature of Minor Degree is 'B.Tech. in XXX with Minor in YYY', where XXX is Discipline in which the student is enrolled and YYY is Discipline which the student has opted as Minor.

i) The CGPA will be calculated for all the courses credited by the students inclusive of major and minor courses.

12. Provision for withdrawal:

Based on the recommendation of the Head of the Institution, a candidate with valid reasons may be granted permission by the University to withdraw from writing the entire semester examination as one Unit. The withdrawal application shall be valid only if it is made earlier than the commencement of the last theory examination pertaining to that semester. Withdrawal shall be permitted only once during the entire course. A candidate who has withdrawn is also eligible to be awarded DISTINCTION provided he/she satisfies the other necessary conditions. But, they are not eligible to be awarded a rank.

13. Provisions for exit in B.Tech. course:

(For courses where AICTE specifies exit in the model curriculum)

The curriculum and the syllabus for all B.Tech programmes have been planned in compliance with the NEP guidelines proposed by AICTE. Accordingly, students joining B.Tech programmes shall have all benefits NEP offers in terms of exercising exit option during the course of study. Every B.Tech programme governed under this school board shall adopt the NEP guidelines, as and when proposed/amended by AICTE, and the following scheme will be applied for all such B.Tech programmes specified by AICTE.

NEP 2020 suggests that a student can exercise exits at multiple stages of the course of study. As per AICTE norms, a student can have two possible exits before the completion of the Full Engineering degree and may get a UG Diploma /Certificate or B.Sc. degree in the relevant discipline if he/she fulfils the following conditions: (Subject to change as per AICTE guidelines)

1. **UG Diploma/Certificate in the relevant branch of study**

   A student should be able to get a UG Diploma if he/she completes:

   a. 50% of the credits for B.Tech. (80-85 credits)

   b. 50% of the program core courses

   c. Students exiting the program after earning 50% credit requirements will be awarded a UG Diploma provided they secure an additional 6 credits through summer internships/apprenticeship of 2 months duration.

   d. Students admitted through lateral entry cannot exercise the exit option as he will not be able to meet out the 50% Credits for B.Tech. degree.

2 **B.Sc. in the relevant branch of study**

A student should be able to get a B.Sc. degree if he/she completes:

(i) 75% of the credits for B.Tech. (minimum 120 credits) and atleast 3 years in the

program.

(ii) 100% of the core program courses.

(iii) Students exiting the program after earning 75% credit requirements will be awarded a B.Sc. provided they secure an additional 6 credits through 2 summer internships/apprenticeship for 2 months each.

(iv) With B.Sc. degree, the student is eligible for entry into programs which take B.Sc. degree as eligibility criteria.

2.1 Award of Class in B.Sc. degree

A candidate who satisfies the course requirements for all semesters and who passes all the examinations within a maximum period of 6 years (5 years for lateral entry candidates) reckoned from the commencement of the first semester to which the candidate was admitted shall be declared to have qualified for the award of B.Sc. degree in the relevant discipline.

i) A candidate who qualifies for the award of the B.Sc. degree passing in all subjects pertaining to semesters the 3 to 6 in his/her first appearance within 4 consecutive semesters (2 academic years) and in addition secures a CGPA of 8.50 and above for the semesters 3 to 6 shall be declared to have passed the examination in **FIRST CLASS** with **DISTINCTION**.

ii) A candidate who qualifies for the award of the B.Sc. degree by passing in all subjects relating to semesters 3 to 6 within a maximum period of six semesters after his/her commencement of study in the third semester and in addition secures CGPA not less than 6.5 shall declared to have passed the examination in **FIRST CLASS.**

iii) All other candidates who qualify for the award of B.Sc. degree shall be declared to have passed the examination in **SECOND CLASS**.

2. Re-entry to complete the program

A student exiting with B.Sc. should be entitled to re-enrol in the programme of the same Engineering discipline. Only students admitted to the B.Tech. programme and exercised an exit option are eligible for readmission to the B.Tech. programme under the same discipline. It is suggested that all credits will be transferred, if the student enrols back within a limited period (3 years) of exiting. In case a student enrols after that, then the decision on the transfer of credits should be based on the changes in the curriculum the student studied. A candidate after exit may rejoin the course only at the commencement of the semester at which he/she discontinued, provided he/she pays the prescribed fees to the University. The total period of completion of the B.Tech. course reckoned from the commencement of the first semester to

which the candidate was admitted shall not in any case exceed 7 years, including of the period of discontinuance.

3. Completion Possibility in other Institutions

A student can earn B.Sc. in one institution (Engineering) and complete the degree program in another institution (same Engineering discipline only).

(Note: If these exit options are accepted for multipleB.Tech. programs, it is suggested that AICTE actively communicate these to the industry and other bodies, so they recognize these and accept them as bona-fide credentials for the purposes of recruitment and/or eligibility for admission to programs, appearing in competitive examinations, etc.)

14. Revision of Regulations and Curriculum:

The University may from time-to-time revise, amend or change the regulations of curriculum and syllabus as and when found necessary.

GENERAL COURSE STRUCTURE & THEME

A. Definition of Credit:

1Hr. Lecture (L) per week	1 Credit
1Hr. Tutorial (T) per week	1 Credit
2 Hours Practical (P) per week	1 Credit

B. Range of Credits:

In the light of the fact that a typical Model Four-year Under Graduate Degree Program in Engineering has about 163 credits, the total number of credits proposed for the four-year B.Tech Artificial Intelligence and Machine Learning (AIML) is kept as168.

C. Structure of UG Program in AIML:

The structure of UG program in Artificial Intelligence and Machine Learning shall haveessentially the following categories of courses with the breakup of credits as given:

S.No.	Category	Breakup of Credits
1	Humanities & Social Science Courses	10
2	Basic Science Courses	26
3	Engineering Science Courses	16
4	Program Core Courses (Branch specific)	76
5	Professional Elective Courses (Branch Specific)	12
6	Open Elective Courses (from Humanities, Technical, Emerging or other Subjects)	6
7	Project work, Seminar and Internship in Industry or elsewhere	22
8	Audit Course [Environmental Sciences, Indian Constitution]	0
	Total	**168**

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D. Course Code and Definitions:

Course code	Definitions
L	Lecture
T	Tutorial
P	Practical
C	Credits
AMHS	Humanities & Social Science Courses
AMBS	Basic Science Courses
AMES	Engineering Science Courses
AMPC	Program Core Courses
AMPE	Professional Elective Courses
AMOE	Open Elective Courses
AMAU	Audit Courses
AMHL	Humanities & Social Science Lab
AMBL	Basic Science Lab
AMEL	Engineering Science Lab
AMPL	Program core Lab
AMPROJ	Project (Project / Summer Internship / Seminar)
AMMR	Minor Courses
AMHR	Honor Courses

- **Course Level Coding Scheme:** First Two-digit indicates the Programme and digit at hundredth place signifies the semester in which course is offered.

- **Category-wise Courses:**

HUMANITIES & SOCIAL SCIENCES COURSES [AMHS]

Sl. No.	Course Code	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	AMHL104	Design Thinking	I	0	0	2	1
2	AMHS201	English	II	2	0	2	3
3	AMHS205	Universal Human Values - II	II	2	1	0	3
4	AMHS405	Entrepreneurship and Start-ups	IV	3	0	0	3
						Total Credits	**10**

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BASIC SCIENCE COURSES [AMBS]

Sl. No.	Course Code	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	AMBS101	Mathematics-I	I	3	1	0	4
2	AMBS102	Physics	I	3	0	0	3
3	AMBL101	Physics Lab	I	0	0	4	2
4	AMBS203	Chemistry	II	3	0	0	3
5	AMBL201	Chemistry Lab	II	0	0	4	2
6	AMBS202	Mathematics-II	II	3	1	0	4
7	AMBS305	Mathematics-III	III	3	1	0	4
8	AMBS506	Discrete Mathematics	V	3	1	0	4
Total Credits							**26**

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ENGINEERING SCIENCE COURSES [AMES]

Sl. No.	Course Code	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	AMES103	Basic Electronics Engineering	I	3	0	0	3
2	AMEL102	Basic Electronics Engineering Lab	I	0	0	4	2
3	AMEL103	Engineering Graphics and Design Lab	I	1	0	4	3
4	AMES204	Problem Solving and Programming	II	3	0	0	3
5	AMEL202	Problem Solving and Programming Lab	II	0	0	4	2
6	AMEL203	Workshop	II	1	0	4	3
Total Credits							**16**

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PROGRAM CORE COURSES [AMPC]

Sl. No.	Course Code	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	AMPC301	Data Structures and Algorithms	III	3	0	0	3
2	AMPC302	Digital Electronics and Systems	III	3	0	0	3
3	AMPC303	Object Oriented Programming	III	3	0	0	3
4	AMPC304	Operating Systems	III	3	0	0	3
5	AMPL301	Data Structures and Algorithms Lab	III	0	0	4	2
6	AMPL302	Object Oriented Programming Lab	III	0	0	4	2
7	AMPL303	Operating Systems Lab	III	0	0	4	2
8	AMPC401	Computer Organization and Architecture	IV	3	0	0	3
9	AMPC402	Database Systems	IV	3	0	0	3
10	AMPC403	Computer Networks	IV	3	0	0	3
11	AMPC404	Artificial Intelligence	IV	3	0	0	3
12	AMPL401	Database Systems Lab	IV	0	0	4	2
13	AMPL402	Computer Networks Lab	IV	0	0	4	2
14	AMPL403	Artificial Intelligence Lab	IV	0	0	4	2
15	AMPC501	Data Science	V	3	1	0	3
16	AMPC502	Machine Learning	V	3	0	0	3
17	AMPC503	Cloud Computing	V	3	0	0	3
18	AMPC504	Optimization Techniques in Machine Leaning	V	3	0	0	3
19	AMPC505	AI and Cyber Security	V	3	0	0	3
20	AMPL501	Data Science and Machine Learning Lab	V	0	0	4	2
21	AMPL502	Cloud Computing Lab	V	0	0	4	2
22	AMPC601	Deep Learning	VI	3	0	0	3
23	AMPC602	Data Visualization and Analytics	VI	3	0	0	3
24	AMPC603	Natural Language Processing	VI	3	0	0	3
25	AMPC604	Internet of Things	VI	3	0	0	3
26	AMPL601	Deep Learning Lab	VI	0	0	4	2
27	AMPL602	Data Visualization and Analytics Lab	VI	0	0	4	2
28	AMPL603	Internet of Things Lab	VI	0	0	4	2
29	AMPC701	Computer Vision	VII	3	0	0	3
						Total Credits	**76**

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PROFESSIONAL ELECTIVE COURSES [AMPE]

Sl. No.	Course Code	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	AMPEXXX	Professional Elective-I	VII	3	0	2	3
2	AMPEXXX	Professional Elective-II	VII	3	0	2	3
3	AMPEXXX	Professional Elective-III	VIII	3	0	2	3
4	AMPEXXX	Professional Elective-IV	VIII	3	0	2	3
						Total Credits	**12**

For detailed syllabus of Professional Elective Course, Refer Appendix III.

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OPEN ELECTIVE COURSES [AMOE]

Sl. No	Course Code	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	AMOEXXX	Open Elective-I	III	3	0	0	3
2	AMOEXXX	Open Elective-II	VII	3	0	0	3
						Total Credits	**6**

For detailed syllabus of Open Elective Course, Refer Appendix IV.

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PROJECT WORK, SEMINAR AND INTERNSHIP IN INDUSTRY OR ELSE WHERE [AMPROJ]

Sl. No.	Course Code	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	AMPROJ404	Minor Project	IV	0	0	3	3
2	AMPROJ503	Minor Project	V	0	0	3	3
3	AMPROJ705	Capstone Project - I	VII	-	-	4	6
4	AMPROJ803	Capstone Project - II	VIII	-	-	4	10
						Total Credits	**22**

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AUDIT COURSES [AMAU]

Note: These are mandatory non-credit courses.

Sl. No.	Course Code	Course Title	Semester	Lecture	Tutorial	Practical	Total Credits
1	-	Induction Program	I	3 Weeks			0
2	AMAU105	IDEA Workshop Lab	I	2	0	4	0
3	AMAU204	Sports & Yoga	II	2	0	0	0
4	AMAU406	Environmental Science	IV	3	0	0	0
5	AMAU506	Indian Constitution	V	3	0	0	0
						Total Credits	**0**

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INDUCTION PROGRAM

The Essence and Details of Induction program can also be understood from the 'Detailed Guide on Student Induction program', as available on AICTE Portal, (Link:https://www.aicteindia.org/sites/default/files/Detailed%20Guide%20on%20Student%20Induction%20program.pdf).

Induction program (mandatory)	Three-week duration
Induction program for students to be offered right at the start of the first year.	• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch & Innovations

E. Mandatory Visits / Workshop / Expert Lectures:

a. It is mandatory to arrange one industrial visit every semester for the students of each branch.

b. It is mandatory to conduct a One-week workshop during the winter break after fifth semester on professional /industry/ entrepreneurial orientation.

c. It is mandatory to organize at least one expert lecture per semester for each branch by inviting resource persons from domain specific industry.

F. Summary of all Courses

Sl.No.	Course Category	Credits per Semester								Total
		I	II	III	IV	V	VI	VII	VIII	
1	HS	1	6	-	3	-	-	-	-	**10**
2	BS	9	9	4	-	4	-	-	-	**26**
3	ES	8	8	-	-	-	-	-	-	**16**
4	PC	-	-	18	18	19	18	3	-	**76**
5	PE	-	-	-	-	-	-	6	6	**12**
6	OE	-	-	3	-	-	-	3	-	**6**
7	PROJ	-	-	-	3	3	-	6	10	**22**
8	AU	0	0	-	0	0	-	-	-	**0**
Total		**18**	**23**	**25**	**24**	**26**	**18**	**18**	**16**	**168**

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Semester wise Structure and Curriculum

for

B.Tech. Artificial Intelligence & Machine Learning

CURRICULUM

SEMESTER I						
Sl. No.	**Course Code**	**Course Title**	**Periods**			**Total Credits**
			L	**T**	**P**	
Induction program			**3 weeks**			**0**
Theory						
1	AMBS101	Mathematics-I	3	1	0	4
2	AMBS102	Physics	3	0	0	3
3	AMES103	Basic Electronics Engineering	3	0	0	3
Practical						
4	AMBL101	Physics Lab	0	0	4	2
5	AMEL102	Basic Electronics Engineering Lab	0	0	4	2
6	AMEL103	Engineering Graphics & Design Lab	1	0	4	3
7	AMHL104	Design Thinking	0	0	2	1
8	AMAU105	IDEA Workshop Lab	2	0	4	0
Total			**12**	**1**	**18**	**18**
Note: ^ Represents "Audit Course"						
SEMESTER II						
Sl. No.	**Course Code**	**Course Title**	**Periods**			**Total Credits**
			L	**T**	**P**	
Theory						
1	AMHS201	English	2	0	1	3
2	AMBS202	Mathematics-II	3	1	0	4
3	AMBS203	Chemistry	3	0	0	3
4	AMES204	Problem Solving for Programming	3	0	0	3
5	AMHS205	Universal Human Values II	2	1	0	3
Practical						
6	AMBL201	Chemistry Lab	0	0	4	2
7	AMEL202	Problem Solving and Programming Lab	0	0	4	2
8	AMEL203	Workshop Lab	1	0	4	3
9	AMAU204	Sports and Yoga	0	0	2	0
Total			**14**	**2**	**15**	**23**

SEMESTER III						
Sl. No.	**Course Code**	**Course Title**	**Periods**			**Total Credits**
			L	**T**	**P**	
Theory						
1	AMPC301	Data Structures and Algorithms	3	0	0	3
2	AMPC302	Digital Electronics & Systems	3	0	0	3
3	AMPC303	Object Oriented Programming	3	0	0	3
4	AMPC304	Operating Systems	3	0	0	3
5	AMBS305	Mathematics-III	3	1	0	4
6	AMOE306	Open Elective-I	3	0	0	3
Practical						
7	AMPL301	Data Structures and Algorithms Lab	0	0	4	2
8	AMPL302	Object Oriented Programming Lab	0	0	4	2
9	AMPL303	Operating Systems Lab	0	0	4	2
		Total	**18**	**1**	**12**	**25**

SEMESTER IV						
Sl. No.	**Course Code**	**Course Title**	**Periods**			**Total Credits**
			L	**T**	**P**	
Theory						
1	AMPC401	Computer Organization and Architecture	3	0	0	3
2	AMPC402	Database Systems	3	0	0	3
3	AMPC403	Computer Networks	3	0	0	3
4	AMPC404	Artificial Intelligence	3	0	0	3
5	AMHS405	Entrepreneurship and Start-ups	3	0	0	3
6	AMAU406	Environmental Science	3	0	0	0
Practical						
7	AMPL401	Database Systems Lab	0	0	4	2
8	AMPL402	Computer Networks Lab	0	0	4	2
9	AMPL403	Artificial Intelligence Lab	0	0	4	2
10	AMPROJ404	Minor Project	0	0	3	3
		Total	**18**	**0**	**15**	**24**

SEMESTER V						
Sl. No.	**Course Code**	**Course Title**	**Periods**			**Total Credits**
			L	**T**	**P**	
Theory						
1	AMPC501	Data Science	3	0	0	3
2	AMPC502	Machine Learning	3	0	0	3
3	AMPC503	Cloud Computing	3	0	0	3
4	AMPC504	Optimization Techniques in Machine Learning	3	0	0	3
5	AMPC505	AI and Cyber Security	3	0	0	3
6	AMBS506	Discrete Mathematics	3	1	0	4
7	AMAU507	Indian Constitution	3	0	0	0
Practical						
8	AMPL501	Data Science and Machine Learning Lab	0	0	4	2
9	AMPL502	Cloud Computing Lab	0	0	4	2
10	AMPROJ503	Minor Project	0	0	3	3
		Total	**21**	**1**	**11**	**26**

SEMESTER VI						
Sl. No.	**Course Code**	**Course Title**	**Periods**			**Total Credits**
			L	**T**	**P**	
Theory						
1	AMPC601	Deep Learning	3	0	0	3
2	AMPC602	Data Visualization and Analytics	3	0	0	3
3	AMPC603	Natural Language Processing	3	0	0	3
4	AMPC604	Internet of Things	3	0	0	3
Practical						
5	AMPL601	Deep Learning Lab	0	0	4	2
6	AMPL602	Data Visualization and Analytics Lab	0	0	4	2
7	AMPL603	Internet of Things Lab	0	0	4	2
		Total	**12**	**0**	**12**	**18**

SEMESTER VII						
Sl. No.	**Course Code**	**Course Title**	**Periods**			**Total Credits**
			L	**T**	**P**	
Theory						
1	AMPC701	Computer Vision	3	0	0	3
2	AMPE702	Professional Elective-I	3	0	2	3
3	AMPE703	Professional Elective-II	3	0	2	3
4	AMOE704	Open Elective-II	3	0	0	3
5	AMPROJ705	Capstone Project - I	-	-	4	6
		Total	**12**	**0**	**8**	**18**
SEMESTER VIII						
Sl. No.	**Course Code**	**Course Title**	**Periods**			**Total Credits**
			L	**T**	**P**	
1	AMPE801	Professional Elective-III	3	0	2	3
2	AMPE802	Professional Elective-IV	3	0	2	3
3	AMPROJ803	Capstone Project - II	-	-	4	10
		Total	**6**	**0**	**8**	**16**

APPENDIX I

LIST OF HONOR COURSES						
Semester	**Course Code**	**Course Title**	**Periods**			**Total Credits**
			L	**T**	**P**	
Theory						
III	AMHR001	Python Programming and Data Visualization	3	1	0	4
IV	AMHR002	Data Visualization Tools	3	1	0	4
V	AMHR003	Drone Technology	3	1	0	4
VI	AMHR004	Introduction to Robotics	3	1	0	4
VII	AMHR005	Cognitive Science	3	1	0	4

APPENDIX II

LIST OF MINOR COURSES						
Semester	**Course Code**	**Course Title**	**Periods**			**Total**
			L	**T**	**P**	**Credits**
Theory						
III	AMMR001	Foundations of Data Science	3	1	0	4
IV	AMMR002	Foundations of AI	3	1	0	4
V	AMMR003	Applications of AI	3	1	0	4
VI	AMMR004	Business Intelligence & Analytics	3	1	0	4
VII	AMMR005	Foundations of ML	3	1	0	4

APPENDIX III

LIST OF PROFESSIONAL ELECTIVES

Sl. No.	Course Code	Course Title	Periods			Total Credits
			L	T	P	
1	AMPE001	Statistical Thinking for Data Science	3	0	2	3
2	AMPE002	Responsible AI	3	0	2	3
3	AMPE003	Data Visualization	3	0	2	3
4	AMPE004	Big Data Analytics	3	0	2	3
5	AMPE005	Soft Computing	3	0	2	3
6	AMPE006	IoT Analytics	3	0	2	3
7	AMPE007	Image and Video Processing	3	0	2	3
8	AMPE008	Explainable AI	3	0	2	3
9	AMPE009	Autonomous Systems	3	0	2	3
10	AMPE010	Bioinformatics	3	0	2	3
11	AMPE011	Reinforcement Learning	3	0	2	3
12	AMPE012	Adversarial AI	3	0	2	3
13	AMPE013	Computational Neuroscience	3	0	2	3
14	AMPE014	AI in Gaming	3	0	2	3
15	AMPE015	AI in Healthcare	3	0	2	3
16	AMPE016	AI in Finance	3	0	2	3

APPENDIX IV

LIST OF OPEN ELECTIVES

Sl. No.	Course Code	Course Title	Periods			Total Credits
			L	T	P	
1	AMOE001	Predictive Analytics	3	0	0	3
2	AMOE002	Robotics	3	0	0	3
3	AMOE003	Machine Learning with Python	3	0	0	3
4	AMOE004	AI for Everyone	3	0	0	3
5	AMOE005	Artificial Neural Networks	3	0	0	3

SEMESTER -I

AMBS101 MATHEMATICS – I

L	T	P	C
3	1	0	4

Course Objective:

- To comprehend the mathematical concepts of matrices, ordinary differential equations and multivariable calculus, problem-solving.

Course Outcomes:

- To determine the rank of a matrix, analyze system consistency, find eigenvalues and eigenvectors, verify the Cayley-Hamilton theorem, and perform diagonalization.
- To solve various types of ordinary differential equations, including higher-order linear equation.
- To compute partial derivatives, determine total derivatives, Jacobians, employ Taylor series, and find extremes of functions of two variables.
- To demonstrate proficiency in evaluating double integration and triple integration and using them to compute area and volume.
- To apply Green's theorem, Stoke's theorem and Gauss divergence theorem.

UNIT I (12 Hrs)

LINEAR ALGEBRA(MATRICES): Rank of a matrix, Consistency of a system of linear equations, Characteristic equation of a matrix, Eigen values and Eigen vectors, Properties of Eigen values and Eigen vectors, Cayley-Hamilton theorem (excluding proof), Verification, Application (Finding Inverse and Power of a matrix), Diagonalization of a matrix by orthogonal and similarity transformation, Quadratic form – Nature of Quadratic Form, Orthogonal reduction of quadratic form to canonical form.

UNIT II (12 Hrs)

ORDINARY DIFFERENTIAL EQUATIONS: Differential Equations of First Order, Exact equations, Leibnitz's linear equations, Bernoulli's equation, Equations solvable for p, Clairaut's equation, Differential equations of Higher order, Linear differential equations of higher order with constant coefficients, Euler's linear equation of higher order with variable coefficients, Method of variation of parameters.

UNIT III (12 Hrs)

MULTIVARIABLE CALCULUS (DIFFERENTIATION): Partial differentiation, Partial derivatives of first order and higher order, Partial differentiation of implicit functions, Euler's theorem on homogeneous functions, Total derivative, Jacobian: Properties, Taylor's series for functions of two variables, Maxima and minima of functions of two variables.

UNIT IV (12 Hrs)

MULTIVARIABLE CALCULUS (MULTIPLE INTEGRALS): Double integration (Cartesian form and Polar form), constant limits, variable limits, over the region R, Change of variables in double integrals (Cartesian to polar), Application of double integral, Area by double integration, Change of Order of Integration, Triple Integration (Cartesian, Spherical and Cylindrical), constant limits, variable limits, over the region R, Application of triple integral, Volume by triple integration.

UNIT V (12 Hrs)

MULTIVARIABLE CALCULUS (VECTOR CALCULUS): Vector Differential Operator, Gradient, Properties, Directional derivative, Divergence and curl: Properties and relations, Solenoidal and Irrotational vector fields, Line integral and Surface integrals, Integral Theorems (excluding Proof), Green's theorem, Stoke's theorem, Gauss divergence theorem.

Text Books:

1. Veerarajan T., "Engineering Mathematics - I & II" , Tata McGraw-Hill, New Delhi, 2014 & 2015.
2. Dr. M.K. Venkataraman, "Engineering Mathematics – Volume I and Volume II, The National Publishing Company, Chennai 2008.

References:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Bali N.P and Manish Goyal., "A Text Book of Engineering Mathematics", Laxmi Publications(P) Ltd, 2011.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi, 9th Edition, 2011
4. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2010.

ONLINE/NPTEL COURSES:

1. https://nptel.ac.in/courses/111106100
2. https://nptel.ac.in/courses/111104125
3. https://nptel.ac.in/courses/111105121
4. https://nptel.ac.in/courses/111107112

AMBS102 PHYSICS

L	T	P	C
3	0	0	3

Course Objectives:

- To understand the fundamental concepts in oscillations, optics and the application in real life optical systems, communication and other applications.

Course Outcomes:

- To understand physical characteristics of SHM and obtaining solution of the oscillator using differential equations.
- To gain knowledge on transverse and longitudinal waves in one dimension.
- To acquire skills to identify and apply formulas of optics and wave physics .
- To apply principles of interference, diffraction and polarization gain knowledge on interferometers.
- To gain knowledge on lasers to engineering situations.

UNIT I (9 Hrs)

SIMPLE HARMONIC MOTION, DAMPED AND FORCED SIMPLE HARMONIC OSCILLATOR: Mechanical and electrical simple harmonic oscillators, complex number notation and phasor representation of simple harmonic motion, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, electrical and mechanical impedance, steady state motion of forced damped harmonic oscillator, power absorbed by oscillator.

UNIT II (9 Hrs)

NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES IN ONE DIMENSION AND INTRODUCTION TO DISPERSION: Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their Eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves and speed of sound, standing sound waves. Waves with dispersion, water waves, superposition of waves and Fourier method, wave groups and group velocity.

UNIT III (9 Hrs)

THE PROPAGATION OF LIGHT AND GEOMETRIC OPTICS: Fermat's principle of stationary time and its applications e.g. in explaining mirage effect,laws

of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them, transfer formula and the matrix method.

UNIT IV (9 Hrs)

WAVE OPTICS: Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Mach-Zehnder interferometer. Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power.

UNIT V (9 Hrs)

LASERS: Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers (ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in science, engineering and medicine.

Text Books:

1. David Halliday, Robert Resnick and Jearl Walker, "Fundamentals of Physics", John Wiley & Sons Inc. USA, 11th Edition, 2018.
2. Arthur Beiser, "Concepts of Modern Physics", Mc-Graw Hill Publications Private Limited, 7th Edition, 2017.
3. N.Subramanyam, "Waves and Oscillations", Vikas Publishing house, 2nd Edition, 2009.

References:

1. Renk, Karl.F, "Basics of laser physics", Springer international publishing, 2nd Edition, 2017.
2. H. J. Pain and Patricia Rankin, "Introduction to vibration and waves", Wiley, 1st Edition, 2015.
3. David Halliday, Robert Resnick and Jearl Walker, "Fundamentals of Physics", Wiley publications, 2013.

ONLINE/NPTEL Courses:

1. Engineering Physics I (Theory): https://nptel.ac.in/courses/122103011

2. Waves and Oscillations: https://nptel.ac.in/courses/115106119
3. Modern Optics: https://nptel.ac.in/courses/115105104

AMES103 BASIC ELECTRONICS ENGINEERING

L	T	P	C
3	0	0	3

Course Objectives:

- To understand the fundamental skills in construction of electronics circuit design and develop various electronic systems.

Course Outcomes:

- To understand the semiconductor physics of the intrinsic, p and n materials.
- To understand the function and operation of diodes, transistors and amplifiers.
- To analyze the performances of BJT & FETs and its uses in amplifiers and oscillators.
- To analyze and design the operational amplifiers circuits.
- To understand the architecture, functions & their applications of IC 741 OP-Amp.

UNIT I (9 Hrs)

SEMI CONDUCTORS AND DIODES: Conductors, Semiconductors, Intrinsic Semiconductors, Extrinsic Semi Conductors- Diode Theory, Basic Ideas, The ideal Diode, Forward and Reverse Bias, Diode Equation, Volt-Ampere Characteristic- Special diodes, symbol of zener diode, operation, V-I characteristics, symbol of photo diode, working principle, LED symbol and principle.

UNIT II (9 Hrs)

RECTIFIERS: Half-wave Rectifier, Full-wave and Bridge Rectifier, derivation of Ripple factor, efficiency of Half-wave, full-wave and Bridge rectifiers- Merits and demerits of Half-wave, full-wave and Bridge rectifiers, Comparisons of rectifiers.

UNIT III (9 Hrs)

BIPOLAR JUNCTION & FIELD-EFFECT TRANSISTORS : Symbols of PNP and NPN transistors and their working principles, Transistor - Construction & working - Input and output characteristics of CB and CE configuration - Transistor as an Amplifier - Principle and working of Hartley oscillator and RC phase shift oscillator - Construction and working of JFET & MOSFET.

UNIT IV (9 Hrs)

DIGITAL CIRCUITS : Boolean algebra – Reduction of Boolean expressions - De-Morgan's theorem – Logic gates -Implementation of Boolean expressions - Flip flops - RS, JK, T and D. Combinational logic - Half adder, Full adder and Subtractors. Sequential logic - Ripple counters and shift registers.

UNIT V (9 Hrs)

OPERATIONAL AMPLIFIERS: Characteristics of Op-Amps, Introduction to Op-amp, Op-amp Block Diagram, ideal and practical Op-amp specifications, 741 Op-amp & its features, Op-amp parameters & Measurement, Applications of Op-Amps, Inverting and Non-inverting amplifier, Integrator and differentiator, Comparators.

Text Books:

1. Albert Malvino and David J Bates, "Electronic Principles", Tata McGraw–Hill, 9th Edition, 2021. (Unit 1 & 2)
2. Boyelstad, "Electronic Devices and Circuits Theory", Pearson Education, 11th Edition, 2013.(Unit 1, 2 & 3)
3. Morris Mano, "Digital design", PHI Learning, 4th Edition, 2016. (Unit 4)
4. Ramakanth A. Gayakwad, "Op-Amps and Linear Integrated Circuits", PHI, 4th Edition, 2015. (Unit 5)
5. D. Roy Chowdhury, "Linear Integrated Circuits", New Age International Pvt.Ltd.,5th Edition, 2018.(Unit 5)

References:

1. Robert L.Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", Pearson/PHI, 10th Edition, 2010.
2. David A.Bell, "Electronic Devices and Circuits", Oxford, 5th Edition, 2009.
3. S.Salivahanan, Kumar, Vallavaraj, "Electronic Devices and Circuits", TATA Mc-Graw Hill, 2nd Edition, 2003.
4. David A, "Operational Amplifiers & Linear ICs", Oxford Uni. Press, 3rd Edition, 2005. (Unit 5)

ONLINE/NPTEL COURSES :

1. http://nptel.ac.in/courses.php http://jntuk-coeerd.in/

AMBL101 PHYSICS LAB

L	T	P	C
0	0	4	2

Course Objectives:

- The physical measurement skills and knowledge about the theory learned in the class to improve ability to analyze experimental result and write laboratory report.

Course Outcomes:

- To develop skills to impart practical knowledge in real time solutions
- To understand principle, concept, working and application of new technology and comparison of results with theoretical calculations.
- To understand measurement technology, usage of new instruments and real time applications in engineering studies.
- To state various laws which they have studied through experiments.
- To describe principles of optical fibre communication.

LIST OF EXPERIMENTS

1. Radius of curvature of a Lens - Newton's rings.
2. Thickness of a thin object by air – wedge.
3. Spectrometer – resolving power of a prism
4. Spectrometer - determination of wavelength using grating.
5. Spectrometer - ordinary and extraordinary rays by calcite prism
6. Laurant's Half shade polarimeter – determination of specific rotatory power.
7. Determination of wavelength of a laser source using transmission grating, reflection grating vernier calipers) and particle size determination.
8. Determination of numerical aperture and acceptance angle of an optical fiber.
9. Determination of optical absorption coefficient of materials using laser
10. Compact disc - determination of width of the groove using laser.

(Total Periods:45)

AMEL102 BASIC ELECTRONICS ENGINEERING LAB

L	T	P	C
0	0	4	2

Course Objectives:

- To design and analyze electronic circuits such as diodes, rectifiers, Zener diode, BJT FET , verify the basic logic operations and simple arithmetic circuits using logic gates.

Course Outcomes:

- To understand the characteristics of basic electronic devices.
- To understand the characteristics of diodes, rectifiers & transistors.
- To construct the adder, subtractor, multiplier circuits to verify their functionalities.
- To interpret the Op-Amp based inverting and non-inverting amplifier circuit.
- To integrate diverse applications of Op-Amp in differentiator, integrator, adder & subtractor circuits.

LIST OF EXPERIMENTS

1. Measurement of different signal parameters using oscilloscope.
2. V-I characteristics of ordinary p-n junction diode.
3. Full wave rectifier –with and without filter.
4. Zener diode as a voltage regulator.
5. Input and output characteristics of BJT.
6. Input and output characteristics of FET.
7. Realization of basic gates using Universal logic gates.
8. Construction of simple Decoder & Multiplexer circuits using logic gates.
9. Construction of simple arithmetic circuits-Adder, Subtractor.
10. Op-Amp based inverting and non-inverting amplifier.
11. Op-Amp based differentiator and integrator.
12. Op-Amp based adder and subtractor.

(Total Periods:45)

AMEL103 ENGINEERING GRAPHICS AND DESIGN LAB

L	T	P	C
1	0	4	3

Course Objectives:

- To provide the basic knowledge about Engineering Drawing and learn the concepts of projections, technical drawing, dimensioning and specifications

Course Outcomes:

- To describe engineering design and its place in society
- To discuss the visual aspects of engineering design.
- To understand engineering graphics standards.
- To illustrate solid modelling.
- To understand computer-aided geometric design
- To understand creation of design working drawings.
- To understand engineering communication inspect.

UNIT I

INTRODUCTION: Introduction, Conics and Special Curves.

UNIT II

PROJECTIONS: Projection of points, lines and planes.

UNIT III

SOLIDS: Projection of solids, section of solids, development of surface.

UNIT IV

ISOMETRIC: Isometric and Orthographic projections.

UNIT V

AUTOCAD: Introduction to computer Aided Drafting hardware overview of application software – 2D drafting commands (Auto CAD) for simple shapes – Dimensioning.

Text Books:

1. Bhatt N.D., Panchal V.M. and Ingle P.R., ”Engineering Drawing”, Charotar Publishing House, 2014.
2. Shah, M.B. and Rana B.C., ”Engineering Drawing and Computer Graphics”, Pearson Education, 2008.
3. Agrawal B. and Agrawal C. M., ”Engineering Graphics”, TMH Publication, 2012.
4. K. Venugopal, ”Engineering Drawing and Graphics + Auto CAD”, New Age International Publication Ltd., 4^{th} Edition, 2004.

References:

1. Narayana, K.L. and P Kannaiah, ”Engineering Drawing”, Scitech Publishers, 2008.
2. CAD Software Theory and User Manuals.

(Total Periods:45)

AMHL104 DESIGN THINKING

L	T	P	C
0	0	2	1

Course Objectives:

- To provide the new ways of creative thinking and learn the innovation cycle of Design Thinking process for developing innovative products.

Course Outcomes:

- To compare and classify the various learning styles and memory techniques and apply them in their engineering education.
- To analyze and inspect emotional expressions in designing products.
- To develop new ways of creative thinking.
- To propose real-time innovative engineering product designs and choose appropriate frameworks, strategies, techniques during prototype development.
- To perceive individual differences and its impact on everyday decisions and further create a better customer experience.

UNIT I (9 Hrs)

AN INSIGHT TO LEARNING: Understanding the Learning Process, Kolb's Learning Styles, Assessing and Interpreting, Remembering Memory:Understanding the Memory process, Problems in retention, Memory enhancement techniques, Emotions: Experience and Expression: Understanding Emotions: Experience and Expression, Assessing Empathy, Application with Peers.

UNIT II (9 Hrs)

BASICS OF DESIGN THINKING: Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts and Brainstorming, Stages of Design Thinking Process (explain with examples) – Empathize, Define, Ideate, Prototype, Test. Being Ingenious and Fixing Problem: Understanding Creative thinking process, Understanding Problem Solving, Testing Creative Problem Solving.

UNIT III (9 Hrs)

PROCESS OF PRODUCT DESIGN: Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design,Examples of best product designs and

functions, Assignment – Engineering Product Design Prototyping and Testing: What is Prototype? Why Prototype? Rapid Prototype Development process, Testing, Sample Example, Test Group Marketing.

UNIT IV (9 Hrs)

CELEBRATING THE DIFFERENCE: Understanding Individual differences and Uniqueness, Group Discussion and Activities to encourage the understanding, acceptance and appreciation of Individual differences. Design Thinking and Customer Centricity: Practical Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product Design.

UNIT V (9 Hrs)

FEEDBACK, RE-DESIGN AND RE-CREATE: Feedback loop, Focus on User Experience, Address ergonomic challenges, user focused design, rapid prototyping and testing, final product, final Presentation, Solving Practical Engineering Problem through Innovative Product Design and Creative Solution.

Text Books:

1. Burgelman, Christensen, and Wheelwright, ”Strategic Management of Technology and Innovation”, 5th Edition, McGraw Hill Publications, 2017.
2. Idris Mootee, ”Design Thinking for Strategic Innovation: What They Can’t Teach You at Business or Design School”, John Wiley & Sons, 2013.

References :

1. E Balaguruswamy, ”Developing Thinking Skills (The way to Success)”, Khanna Book Publishing Company, 2022.
2. Roger Martin, ”The Design of Business: Why Design Thinking is the Next Competitive Advantage”, Harvard Business Press , 2009.
3. Hasso Plattner, Christoph Meinel and Larry Leifer , ”Design Thinking: Understand –Improve– Apply”, Springer, 2011.
4. Jeanne Liedtka, Andrew King and Kevin Bennett, ”Book - Solving Problems with Design Thinking - Ten Stories of What Works”, Columbia Business School Publishing, 2013.
5. Maur´ıcio Vianna, Ysmar Vianna, Isabel K. Adler, Brenda Lucena and Beatriz Russo, ”Design thinking: Business Innovation”, MJV Press, 2011.

(Total Periods:45)

AMAU105 IDEA WORKSHOP LAB

L	T	P	C
2	0	4	0

Course Objectives:

- To learn all the skills associated with the tools and inventory associated with the IDEA Lab and to build useful standalone system/ project with mechanical and electronic fabrication process.

Course Outcomes:

- To Understand the working of tools and inventory associated with the IDEA lab.
- To Understand the working of mechanical and electronic fabrication processes and designing the standalone project and report preparation.

UNIT I

DESIGNING AND INTRODUCTION TO HAND AND POWER TOOLS: Electronic component familiarization, Electronic system design flow.Schematic design and PCB layout and Gerber creation using Eagle CAD. Documentation: Doxygen, Google Docs, Overleaf. Version control tools - GIT and GitHub. Basic 2D and 3D designing using CAD tools: FreeCAD, Sketchup, Prusa Slicer, FlatCAM, Inkspace, OpenBSP and VeriCUT. Introduction to basic hand tools: Tape measure, combination square, Vernier caliper, hammers, fasteners, wrenches, pliers, saws, tube cutter, chisels, vice and clamps, tapping and threading. Adhesives Introduction to Power tools: Power saws, band saw, jigsaw, angle grinder, belt sander, bench grinder, rotary tools. Various types of drill bits.

UNIT II

CIRCUIT PROTOTYPING AND MECHANICAL CUTTING AND JOINING PROCESS: Familiarization and use of basic measurement instruments - DSO including various triggering modes, DSO probes, DMM, LCR bridge, Signal and function generator. Logic analyzer and MSO. Bench power supply (with 4-wire output) Circuit prototyping using (a) breadboard, (b) Zero PCB (c) 'Manhattan' style and (d) custom PCB. Single, double and multilayer PCBs. Single and double-sided PCB prototype fabrication in the lab. Soldering using soldering iron/station. Soldering using a temperature controlled reflow oven. Automated circuit assembly and soldering using pick and place machines. Mechanical cutting processes - 3-axis CNC routing, basic turning, milling, drilling and grinding operations, Laser cutting, Laser engraving etc. Basic welding and brazing and other joining techniques for assembly. Concept of Lab aboard a Box.

UNIT III

ELECTRONIC CIRCUIT BUILDING AND 3D PRINTING: Electronic circuit building blocks including common sensors. Arduino and Raspberry Pi programming and use. Digital Input and output. Measuring time and events. PWM. Serial communication. Analog input. Interrupts programming. Power Supply design (Linear and Switching types), Wireless power supply, USB PD, Solar panels, Battery types and charging. 3D printing and prototyping technology – 3D printing using FDM, SLS and SLA. Basics of 3D scanning, point cloud data generation for reverse engineering. Prototyping using subtractive cutting processes. 2D and 3D Structures for prototype building using Laser cutter and CNC routers. Basics of IPR and patents; Accessing and utilizing patent information in IDEA Lab.

UNIT IV

Discussion and implementation of a mini project.

UNIT V

Documentation of the mini project (Report and video).

Laboratory Activities:

List of Lab activities and experiments

1. Schematic and PCB layout design of a suitable circuit, fabrication and testing of the circuit.
2. Machining of 3D geometry on soft material such as soft wood or modelling wax
3. 3D scanning of computer mouse geometry surface. 3D printing of scanned geometry using FDM or SLA printer.
4. 2D profile cutting of press fit box/casing in acrylic (3 or 6 mm thickness)/cardboard, MDF (2 mm) board using laser cutter and engraver.
5. 2D profile cutting on plywood /MDF (6-12 mm) for press fit designs.
6. Familiarity and use of welding equipment.
7. Familiarity and use of normal and wood lathe.
8. Embedded programming using Arduino and/or Raspberry Pi.
9. Design and implementation of a capstone project involving embedded hardware, software and machined or 3D printed enclosure.

Text Books:

1. Chris Hackett, Weldon Owen, ”The Big Book of Maker Skills: Tools and Techniques for Building Great Tech Projects”, 2018.
2. Sean Michael Ragan, Weldon Owen ”The Total Inventors Manual (Popular Science): Transform Your Idea into a Top-Selling Product”, 2017.
3. Paul Horowitz and Winfield Hill, ”The Art of Electronics”, 3rd Edition, Cambridge University Press.

References:

1. Paul Sherz and Simon Monk. ”Practical Electronics for Inventors” McGraw Hill, 4th Edition.
2. Charles Platt, ”Encyclopedia of Electronic Components (Volume 1,2 and 3)”, Shroff Publishers.
3. John H. Moore, Christopher C. Davis, Michael A. Coplan and Sandra C. Greer, ”Building Scientific Apparatus”, Cambridge University Press, 4th Edition . ISBN-13: 978-0521878586
4. Simon Monk ”Programming Arduino: Getting Started with Sketches”, 2nd Edition, McGraw Hill.
5. Simon Monk and Duncan Amos, ”Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards”, McGraw Hill Education.

SEMESTER II

AMHS201 ENGLISH

L	T	P	C
2	0	2	3

Course Objective:

- Build the competence in English grammar and vocabulary for effective communication by developing Reading, Writing, Listening and Speaking skills of students.

Course Outcomes:

- To enhance communication skills through formal and informal mode.
- To apply the technical writing and communication skills in their academic and professional life.
- To gain self-confidence with improved command over English.
- To understand the technical aspects of communication for better performance in extra curricular activities, recruitment process and prospective jobs.
- To develop and deliver professional presentations.

UNIT I (9 Hrs)

FUNDAMENTALS OF COMMUNICATION SKILLS: Importance of communication through English, Process of communication and factors that influence speaking-Importance of audience and purpose, Principles of communication, comparing general communication and business Communication, Professional Communication, barriers to communication, strategies to overcome communication barriers, formal and informal communication.

UNIT II (9 Hrs)

WRITING SKILLS: Basics of Grammar, Placing of Subject and Verb, Sentence Structures, Use of Phrases and Clauses in sentences, Importance of proper punctuation, Creating coherence, Techniques for writing precisely, Parts of Speech, Uses of Tenses, Active and Passive, Modes of Writing.

UNIT III (9 Hrs)

VOCABULARY BUILDING AND WRITING: The Concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes, Synonyms & Antonyms-Words often confused, One-word substitutes, Idioms and Phrasal Verbs, Abbreviations of Scientific and Technical Words.

UNIT IV (9 Hrs)

SPEAKING SKILLS: Introduction to Phonetic Sounds & Articulation, Word Accent, Rhythm and Intonation, Interpersonal Communication, Oral Presentation, Body Language and Voice Modulation (Para linguistics and Non-Verbal), Negotiation and Persuasion, Group Discussion, Interview Techniques (Telephonic and Video Conferencing).

UNIT V (9 Hrs)

TECHNICAL WRITING: Job Application, CV Writing, Business Letters, Memos, Minutes, Notices, Report Writing Structures, E-mail Etiquette, Blog Writing.

Text Books:

1. Ludlow R. and Panton F., ”The Essence of Effective Communication”, Prentice Hall, 2020.
2. Kul Bhushan Kumar & R. S. Salaria, ”Effective Communication Skills”, Khanna Publishing House, 2018.
3. Dr. Bikram K. Das et al., ”An Introduction to Profession English and Soft Skills”, Cambridge University Press, 2009.

References:

1. Michael Mccarthy and Felicity O’Dell, ”English Vocabulary in Use”, McCarthy M, Cambridge University Press, 3rd Edition, 2017.
2. Raman M. Sharma S, ”Technical Communication: Principles and Practice, Raman, Oxford University Press, 2nd Edition, 2012.

ONLINE/ NPTEL Courses:

1. English Language and Literature: https://nptel.ac.in/courses/109103020
2. Business English Communication: https://nptel.ac.in/courses/109106129
3. Technical English: https://nptel.ac.in/courses/109106066

AMBS202 MATHEMATICS-II

L	T	P	C
3	1	0	4

Course Objective:

- The course aims to formulate and solve partial differential equations, and apply Laplace and Fourier transforms within the engineering domain.

Course Outcomes:

- To formulate and solve various types of partial differential equations.
- To understand the Laplace transform and its properties.
- To apply Laplace transforms to solve ordinary differential equations with constant coefficients and simultaneous ordinary differential equations.
- To understand and apply Fourier transform techniques, including Fourier integral theorem, properties of Fourier transforms, convolution, and Parseval's identity.
- To apply Fourier series and harmonic analysis, enabling them to analyze and synthesize periodic signals and functions in various engineering and mathematical applications.

UNIT I (12 Hrs)

PARTIAL DIFFERENTIAL EQUATIONS: Formation of partial differential equations; Solutions of standard types of first order partial differential equations; Lagrange's linear equation; Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II (12 Hrs)

LAPLACE TRANSFORM: Existence conditions; Transforms of elementary functions; Properties; Transform of unit step function and unit impulse function; Transforms of derivatives and integrals; Transforms of Periodic Functions; Initial and final value theorems.

UNIT III (12 Hrs)

INVERSE LAPLACE TRANSFORM: Inverse Laplace Transforms – Properties, Convolution theorem, Application - Solution of ordinary differential equations with constant coefficients - Solution of simultaneous ordinary differential equations.

UNIT IV (12 Hrs)

FOURIER TRANSFORM: Fourier Integral theorem (statement only); Fourier transform and its inverse; Properties: Fourier sine and cosine transforms; Properties, Convolution and Parseval's identity.

UNIT V (12 Hrs)

FOURIER SERIES: Dirichlet's conditions; Expansion of periodic functions into Fourier series- Change of interval; Half-range Fourier series; Root mean square value - Parseval's theorem on Fourier coefficients; Harmonic analysis.

Text Books:

1. Grewal B.S, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2015.
2. Veerarajan T, "Transforms and Partial Differential Equations", Tata McGraw-Hill, New Delhi, 2012.

References:

1. Bali N.P and Manish Goyal., "A Text Book of Engineering Mathematics", Laxmi Publications(P) Ltd, 2011.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi, 9^{th} Edition, 2011.
3. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2010.

ONLINE/ NPTEL Courses:

1. https://nptel.ac.in/courses/111106139
2. https://nptel.ac.in/courses/111101153
3. https://nptel.ac.in/courses/111107119

AMBS203 CHEMISTRY

L	T	P	C
3	0	0	3

Course Objective:

- To understand the developments and breakthroughs efficiently with upgraded knowledge of new technologies.

Course Outcomes:

- To analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
- To rationalise bulk properties and processes using thermodynamic considerations.
- To distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
- To rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
- To understand the major chemical reactions those are used in the synthesis of molecules.

UNIT I (9 Hrs)

ATOMIC AND MOLECULAR STRUCTURE: Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Pi-molecular orbitals of butadiene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure and role of doping of solids.

UNIT II (9 Hrs)

SPECTROSCOPIC TECHNIQUES AND APPLICATIONS: Principles of spectroscopy and selection rules. Electronic spectroscopy of Fluorescence and its applications in medicine. Applications of Vibrational and rotational spectroscopy of diatomic molecules. . Nuclear magnetic resonance imaging and surface characterization techniques.

UNIT III (9 Hrs)

USE OF FREE ENERGY IN CHEMICAL EQUILIBRIUM: Thermodynamic functions: energy, entropy and free energy. Applications of Cell potentials,Nernst equation ,acid-base,oxidation-reduction and solubility equilibrium. Use of free energy considerations in metallurgy through Ellingham diagrams. **Intermolecular forces and potential energy:** surfaces: Ionic, dipolar and van Der Waals interactions. Equations on state of real gases and critical phenomena.

UNIT IV (9 Hrs)

PERIODIC PROPERTIES: Effective nuclear charge, variations of s, p, d and f orbital and energies of atoms in the periodic table, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability and molecular geometries.

UNIT V (9 Hrs)

STEREO CHEMISTRY: Representations of 3 dimensional structures, structural isomers and stereoisomers, symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. **Organic reactions and synthesis of a drug molecule:** Introduction to reactions involving substitution, addition, elimination, oxidation and reduction. Synthesis of a commonly used drug molecule.

Text Books:

1. Manisha Agrawal, ”Chemistry-I”, Khanna Book Publishing Co., 1st Edition, 2021.
2. P.W.Atkins, Julio de Paula and James Keeler, ”Physical Chemistry”, Oxford University, 11th Edition, 2018.
3. B. H. Mahan, ”University chemistry”, Pearson Education, 4th Edition, 2013.
4. C.N.Banwell, ”Fundamentals of Molecular Spectroscopy”, 3rd Edition, 2008.

References:

1. K.P.C. Volhardt and N. E. Schore, ”Organic Chemistry: Structure and Function”, 5th Edition, 2022.

ONLINE/ NPTEL COURSES:

1. Spectroscopic Techniques for Pharmaceutical and Biopharmaceutical Industries: https://nptel.ac.in/courses/104102113
2. Engineering Chemistry I: https://archive.nptel.ac.in/courses/122/106/122106028
3. Quantum Chemistry of Atoms and Molecules: https://nptel.ac.in/courses/104101124

4. https://archive.nptel.ac.in/courses/122/106/122106028/

AMES204 PROBLEM SOLVING AND PROGRAMMING

L	T	P	C
3	0	0	3

Course Objective:

- To acquaint knowledge of programming in python and learn the concepts, principles, functions and develop an application.

Course Outcomes:

- To understand the basic concepts and working principles of Python Programming.
- To develop algorithmic solutions to simple computational problems.
- To understand the structure of solving problems using programming.
- To explore the concepts of compound data using Python lists, tuples, dictionaries.
- To explore in working of pdf and documents using manipulating images.

UNIT I (9 Hrs)

INTRODUCTION: History , Features , Working with Python, Installing Python, basic syntax, Data types, variables, Manipulating Numbers, Text Manipulations, Python Build in Functions.

UNIT II (9 Hrs)

COMPONENTS OF PYTHON PROGRAMMING: Python objects and other languages, operator Basics, Numbers, String, List, Tuples, Dictionaries, Files, Object Storage, Type Conversion, Type Comparison, Statements, Assignments, Control Statements.

UNIT III (9 Hrs)

FUNCTIONS AND MODULES: Functions Definition and Execution, Arguments, Return Values, Advanced Function Calling, Modules, Importing modules, Tricks for Importing Modules, Packages, Creating a module.

UNIT IV (9 Hrs)

OBJECT ORIENTED AND EXCEPTION HANDLING : Classes and Objects, creating a class, class methods, class inheritance. Exceptions Handling: Build in Exceptions. Files: File operations, reading a file content, writing a file, change position, controlling file I/O, Manipulating file paths.

UNIT V (9 Hrs)

APPLICATIONS : Working with PDF and Word Documents, Working with CSV Files and JSON Data, Sending Email and Text Messages, Manipulating Images, Using Python for Multimedia.

Text Books:

1. Allen B.Downey, ”Think Python: How to Think Like a Computer Scientist”, Shroff O‘Reilly Publishers, 2nd edition, 2016.
2. Guido van Rossum and Fred L. Drake Jr, ”An Introduction to Python”, Revised and updated for Python, Network Theory Ltd., 2011.
3. Martin C.Brown, ”The Complete reference - Python”, Tata McGraw hill edition, 2010.

References:

1. Eric Matthes, ”A Hands-On, Project-Based Introduction To Programming Paperback–3”, 2nd edition, Edition, 2019.
2. Budd T A, ”Exploring Python”, Tata McGraw Hill Education, 2011.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, ”Introduction to Programming in Python: An Inter-disciplinary Approach”, Pearson India Education Services Pvt. Ltd., 2016.

ONLINE/ NPTEL Courses:

1. Programming, Data Structures and Algorithms using Python: https://nptel.ac.in/courses/106106145
2. The Joy of Computing using Python: https://nptel.ac.in/courses/106106182
3. Python for Data Science: https://nptel.ac.in/courses/106106212

AMHS205 UNIVERSAL HUMAN VALUES – II

L	T	P	C
2	1	0	3

Course Objective:

- To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

Course Outcomes:

- To have a holistic vision of life
- To enhance a socially responsible behavior
- To understand the responsibility of an environmental work
- To understand the Competence and Capabilities for Maintaining Health and Hygiene
- To Appreciate the aspiration for excellence (merit) and gratitude for all

UNIT I (9 Hrs)

INTRODUCTION TO VALUE EDUCATION: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations.

UNIT II (9 Hrs)

HARMONY IN THE HUMAN BEING: Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.

UNIT III (9 Hrs)

HARMONY IN THE FAMILY AND SOCIETY: Harmony in the Family, the Basic Unit of Human Interaction, 'Trust', Foundational Value in Relationship,'Respect', Right Evaluation, Other Feelings, Justice in Human to Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.

UNIT IV (9 Hrs)

HARMONY IN THE NATURE/EXISTENCE: Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence. Describing, Defining, Classifying, Providing examples or evidence, Writing introduction and conclusion

UNIT V (9 Hrs)

IMPLICATIONS OF THE HOLISTIC UNDERSTANDING: Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession.

Text Books:

1. Premvir Kapoor, "Professional Ethics and Human Values", Khanna Book Publishing Company, New Delhi, 2022.
2. R R Gaur,R Asthana, G P Bagaria, "The Textbook - A Foundation Course in Human Values and Professional Ethics", Excel Books, New Delhi, 2nd Edition, 2019.
3. RR Gaur, R Asthana, G P Bagaria, "The Teacher's Manual- Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Edition, 2019.

REFERENCE BOOKS:

1. Annie Leonard, "The Story of Stuff", Paperback, 2011.
2. A.N. Tripathi,"Human Values", New Age Intl. Publishers, New Delhi, 2004.
3. Mohandas Karamchand Gandhi, "The Story of My Experiments with Truth", FP classic, 2009.
4. A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, "VanVidya: EkParichaya", 1999.

AMBL201 CHEMISTRY LAB

L	T	P	C
0	0	4	2

Course Objective:

- To explain various methods of volumetric analysis i.e. Redox, Iodometric, complexometric, Neutralization etc. and use of conductivity meter for measurement of conductance of water sample..

Course Outcomes:

- To illustrate the principles of physical chemistry relevant to the study of rate of reactions.
- To estimate rate constants of reactions from concentration of reactants/products as a function of time.
- To measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc.
- To explore chemical concepts, changes in matter and acquire scientific skills in the laboratory.
- To synthesize a small drug molecule and analyze a salt sample.

LIST OF EXPERIMENTS

1. Determination of surface tension and viscosity
2. Thin layer chromatography.
3. Ion exchange column for removal of hardness of water.
4. Determination of chloride content of water.
5. Determination of cell constant and conductance of solutions.
6. Potentiometry - determination of redox potentials and emfs.
7. Synthesis of a polymer/drug.
8. Determination of the partition coefficient of a substance between two immiscible liquids.
9. Saponification/acid value of an oil.
10. Chemical analysis of a salt.

11. Lattice structures and packing of spheres.
12. Determination of the rate constant of a reaction.
13. Colligative properties using freezing point depression.
14. Models of potential energy surfaces.
15. Chemical oscillations- Iodine clock reaction.
16. Adsorption of acetic acid by charcoal.
17. Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

(Total Periods : 45)

EXPERIMENTS THAT MAY BE PERFORMED THROUGH VIRTUAL LABS:

S. No.	Experiment Name	Experiment Link(s)
1	Determination of surface tension and viscosity.	http://pcv-au.vlabs.ac.in/ physical- which has to be broken of_Organic_Solvents/
2	Ion exchange column for removal of hardness of water.	http://icv-au.vlabs.ac.in/inorganic-chemistry/Water*Analysis* _Determination _of*Chemical*_ *Parameters/*
3	Determination of chloride content of water.	http://vlabs.iitb.ac.in/vlabs dev/labs/nitk*labs/Environmental* _Engineering_1/ experiments/determination-of-chloride-nitk/simulation.html
4	Colligative properties using freezing point depression.	http://pcv-au.vlabs.ac.in/ physical- chemistry/Cryoscopy/
5	Determination of the rate constant of a reaction.n.	http://pcv-au.vlabs.ac.in/ physical- chemistry/EMF _Measurement/
6	Determination of cell constant and conductance of solutions.	http://icv-au.vlabs.ac.in/ inorganic- chemistry/ Water*Analysis*D*eterminatio of*P *hysical*P *arameters/*
7	Potentiometry - determination of redox potentials and emfs.	http://pcv-au.vlabs.ac.in/ physical- chemistry/EMF*M easurement/*
8	Saponification/acid value of an oil	http://biotech01.vlabs.ac.in/bio chemistry/ Estimation_of _Saponificatio n*V alue_ of Fats_ or_ Oils/*
9	Lattice structures and packing of spheres.	https://vlab.amrita.edu/ ?sub=1&brch=2 82&sim=370&cnt=1

AMEL202 PROBLEM SOLVING AND PROGRAMMING LAB

L	T	P	C
0	0	4	2

Course Pre-requisite:

- Basic Programming language

Course Objective:

- To develop an application using python libraries and packages.

Course Outcomes:

- To develop an application for simple real life problems with flow charts.
- To write a program using python statements and expressions.
- To write a program by implementing functions and strings in python.
- To demonstrate an application by dealing with an exceptions
- To explore pygame tool by developing a gaming application.

LIST OF EXPERIMENTS

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets &Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)

7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, Scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
11. Exploring Pygame tool.Developing a game activity using Pygame like bouncing ball, car race etc.

(Total Periods:45)

AMEL203 WORKSHOP

L	T	P	C
1	0	4	3

Course Objective:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

Course Outcomes:

- To fabricate components with their own hands.
- To relate practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
- To design small devices of their interest by assembling different components.
- To practice Arc Welding and Gas Welding.
- To develop a casted products.

Course Content:

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods.
2. CNC machining, Additive manufacturing.
3. Fitting operations & power tools.
4. Electrical & Electronics.
5. Carpentry.
6. Plastic moulding, glass cutting.
7. Metal casting.
8. Welding (arc welding & gas welding), brazing.

Practicals:

1. Machine shop
2. Fitting shop
3. Carpentry
4. Electrical & Electronics
5. Welding shop (Arc welding + Gas welding)
6. Casting
7. Smithy
8. Plastic moulding& Glass Cutting

EXPERIMENTS THAT MAY BE PERFORMED THROUGH VIRTUAL LABS:

S. No.	Experiment Name	Experiment Link(s)
1	Welding shop (Arc welding + Gas welding).	http://mm- coep.vlabs.ac.in/ LaserSpotWelding/Theory.html? domain=Mechanical%20Engineering &lab=Welcome %20to %20Micromachining %20laboratory
2	Casting	http://fab- coep.vlabs.ac.in/exp7/Theory.html? domain=Mechanical %20Engineering&lab=Welcome%20tO %20FAB%20laboratory

(Total Periods:45)

AMAU204 SPORTS AND YOGA

L	T	P	C
2	0	0	0

Course Objective:

- To expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness.

Course Outcomes:

- To practice Physical activities and Hatha Yoga focusing on yoga for strength, flexibility, and relaxation.
- To learn techniques for increasing concentration and decreasing anxiety which leads to stronger academic performance.
- To learn breathing exercises and healthy fitness activities
- To understand basic skills associated with yoga and physical activities including strength and flexibility, balance and coordination.
- To perform yoga movements in various combination and forms.

UNIT I:

Introduction to Physical Education, Olympic Movement, Physical Fitness, Wellness and Lifestyle.

UNIT II:

Fundamentals of Anatomy & Physiology in Physical Education, Sports and Yoga, Kinesiology, Biomechanics & Sports.

UNIT III:

Postures, Yoga, Yoga & Lifestyle.

UNIT IV :

Training and Planning in Sports, Psychology & Sports,Doping.

UNIT V:

Sports Medicine,Sports/Games.

References:

1. Prof. Ajmer Singh, ”Modern Trends and Physical Education
2. B.K.S. Iyengar, ”Light On Yoga”.
3. Health and Physical Education – NCERT (11th and 12th Classes)

SEMESTER III

AMPC301 DATA STRUCTURES AND ALGORITHMS

L	T	P	C
3	0	0	3

Course Objective:

- To impart knowledge about the importance of data structures in programming and to familiarise basic searching and sorting algorithms.

Course Outcomes:

- To comprehend the basics of algorithms and understand the operations performed using arrays.
- To understand the linear data structures and its applications.
- To realize the properties of tree data structure and its importance in searching large database.
- To understand graph data structure and its applications.
- To know the need for hash tables.

UNIT I (9 Hrs)

INTRODUCTION: Data structures: Definition, Types - Algorithm: Definition, Properties, Analyzing algorithms: Space and Time Complexity-Arrays: One dimensional array, multidimensional array, Applications. Searching Algorithms: Linear search, Binary Search, Fibonacci search. Sorting Algorithms: Selection Sort, Bubble Sort, Quick Sort, Insertion sort, Heap Sort and Merge Sort.

UNIT II (9 Hrs)

STACK,QUEUE AND LINKED LISTS: Stacks: Definition – Operations - Applications of stack. Queues: Definition - Operations - Priority queues – De-queues – Applications of queue. Linked List: Singly Linked List, Doubly Linked List, Circular Linked List, Linked stacks, Linked queues, Applications of Linked List – Dynamic storage management.

UNIT III (9 Hrs)

TREE: Definition - Binary tree – Terminology – Representation – Operations - Applications – Binary search tree – AVL tree. B Trees: B Tree indexing - Operations on a B Tree - B + Tree Indexing. Trie - Trie operations.

UNIT IV (9 Hrs)

GRAPH: Definition – Terminology – Representation - Traversals – Applications - Spanning tree, Shortest path and Transitive closure, Topological sort. Set: Definition - Representation - Operations on sets – Applications

UNIT V (9 Hrs)

HASH TABLE: Tables: Rectangular tables - Jagged tables – Inverted tables - Symbol tables – Static tree tables - Dynamic tree tables - Hash tables-Overflow handling- Files: Sequential organization – Indexed organization.

Text Books:

1. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures, Galgotia Book Source, Pvt. Ltd., 2004.
2. D. Samanta, Classic Data Structures, 2nd, Prentice-Hall of India, Pvt. Ltd., India, 2012.

References:

1. Thomas Cormen, Charles Lieserson, Ronald L Rive stand Clifford Stein, "Introduction to Algorithms", MIT Press/McGraw-Hill, 4th Edition, 2022.
2. John Canning, Alan Broder, Robert Lafore, "Data Structures & Algorithms in Python", Addison-Wesley Professional,1st Edition, 2022.

ONLINE/ NPTEL COURSES:

1. Programming, Data Structures and Algorithms Using Python: https: //onlinecourses.nptel.ac. in/noc23 _cs95
2. Introduction to Programming, Data Structures and Algorithms Using Python: https: //onlinecourses.nptel.ac.in/noc2 3_ cs15
3. Programming, Data Structures and Algorithms using Python for beginners: https: //nptel.ac.in /courses/106106145

AMPC302 DIGITAL ELECTRONICS AND SYSTEMS

L	T	P	C
3	0	0	3

Course Pre-requisite:

- Basic Electronics Engineering

Course Objective:

- To design combinational logic circuits and Sequential logic circuits, including multiplexers, decoders, encoders, adders, subtractors, Flip Flops and Latches. To learn the basics of IoT devices and types of boards.

Course Outcomes:

- To understand various combinational digital circuits using logic gates.
- To understand sequential circuits and analyze the design procedures.
- To understand Verilog HDL and hierarchial modeling concepts.
- To understand various protocols of IoT using various sensors and actuators.
- To design and develop system using Rasperry Pi/Arduino.

UNIT I (9 Hrs)

COMBINATIONAL LOGIC: Combinational Circuits – Karnaugh Map, Analysis and Design Procedures of combinational circuit, Magnitude Comparator, Parity generator/checker, Decoder, Encoder, Implementation of combinational logic using Multiplexers, Demultiplexers.

UNIT II (9 Hrs)

SYNCHRONOUS SEQUENTIAL LOGIC: Introduction to Sequential Circuits – Flip-Flops, operation and excitation tables, Triggering of Flip Flop, Analysis and design of clocked sequential circuits – Design of Moore/Mealy models, state minimization, state assignment, circuit implementation- Implementation of combinational logic/sequential logic design using standard ICs, PROM, PLA and PAL.

UNIT III (9 Hrs)

DIGITAL DESIGN WITH VERILOG HDL: Modules – instances – Data types – Arrays – System tasks – directives – Modules and Ports – Gate-Level Modeling – Dataflow Modeling – Behavioral Modeling - Design of Multiplexers, counters and full adders – Introduction - Hierarchical Modeling concepts – 4-bit ripple carry counter.

UNIT IV (9 Hrs)

SENSORS AND ACTUATORS: Introduction to the Concept of IoT Devices – IoT Devices Versus Computers, IoT Configurations, IoT Basic Components, IoT Architecture - State of the Art,Functional View, Information View, Deployment and Operational View, Integration of Sensors and Actuators with Arduino.

UNIT V (9 Hrs)

DESIGN AND DEVELOPMENT: Introduction to Arduino – Arduino Board, Arduino types - Micro, UNO, NANO, Modules - WiFi, Bluetooth Node ESP, Raspberry: Raspberry Pi Board Types, IDE programming - Interfaces and Raspberry Pi with Python Programming.

Text Books:

1. A. P. Godse and D. A. Godse, ”Digital Principles and System Design”, Technical Publications, 4th Edition, 2021.
2. M. Morris Mano, Michael D. Ciletti, ”Digital Design : With an Introduction to the Verilog HDL, VHDL, and System Verilog”, Pearson Education, 6th Edition, 2018.
3. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, ”IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, CISCO Press, 2017.

References:

1. Charles H. Roth, Larry L. Kinney and Raghunandan G. H, ”Fundamentals of Logic Design”, Cengage India Private Limited, 1st Edition, 2019.
2. Arshdeep Bahga, Vijay Madisetti, ”Internet of Things – A hands-on approach”, Universities Press, 2015.
3. Jan Holler, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand, David Boyle, ”From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence”, Elsevier, 2014.
4. Olivier Hersent, David Boswarthick, Omar Elloumi , ”The Internet of Things – Key applications and Protocols”, Wiley, 2012 (for Unit 4).

ONLINE/ NPTEL COURSES:

1. Digital Circuits: https://nptel.ac.in/courses/108105113
2. Microelectronics: Devices To Circuits: https://nptel.ac.in/courses/108107142

AMPC303 OBJECT ORIENTED PROGRAMMING

L	T	P	C
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Course Pre-requisite:

- Basic knowledge in C programming.

Course Objectives:

- To acquire skill on object oriented programming and expertise programming skills through JAVA language, Java beans and RMI.

Course Outcomes:

- To understand object oriented programming concepts.
- To apply the OO programming features in real time applications.
- To design and develop GUI for object oriented applications.
- To understand, design and develop a Generic and package applications.
- To develop a complete object oriented applications using Java beans and RMI.

UNIT I (9 Hrs)

INTRODUCTION: Java features: Java Platform –Java Fundamentals – Expressions, Operators, and Control Structures – Classes and Objects, Constructors – Destructors - Packages and Interfaces – Internationalization.

UNIT II (9 Hrs)

OVERLOADING: Inheritance – Files and Stream – Multithreading – Exception Handling.

UNIT III (9 Hrs)

GUI COMPONENTS: AWT package - Layouts –Containers - Event Package - Event Model –Painting –Garbage Collection – Java Applets – Applet Application - Swing Fundamentals - Swing Classes.

UNIT IV (9 Hrs)

GENERICS: Collections - Utility Packages –Input Output Packages - Inner Classes – Java Database Connectivity – Java security.

UNIT V (9 Hrs)

JAVA BEANS: Application Builder Tools - Using the Bean Developer Kit -Jar Files-Introspection – BDK-Using BeanInfo Interface –Persistence-Java Beans API Using Bean Builder - Networking Basics - Java and the Net –InetAddress –TCP/IP Client Sockets – URL – URL Connection –TCP/IP Server - Sockets - A Caching Proxy HTTP Server – Datagrams – RMI.

Text Books:

1. Deitel and Deitel, "JAVA How to Program", Prentice Hall, 11th Edition, 2017.
2. Hari Mohan Pandey, "JAVA Programming", Pearson, 1st Edition, 2011.

References:

1. Herbert Schildt and Dale Skrien, "Java Fundamentals – A Comprehensive Introduction", Tata Mc Graw Hill, 1st Edition, 2017.
2. John Dean, Raymond Dean, "Introduction to Programming with JAVA –A Problem Solving Approach", Tata Mc Graw Hill, 1st Edition, 2012.
3. Ralph Bravaco and Shai Simonson, "Java Programming: From the Ground Up", Tata McGraw Hill, 2nd Edition, 2012.

ONLINE/NPTEL Courses:

1. Object Oriented System Development using UML: https://nptel.ac.in/courses/106105224
2. Java: https://nptel.ac.in/courses/106105225

AMPC304 OPERATING SYSTEMS

L	T	P	C
3	0	0	3

Course Pre-requisite:

- Programming Languages, Data Structures and Algorithms, Computer Organization and Architecture.

Course Objective:

- To learn the details of the abstractions, interfaces provided by the OS for program execution and execution requirements, processes, threads, memory management, files. To analyse concurrency and related synchronization based solutions.

Course Outcomes:

- To understand the role, functionality of the layering systems software components
- To understand the design and usage of the OS API and OS services.
- To understand process management, concurrency and thread introduction.
- To understand problems arising due to concurrency and related synchronization based solutions.
- To have Hands-on practical experience with usage of the OS API and basics of OS mechanisms.

UNIT I (9 Hrs)

INTRODUCTION TO OPERATING SYSTEMS: Application requirements, The systems stack and role of OS, resources, abstractions and interfaces, Components overview of an OS, Examples of different types of OS - Basic organization of hardware components, Von Neumann architecture -Processes: Process abstraction, Process Control Block (PCB),Design of system calls - Invocation and basic OS handling, Process control system calls, fork, wait, getpid, getppid and variants, The limited direct execution model.

UNIT II (9 Hrs)

MEMORY MANAGEMENT: Address bus and memory access, Memory view of a process, heap, stack, code, data - Process memory usage requirements, virtual memory and related system calls (mmap, munmap, sbrk, mprotect) -Address translation mechanisms: static mapping, segmentation, paging Page faults, page sharing, read/write permissions, swapping, process vs OS memory - Memory bookkeeping and management - motivation and mechanisms (process and OS) - Case studies: malloc and role of OS for program to process.

UNIT III (9 Hrs)

PROCESS MANAGEMENT AND CONCURRENCY: The process lifecycle, source code to execution, The OS mode of execution, limited direct execution recap, interrupts, system calls, switch mechanism and PCB state- Scheduling policies, scheduling metrics, goals and examples (interactive vs. real-time, priority)- Motivation, application, process and OS use cases- Introduction to threads and the pthread API.

UNIT IV (9 Hrs)

SYNCHRONIZATION: Synchronization primitives, limitations of software solutions, atomic Instructions, test-and-set, spinlocks, mutexes, condition variables, semaphores- Introduction to the pthread synchronization API- Case studies, producer-consumer, reader, writers, barriers- Discussion on issues with concurrency: race conditions, deadlocks, order violation.

UNIT V (9 Hrs)

FILE SYSTEMS: Persistence and the File abstraction, Hardware view- Hard disk architecture and its interfacing, Process view - System calls for file handling, Roles and responsibilities of file system, File system design details- file and file system metadata, directory structure, caching optimizations, File System case study (the Unix file system etc.).

Text Books:

1. Andrew S. Tannenbaum and Herbert Bos, Modern Operating Systems, Pearson Education India, 4th Edition 2014.
2. Avi Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts, Wiley India; John Wiley & Sons, 9th Edition, 2013.

References:

1. William Staling, Operating Systems: Internals and Design Principles, Prentice Hall, 7th Edition, 2012.
2. D M Dhamdhere, Operating Systems:A Concepts Based Approach, McGraw-Hill Education, 3rd Edition, 2017.

ONLINE/ NPTEL COURSES:

1. Introduction to Operating Systems: https://nptel.ac.in/courses/106106144
2. Operating System Fundamentals: https://nptel.ac.in/courses/106105214
3. Operating Systems: https://nptel.ac.in/courses/106108101

AMBS305 MATHEMATICS – III

L	T	P	C
3	1	0	4

Pre-requisite:

- Basic Knowledge in Maths & Statistics

Course Objective:

- To learn the foundations of probabilistic and statistical methods in engineering field.

Course Outcomes:

- To understand the fundamental concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
- To understand and apply measures of central tendency, dispersion, moments, skewness, kurtosis, correlation, regression, and rank correlation for effective data analysis and interpretation.
- To attain proficiency in curve fitting techniques and conduct significance tests for large samples.
- To perform t-tests for means, correlation tests, F - test, and Chi-square tests for goodness of fit and independence of attributes.
- To apply the fundamental principles of experimental design classifications in the field of engineering.

UNIT I (9 Hrs)

BASIC PROBABILITY: Sample Space and Events, Axioms of Probability, Conditional Probability, Bayes' Theorem, Independent Events, Random Variables, Discrete and Continuous Random Variables – Probability Mass Function - Probability Density Function – Cumulative Distribution Function - Expectation and Variance, Standard Probability Distributions (Problems only): Bernoulli, Binomial, Poisson, Geometric, Multinomial, Uniform , Exponential, Gamma, Erlang and Normal Distribution.

UNIT II (9 Hrs)

BASIC STATISTICS: Measures of Central tendency – Mean – Median – Mode; Measure of Dispersion – Range – Variance – Standard Deviation; Moments, Skewness and Kurtosis, Correlation and regression, Rank Correlation.

UNIT III (9 Hrs)

APPLIED STATISTICS (LARGE SAMPLES): Curve Fitting by the Method of Least Squares- Fitting of straight lines, second degree parabolas and more general curves. **Test of Significance:** Large Sample Test for Single Proportion, Difference of Proportions, Single Mean, Difference of Means and Difference of Standard Deviations.

UNIT IV (9 Hrs)

APPLIED STATISTICS (SMALL SAMPLES): Student's' t-Tests - Test for Single Mean, Difference of Means and Correlation Coefficients, Test for ratio of variances (F - Test), Chi-square Test for goodness of fit and Independence of Attributes.

UNIT IV (9 Hrs)

DESIGN OF EXPERIMENTS: One-Way and Two-way Classifications- Completely randomized design- Randomized block design- Latin square design -2 factorial designs.

Text Books:

1. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003.
2. S. Ross, A First Course in Probability, Pearson Education India,9th Edition, 2013.

References:

1. Bali N.P and Manish Goyal, A Textbook Of Engineering Mathematics, Laxmi Publications(P) Ltd, 10th Edition, 2019.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, New Delhi, 10th Edition, 2018.
3. Grewal B.S, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 43rd Edition, 2017.
4. William Feller, An Introduction to Probability Theory and its Applications, (WSE) Vol. 1, 3rd Edition, 2013.

ONLINE/ NPTEL COURSES:

1. Probability and Statistics: https://nptel.ac.in/courses/111105090
2. Advanced Engineering Mathematics: https://nptel.ac.in/courses/111107119
3. Introduction to Probability Theory and Statistics: https://nptel.ac.in/courses/111102160

AMPL301 DATA STRUCTURES AND ALGORITHMS LAB

L	T	P	C
0	0	4	2

Course Pre-requisite:

- Basic knowledge in programming

Course Objective:

- To enable students write programs using various data structures, analyse and understand the benefits of choosing the right data structure.

Course Outcomes:

- To write programs for search and sorting algorithms.
- To write programs for implementing stacks, queues and linked list.
- To write programs for searching using tree data structure.
- To write programs for identifying shortest path in a network.
- To write programs that implements hash tables.

LIST OF EXPERIMENTS

1. Searching Algorithms (With the Number of Key Comparisons) - Sequential, Binary and Fibonacci Search Algorithms on an Ordered List
2. Sorting Algorithms: Insertion Sort, Selection Sort, Bubble Sort, Quick Sort, Heap Sort and Merge Sort.
3. Implementation of Stack and Its Operations.
4. Application of Stack for Converting an Arithmetic Expression into Postfix Form and Evaluation of Postfix Expression.
5. Implementation of Queue, Circular Queue, Priority Queue, Dequeue and their Operations.
6. Implementation of Singly Linked List, Doubly Linked List, Circular Linked List.
7. Implementation of Binary Tree and Binary Traversal Techniques.
8. Implementation of Graph Traversal Techniques.
9. Implement Dijkstra’s Algorithm to Obtain the Shortest Paths.
10. Implementation of Hash Tables and its Operations.

(Total Periods:45)

AMPL302 OBJECT ORIENTED PROGRAMMING LAB

L	T	P	C
0	0	4	2

Course Pre-requisite:

- Basic knowledge in C, C++ and Java Programming.

Course Objectives:

- To familiarize the concept of object-oriented programming like classes, constructors, Polymorphism, inheritance, and file handling and open source libraries.

Course Outcomes:

- To understand the basic concepts of OOPs.
- To apply various Python Libraries to address Programming Issues.
- To understand the advanced concepts of python and apply for accessing databases and web data.
- To understand APIs and third-party libraries to be used with Python.
- To demonstrate the ability to apply the OOPs approaches in real time.

LIST OF EXPERIMENTS

TOTAL PERIODS:45

1. Program to implement classes and objects.
2. Program to implement constructors and destructors with array of objects.
3. Program to demonstrate function overloading.
4. Program to implement different types of inheritances like multiple, Multilevel and hybrid.
5. I/O Program to demonstrate the use of abstract classes.
6. Program to demonstrate I/O streams and functions.
7. Program to perform all possible type conversions.
8. Program to demonstrate exception handling technique.

9. Program to implement networking concepts.
10. Program to implement RMI concepts.
11. Program to implement AWT concepts.
12. Program to implement swing concepts.
13. Program to design and implement applet.
14. Program to design and implement JDBC
15. Program to design an event handling event for simulating a simple calculator.

AMPL303 OPERATING SYSTEMS LAB

L	T	P	C
0	0	4	2

Course Pre-requisite:

- Basic Programming language, Data Structures and Algorithms.

Course Objective:

- The program execution and requirements processes, threads, memory management, files and to impart Hands-on practical experience in different OS concepts.

Course Outcomes:

- To understand the role, functionality and layering of the system software components.
- To understand the design and usage of OS API and OS services.
- To understand the details of the abstractions and interfaces provided by the OS for program.
- To understand problems arising due to concurrency and related synchronization based solutions.
- To demonstrate the usage of OS API and basics of OS services.

LIST OF EXPERIMENTS

1. Usage of tools — unix shell commands (file commands, ps, ls, top), text editor (nano, vi, gedit, emacs)
2. C programming language refresher — header files, compilation and linking using GCC, program execution, functions, argument passing, structures, pointers, file handling.
3. Usage of tools — GCC, GDB, Objdump, shell scripts
4. Simple strace usage to showcase different interfaces (stdlib, system call)
5. Tools usage — ps, pstree, top
6. Usage of process control system calls to identity process identifiers, create process hierarchies, launch new executables, control exit sequence of parent and child processes.
7. Familiarity with files in the / proc / pid/ directory

8. (Virtual) addresses of variables and initialized pointers.
9. Use of malloc() and demonstration of per-process virtual addresses
10. Tools usage — strace, free, top, htop, vmstat, /proc/pid/maps
11. Free memory statistics correlated with malloc(). Number of system calls and malloc() usage.
12. Implement a custom memory allocator using system calls
13. User mode programs to demonstrate LDE
14. Demonstration of process execution interleaving in different orders
15. Simulation based analysis of scheduling policies
16. Tools usage — nice/proc/pid/status
17. Creation of threads using the pthread API and modification of shared variables with and without Synchronization
18. Using spinlock, mutexes and condition variables to implement semaphores, barriers (using the threads API)
19. Implement solutions to the producer-consumer, readerwriters problems using the different synchronization primitives
20. Develop synchronization solutions for applications that use shared data (e.g., ordering of threads, concurrent hash tables, etc.)
21. Using shared memory and semaphores implement synchronized access to a shared memory area across processes (e.g., a message queue).
22. Command line tools usage - state, file, du, df, fsck
23. Implementation of file utilities (e.g., find, grep) using the system call API.
24. Implement a simple file system to handle files on an emulated disk (via a large file) — file system API, superblock, inode and data block management.

(Total Periods:45)

SEMESTER –IV

AMPC401 COMPUTER ORGANIZATION AND ARCHITECTURE

L	T	P	C
3	0	0	3

Course Pre-requisite:

- Problem solving and programming.

Course Objective:

- To learn the basic components of computer, instruction set architecture, memory hierarchy, super scalar processor and multicore systems.

Course Outcomes:

- To understand the components of a basic computer.
- To understand the key components of a CPU and how the instructions are executed.
- To analyze the execution time taken in a pipelined processor.
- To understand the need of memory hierarchy and efficiency achieved due to the use of cache.
- To interpret how the data is stored and input-output is performed in computers.

UNIT I (9 Hrs)

INTRODUCTION: Role of abstraction, Basic functional units of a computer, Von-Neumann model of computation, Moore's law, form Notion and perance- Data representation and basic operations.

UNIT II (9 Hrs)

INSTRUCTION SET ARCHITECTURE (RISC-V): CPU registers, Instruction format and Encoding, addressing modes, Instruction set, Instruction types, Instruction Decoding and Execution, Basic Instruction cycle, Reduced Instruction Set Computer (RISC), Complex Instruction Set Computer (CISC), RISC-V instructions - X86 Instruction set.

UNIT III (9 Hrs)

PROCESSOR: Revisiting clocking methodology, Amdahl's law, Building a data path and control, single cycle processor, multi-cycle processor, instruction pipelining, Notion of ILP, data and control hazards and mitigations - Limits of ILP.

UNIT IV (9 Hrs)

MEMORY HIERARCHY: SRAM/DRAM, Locality of reference, Caching - different indexing mechanisms, trade-offs related to block size, associativity, cache size, processor, cache interactions for a read/write request, basic optimizations - write through/writeback caches, average memory access time, cache replacement policies, memory interleaving.

UNIT V (9 Hrs)

STORAGE AND I/O: Introduction to magnetic disks, flash memory- I/O mapped I/O and memory mapped I/O - I/O data transfer techniques - programmed I/O, Interrupt-driven I/O and DMA.

Text Books:

1. Carl Hamacher, "Computer Organization and Embedded Systems", McGrawHill Higher Education, 6th Edition, 2022.
2. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", Elsevier, 5th Edition, 2014.

References:

1. Vincent P. Heuring and Harry F. Jordan, "Computer System Design and Architecture", Pearson Education, 2nd Edition, 2016.
2. Smruti Ranjan Sarangi, "Computer Organisation & Architecture", McGraw Hill, 2014.
3. Mano M. Morris, "Computer System Architecture", Pearson, 2007.

ONLINE/ NPTEL COURSES:

1. Introduction to computer System and its submodules: https://nptel.ac.in/courses/106103068
2. Computer Organization and Architecture: https://nptel.ac.in/courses/106106166
3. Computer Organization and Architecture A Pedagogical Aspect: https://nptel.ac.in/courses/106103180

AMPC402 DATABASE SYSTEMS

L	T	P	C
3	0	0	3

Pre-requisite:

- Data Structures and Algorithms

Course Objective:

- To design and implement database schema, query languages for an application using RDBMS concepts such as transactions and concurrency control.

Course Outcomes:

- To design and implement database schema for an application using RDBMS concepts.
- To understand SQL queries for tasks of various complexities.
- To design ER-models to represent simple database application and Improve the database design by normalization.
- To understand the working of Database including data storage, indexing and query processing.
- To study non-relational and distributed database management systems with a focus on query optimization.

UNIT I: (9 Hrs)

INTRODUCTION: Introduction to Data Models (Relational, Semi structured, ER), Relational Data Model- Relational Algebra, Relational Calculus or Connection to First Order Logic (Optional).

UNIT II: (9 Hrs)

SQL INTERACTING WITH DATABASE: DDL, Insert/Delete/Update, Simple Queries (select/ project/ join/ aggregate queries), Complex queries (With Clause, Nested Sub queries, Views) - Programming in a standard language and interfacing with a DB backend.

UNIT III: (9 Hrs)

DATABASE DESIGN AND BIG DATA: Key-value Stores and Semi-structured Data, JSON and Mongo DB, other combinations. Introduction to ER model: Mapping from ER to relational model, Functional Dependencies, Normalization (BCNF, Optionally 3NF).

UNIT IV: (9 Hrs)

PHYSICAL DESIGN AND QUERY PROCESSING: Overview of Physical Storage (Hard Disks, Flash/SSD/RAM) – sequential vs random I/O, Reliability via RAID, Storage Organization (Records, Pages and Files) – Database Buffers, Database Metadata, Indexing, B+-Trees- Query Processing: External sort, Joins using nested loops, indexed nested loops.

UNIT V: (9 Hrs)

QUERY OPTIMIZATION AND TRANSACTION PROCESSING: Overview of Query Optimization - equivalent expressions, concept of cost based optimization, Concept of transactions and schedules, ACID properties, Conflict - Serializability, Concurrency control- locks, 2PL, Strict 2PL, optional- isolation level, Recovery using undo and redo logs.

Text Books:

1. Silberschatz, Korth and Sudarshan, ”Database System Concepts”, McGraw-Hill, 7^{th} Edition, 2021.
2. RP Mahapatra, ”Database Management Systems”, Khanna Publishing House, 2020.
3. Krishnan, ”Database Management Systems”, McGraw Hill Higher Education, 3^{rd} Edition, 2002.

References:

1. Hector Garcia-Molina, Jeffrey Ullman and Jennifer Widom, ”Database Systems”, Pearson, 2^{nd} Edition, 2008

ONLINE/NPTEL COURSES:

1. Introduction to Database Systems: https://nptel.ac.in/courses/106106220
2. Databse Systems: https://nptel.ac.in/courses/106106095
3. Basic Database Queries: https://nptel.ac.in/courses/106104021

AMPC403 COMPUTER NETWORKS

L	T	P	C
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Course Pre-requisite:

- Basic knowledge in computer.

Course Objective:

- To learn the fundamental concepts of networks and OSI layers. To analyze various routing algorithms and security algorithms in networks.

Course Outcomes:

- To understand the fundamentals of network and transmission media.
- To understand the error detection, correction codes and datalink layer protocols.
- To understand the various routing algorithms and Internetworking.
- To enhance the knowledge of sockets and congestion control techniques.
- To enhance the knowledge in IDS and cryptographic techniques.

UNIT I (9 Hrs)

PHYSICAL LAYER: Introduction- Uses, Network Hardware, Software, Reference Models - Theoretical Basis for Communication - Electromagnetic Spectrum, Radio Transmission, Digital Modulation, Baseband Transmission -Transmission Media, Wireless Transmission.

UNIT II (9 Hrs)

DATALINK LAYER: Design Issues - Services, Framing, Error Control, Flow Control - Error Detection and Correction Codes, Hamming Code, Cyclic Redundancy Check - Data Link Layer Protocols, Simplex Protocol , Sliding Window Protocols - Medium Access Control Sublayer, Channel Allocation Problem, Multiple Access Protocols, ALOHA, CSMA Protocols, Collision-Free Protocols, Wireless LAN Protocols - Ethernet MAC Sublayer Protocol, 802.11 MAC Sublayer Protocol - Data Link Layer Switching, Uses of Bridges, Learning Bridges, Repeaters, Hubs, Bridges, Switches, Routers and Gateways.

UNIT III (9 Hrs)

NETWORK LAYER: Design Issues- Routing Algorithms, The Optimality Principle, Shortest Path Algorithm, Flooding, Distance Vector Routing, Link State Routing - Congestion Control Approaches, Traffic-Aware Routing, Admission Control, Traffic Throttling, Load Shedding - Internetworking, Tunneling, Internetwork Routing, IPv4, IP Addresses, IPv6.

UNIT IV (9 Hrs)

TRANSPORT LAYER: Services- Berkeley Sockets, Example - Elements of Transport Protocols Addressing, Connection Establishment, Connection Release, Flow Control and Buffering, UDP – TCP Segment Header, Connection Establishment, Connection Release, Sliding Window, Timer Management - Congestion Control.

UNIT V (9 Hrs)

APPLICATION LAYER: DNS, E-Mail, WWW, Architecture, HTTP, Content Delivery, Server Farms and Web Proxies, Peer-To-Peer Networks, Firewalls - Intrusion Detection System - Network Security - Introduction to Cryptography, Substitution Ciphers, Transposition Ciphers, Public Key Algorithms, RSA, Symmetric Algorithm.

Text Books:

1. A.S.Tanenbaum and D.J.Wetherall, Computer Networks , Pearson, 6th Edition, 2021.
2. Behrouz A. Ferouzon Data Communication and Networking with TCP/IP Protocol Suite, McGraw Hill, 6th Edition, 2022.

References:

1. J.F.Kurose and K.W. Ross, Computer Networking: A Top-down approach, Pearson, 7th Edition , 2017.
2. Larry L. Peterson and Bruce S. Davie, Computer Networks- A System Approach, Elsevier, 5th Edition, 2012.

ONLINE/ NPTEL COURSES:

1. Computer Networks: https://nptel.ac.in/courses/106105080
2. Emergence of Networks & Reference Models: https://nptel.ac.in/courses/106105081
3. Introduction on Computer Networks: https://nptel.ac.in/courses/106106091

AMPC404 ARTIFICIAL INTELLIGENCE

L	T	P	C
3	0	0	3

Course Pre-requisite:

- Basic knowledge in programming and logics.

Course Objectives:

- To apply heuristic concepts to design efficient algorithms and knowledge representation schemes for typical AI problems.

Course Outcomes:

- To understand AI & its types, Problem space, its searching and implement heuristic concepts in real time applications.
- To familiarize with knowledge representation schemes for typical AI problems.
- To understand the concept of basics of reasoning under uncertainty, rule based system and fuzzy logic.
- To understand the concepts of learning and planning.
- To implement a typical AI applications using LISP & Prolog.

UNIT I (9 Hrs)

INTRODUCTION: Overview of AI, Problems, Problem space and searching techniques, Definition production system, Control strategies, Heuristic search techniques - Game Playing - Minmax search procedure-Adding alpha-beta cutoff Intelligent agents - Agents and environment – structure of agents and its functions - simple reflex agent- goal based agent – utility based agent – learning agents, Knowledge Based Agent.

UNIT II (9 Hrs)

KNOWLEDGE REPRESENTATION: Approaches and issues in knowledge representation, Predicate logic, propositional logic, Forward and backward reasoning - Unification-Resolution- Weak slot-filler structure – Strong slot-filler structure.

UNIT III (9 Hrs)

REASONING UNDER UNCERTAINTY: Logics of non-monotonic reasoning-Implementation-Basic probability notation - Bayes rule – Certainty factors and rule based systems-Bayesian networks – Dempster - Shafer Theory - Fuzzy Logic.

UNIT IV (9 Hrs)

PLANNING AND LEARNING: Planning with state space search -partial order planning - planning graphs - conditional planning-continuous planning - Multi - Agent planning - Forms of learning- Learning from observation - Inductive learning – Decision trees –Explanation based learning – Statistical Learning methods - Reinforcement Learning - Neural Net learning and Genetic learning.

UNIT V (9 Hrs)

EXPERT SYSTEM & DECLARATIVE LANGUAGES: Expert System - Representation - Expert System shells - Knowledge Acquisition - AI Languages - Introduction to LISP, expressions, functions, Recursion - Introduction to Prolog - Knowledge representation and reasoning using Prolog.

Text Books:

1. Elaine Rich, Kevin Knight, Shivashankar and B. Nair, Artificial Intelligence, Tata McGraw Hill, 3rd Edition, 2017.
2. Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson Education Asia, 4th Edition, 2022.
3. I. Bratko, Prolog: Programming for Artificial Intelligence, Addison-Wesley Educational Publishers Inc., 4th Edition, 2011.

References:

1. Ben Coppin, ”Artificial Intelligence Illuminated”, Jones and Bartlett Publishers, 1st Edition, 2004.
2. N.P. Padhy, ”Artificial Intelligence and Intelligent Systems”, Oxford University Press, 2nd Edition, 2005.
3. Deepak Khemani, ”Artificial Intelligence”, Tata McGraw Hill Education, 2013.

ONLINE/ NPTEL COURSES:

Artificial Intellegence:

1. https://nptel.ac.in/courses/106106184
2. https://nptel.ac.in/courses/106105216

AMHS405 ENTREPRENEURSHIP AND START-UPS

L	T	P	C
3	0	0	3

Course Pre-requisite:

- Basics of Entrepreneurship.

Course Objectives:

- To impart knowledge about start-up projects in the realm of globalisation, crowd-sourcing and the emergence of ”open-source” innovations.

Course Outcomes:

- To understand economic models in the digital environment and types of monetisation used for open innovations.
- To understand the digital technologies behind open source innovations.
- To understand organization management.
- To understand start-up environment.
- To understand operation and strategy management.

UNIT I (9 Hrs)

INTRODUCTION: Introduction to Entrepreneurship Strategy: from Ideation to Exit, identifying the trade-offs, Intellectual activity & knowledge economy, sharing economy – approach to construct social- economic models.

UNIT II (9 Hrs)

DIGITAL TECHNOLOGIES: Transaction costs: trust and reviewing system (personification), Hard & software - Robotics and Intelligence: Computing Recognition and Decision Making, Infrastructure Building, Cyberphysical systems as a product and as an infrastructure.

UNIT III (9 Hrs)

MANAGEMENT OF OPEN INNOVATION PROJECTS: History the emergence of open innovation, Analysis of elements of open innovation in the traditional management, Agile – flexible project management. Methodologies within agile approach, from project to product: steps of converting ideas into goods, Stakeholders of open innovation project: customers, investors, employees etc. Indicators of effectiveness for the various groups of stakeholders.

UNIT IV (9 Hrs)

START-UP ENVIRONMENT: Types of financing, Infrastructure supporting small innovative enterprises and start-ups, Programs to support innovative projects at the federal and regional level.

UNIT V (9 Hrs)

OPERATION AND STRATEGY MANAGEMENT: Introduction to Operations Management, Operations Analysis, Coordination and Planning, Quality Management, Project Management, and Logistics and Supply Chain Management, strategy management, technological strategy.

Text Books:

1. Peter F. ”Drucker Innovation and Entrepreneurship”, (Classic Drucker Collection), Collins, 2007.
2. Perihan Hazel, Joseph A. ”Schumpeter’s views on entrepreneurship and innovation”, 2012.

References:

1. Dr. Ramesh Parihar and Dr. Chandresh Sharma, ”Entrepreneurship and Start-ups”, Shreeram, 2023.

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/110106141

AMAU406 ENVIRONMENTAL SCIENCE

L	T	P	C
3	0	0	0

Course Pre-requisite:

- 12th qualification or equivalent with at least one or two science subjects such as Physics, Mathematics, Chemistry, and Biology, with a minimum percentile.

Course Objectives:

- People working in industries or elsewhere essentially require the knowledge of environmental science so as to enable them to work and produce most efficient, economical and eco-friendly finished products.

Course Outcomes:

- To understand the ecosystem and terminology and solve various engineering problems applying ecosystem knowledge to produce eco – friendly products.
- To understand the suitable air, extent of noise pollution, and control measures.
- To understand the water and soil pollution, and control measures and acts.
- To understand renewable energy resources and efficient process of harvesting.
- To understand solid Waste Management and Environmental Management.

UNIT I (9 Hrs)

ECOSYSTEM: Structure of ecosystem - Biotic and Abiotic components - Food chain and food web - Aquatic (Lentic and Lotic) and terrestrial ecosystem - Carbon, Nitrogen, Sulphur, Phosphorus cycle - Global warming -Causes, effects, process, Green House Effect, Ozone depletion.

UNIT II (9 Hrs)

AIR AND NOISE POLLUTION: Definition of pollution and pollutant - Natural and manmade sources of air pollution (Refrigerants, I.C., Boiler) - Air Pollutants: Types, Particulate Pollutants: Effects and control (Bag filter, Cyclone separator, Electrostatic Precipitator) - Gaseous Pollution Control: Absorber - Catalytic Converter - Effects of air pollution due to Refrigerants, I.C., Boiler - Noise pollution: sources of pollution, measurement of pollution level - Effects of Noise pollution, Noise pollution (Regulation and Control) Rules, 2000.

UNIT III (9 Hrs)

WATER AND SOIL POLLUTION: Sources of water pollution - Types of water pollutants - Characteristics of water pollutants - Turbidity, pH - total suspended solids - Total solids BOD and COD: Definition, calculation. Waste Water Treatment: Primary methods: sedimentation, froth floatation, Secondary methods: Activated sludge treatment, Trickling filter, Bioreactor, Tertiary Method: Membrane separation technology, RO (reverse osmosis). Causes, Effects and Preventive measures of Soil Pollution: Causes-Excessive use of Fertilizers, Pesticides and Insecticides, Irrigation, E-Waste.

UNIT IV (9 Hrs)

RENEWABLE SOURCES OF ENERGY: Solar Energy: Basics of Solar energy - Flat plate collector (Liquid and Air) - Theory of flat plate collector - Importance of coating - Advanced collector - Solar pond - Solar water heater, solar dryer - Solar stills. Biomass: Overview of biomass as energy source - Thermal characteristics of biomass as fuel - Anaerobic digestion - Biogas production mechanism - Utilization and storage of biogas. Wind energy: Current status and future prospects of wind energy - Wind energy in India - Environmental benefits and problem of wind energy. Need of new sources: Different types new energy sources - Applications of (Hydrogen energy, Ocean energy resources, Tidal energy conversion.) - Concept, origin and power plants of geothermal energy.

UNIT V (9 Hrs)

SOLID WASTE MANAGEMENT, ISO 14000 and ENVIRONMENTAL MANAGEMENT: Solid waste generation- Sources and characteristics of Municipal solid waste, E- waste, biomedical waste - Metallic wastes and Non-Metallic wastes (lubricants, plastics, rubber) from industries - Collection and disposal: MSW (3R, principles, energy recovery, sanitary landfill), Hazardous waste - Air quality act 2004, air pollution control act 1981 and water pollution and control act1996 - Structure and role of Central and state pollution control board - Concept of Carbon Credit, Carbon Footprint - Environmental management in fabrication industry - ISO14000: Implementation in industries, Benefits.

Text Books:

1. S.C. Sharma and M.P. Poonia, ”Environmental Studies”, Khanna Publishing House, New Delhi, 2021.
2. O.P. Gupta, ”Elements of Environmental Pollution Control”, Khanna Publishing House, New Delhi, 2018.
3. Keshav Kant, ”Air Pollution & Control”, Khanna Publishing House, 2018.

References:

1. Rao, M. N.Rao, H.V.N, ”Air Pollution”, Tata Mc-Graw Hill Publication, New Delhi, 1988, ISBN: 0-07- 451871-8.

ONLINE/NPTEL Courses:

1. Introduction to Environmental Engineering: https://nptel.ac.in/courses/103107084
2. Environmental Quality Monitoring & Analysis: https://nptel.ac.in/courses/103106162
3. Basic Env.Engineering and Pollution Abatement: https://nptel.ac.in/courses/103107215
4. Environmental Air Pollution: https://nptel.ac.in/courses/105104099

AMPL401 DATABASE SYSTEMS LAB

L	T	P	C
0	0	4	2

Course Pre-requisite:

- Programming language, Basic Understanding of DBMS Concepts

Course Objective:

- Design and implement database schema for an application using DBMS concepts.

Course Outcomes:

- To design and implement database schema for an application using DBMS concepts.
- To write SQL queries for tasks of various complexities.
- To write an application program that uses a database system as the backend.
- To demonstrate the working of a DBMS including Data storage, indexing, Query processing, concurrency control and recovery mechanism.
- To illustrate an application development using MongoDB.

LIST OF EXPERIMENTS

1. Write SQL queries for various tasks in PostgreSQL preferably, or MySQL.
2. Practice interfacing with a database from a program using connectors like JDBC/ODBC.
3. Small exercises on MongoDB.
4. Exercise in ER design for an application starting with natural language description.
5. Convert ER design to tables.
6. Pen-and-paper exercises with FDs and normalization.
7. Write a PL/SQL block to satisfy some conditions by accepting input from the user.
8. Write a PL/SQL block that handles all types of exceptions.
9. Use a B+-tree visualization system to understand how B+- trees work.
10. Examine query plans for sample queries by using the feature of database systems.
11. Small exercises to show benefit of indices.
12. Application Development Using MongoDB :Hospital Management System & Railway Reservation System.

(Total Periods:45)

AMPL402 COMPUTER NETWORKS LAB

L	T	P	C
0	0	4	2

Course Pre-requisite:

- Programming Language

Course Objective:

- Practice the tools like ping and trace route to explore various Internet paths to popular servers using NS-2/NS-3 simulator to evaluate performance of network under various conditions.

Course Outcomes:

- To understand the network configuration of the computer.
- To write socket programming for client server using TCP/UDP.
- To gain knowledge in how to Install and configure some network applications.
- To gain knowledge in how to use tools like ping and trace route to explore various Internet paths to popular server.
- To gain knowledge in how to use NS-2/NS-3 to simulate a mesh of at least 4 nodes and 3 links to evaluate performance under various conditions.

LIST OF EXPERIMENTS

1. Use Linux tools like ifconfig, dig, ethtool, route, netstat, nslookup, and ip to understand the networking configuration of the computer that the student is working on.
2. Use a tool like Wireshark to capture packets and examine the packets
3. Implementation of a Program For CRC and Hamming Code for Error Handling.
4. Understand various header fields and their usage in different application layer protocols using Wireshark packet capture.
5. Socket programming: write a simple clientserver program using TCP and UDP sockets.
6. Implementation of a socket program for Echo/Ping/Talk commands.

7. Measure TCP throughput between two hosts in a network using tools like iperf. Modify TCP Configuration parameters. Use the tc Linux utility or similar to control bandwidth, delay, loss. Observe impact on measured throughput.
8. Implementation of Public Key Encryption.
9. Use tools like ping and trace route to explore various Internet paths to popular servers.
10. Simulation of DNS server.
11. Use Linux network tools like ethtool to observe and analyze link layer packet statistics and errors.
12. Use cellphone to measure Wi-Fi signal strength (RSS) at various places in the campus. Draw a Contour map with access points and RSS levels. Correlate with upload/download speed using tools like Measurement Lab speed test.
13. Learn to use commands like tcpdump, netstat, ipconfig, nslookup and traceroute. Capture ping and trace route PDUs using a network protocol analyzer and examine.
14. Write a code simulating ARP /RARP protocols.
15. Simulation of Distance Vector/ Link State Routing algorithm.

(Total Periods:45)

AMPL403 ARTIFICIAL INTELLIGENCE LAB

L	T	P	C
0	0	4	2

Course Pre-requisite:

- Programming Language.

Course Objective:

- To enable the students to analyse and interpret large amounts of data quickly.

Course Outcomes:

- To understand the prediction of equipment failures using AI.
- To understand the Predictive analytics used in forecast inventory needs.
- To understand and analyze historical data in predicting future trends and patterns, allowing for better decision-making in the lab.
- To understand Predictive analytics used in helping researchers to prioritize their efforts.
- To understand and predict the optimal conditions for an experiment.

LIST OF EXPERIMENTS

1. Write a Program to Implement Breadth First Search using Python.
2. Write a Program to Implement Depth First Search using Python.
3. Write a Program to Implement Tic-Tac-Toe game using Python.
4. Write a Program to Implement 8-Puzzle problem using Python.
5. Write a Program to Implement Water-Jug problem using Python.
6. Write a Program to Implement Travelling Salesman Problem using Python.
7. Write a Program to Implement Tower of Hanoi using Python.
8. Write a Program to Implement Monkey Banana Problem using Python.
9. Write a Program to Implement Missionaries-Cannibals Problems using Python.
10. Write a Program to Implement N-Queens Problem using Python.

(Total Periods:45)

AMPROJ404 MINOR PROJECT

L	T	P	C
0	0	3	3

Course Pre-requisite:

- Knowledge in Software Engineering and Programming.

Course Objectives:

- To design and develop software application using software engineering principles.

Course Outcomes:

- To expertise software development lifecycle Models.
- To develop the software requirements specification for the project.
- To use UML diagrams for analysis and design.
- To use the suitable architectural styles and design patterns.
- To develop the test cases and deploy the software.

SUGGESTED APPLICATIONS FOR MINOR-PROJECT

1. Passport automation system.
2. Book bank system.
3. Exam registration system.
4. Stock maintenance system.
5. Online course reservation system.
6. Airline/Railway reservation system.
7. Software personnel management system.
8. Credit card processing.
9. Recruitment system.
10. Foreign trading system.
11. Conference management system.
12. BPO management system.

13. Library management system.
14. Student information system.
15. Quiz App.
16. Restaurant Website Application.

GUIDELINES

1. Identify a software system that needs to be developed.
2. Document the Software Requirements Specification (SRS) for the identified system.
3. Identify use cases and develop the Use Case model.
4. Identify the conceptual classes and develop a Domain Model and also derive a Class Diagram from that.
5. Using the identified scenarios, find the interaction between objects and represent them using UML Sequence and Collaboration Diagrams
6. Draw relevant State Chart and Activity Diagrams for the same system.
7. Implement the system as per the detailed design
8. Test the software system for all the scenarios identified as per the usecase diagram
9. Improve the reusability and maintainability of the software system by applying appropriate design patterns.
10. Implement the modified system and test it for various scenarios
11. Preparation of Project Report.

SEMESTER –V

AMPC501 DATA SCIENCE

L	T	P	C
3	0	0	3

Course Objectives:

- To gain knowledge in the basic concepts of data analysis, data preparatory and preprocessing, tools and packages in python for data science.

Course Outcomes:

- To perform exploratory data analysis.
- To understand data dependencies.
- To perform array process.
- To understand regression analysis.
- To understand and apply the knowledge of data visualization using matplotlib.

UNIT I (9 Hrs)

INTRODUCTION: Need for data science – benefits and uses – facets of data – data science process – setting their search goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications.

UNIT II (9 Hrs)

DESCRIBING DATA : Frequency distributions – Outliers – relative frequency distributions – cumulative frequency distributions – frequency distributions for nominal data – interpreting distributions – graphs –averages – mode – median – mean – averages for qualitative and ranked data – describing variability – range – variance – standard deviation – degrees of freedom – inter quartile range –variability for qualitative and ranked data.

UNIT III (9 Hrs)

PYTHON FOR DATA HANDLING: Basics of Numpy arrays – aggregations – computations on arrays – comparisons, masks, Boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – hierarchical indexing – combining datasets –aggregation and grouping – pivot tables.

UNIT IV (9 Hrs)

DATA ANALYSIS: Normal distributions – z scores – normal curve problems– finding proportions – finding scores –more about z scores – correlation – scatter plots – correlation coefficient for quantitative data –computational formula for correlation coefficient – regression – regression line – least squares regression line – standard error of estimate – interpretation of r^2– multiple regression equations –regression toward the mean.

UNIT V (9 Hrs)

PYTHON FOR DATA VISUALIZATION: Visualization with matplotlib – line plots – scatter plots – visualizing errors – density and contour plots – histograms, binnings, and density – three dimensional plotting – geographic data – data analysis using state models and seaborn – graph plotting using Plotly – interactive data visualization using Bokeh.

Text Books:

1. Davy Cielen, Arno D. B. Meysman and Mohamed Ali, "Introducing Data Science Big Data, Machine Learning, and More, using Python Tools", Manning Publications Co., 1st Edition 2016.
2. Steven S. Skiena, "The Data Science Design Manual", Springer, 2017.
3. Joel Grus, "Data Science from Scratch", O'Reilly Media, 2nd Edition 2019.

References:

1. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2nd Edition, 2012.
2. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem Solving Focus", Wiley India, 1st Edition, 2013.

ONLINE/ NPTEL COURSES:

1. https://onlinecourses.nptel.ac.in/noc21_cs69

AMPC502 MACHINE LEARNING

L	T	P	C
3	0	0	3

Course Pre-requisite:

- Basic knowledge in AI, algorithm design, basics of probability & statistics.

Course Objectives:

- To understand the need, concepts and applications of machine learning.

Course Outcomes:

- Evaluate machine learning theory in problem solving.
- Understand dimension reduction techniques.
- Understand Bayesian classifications.
- Learn MLP and BackPropogation.
- Understand ensemble learning models.

UNIT I (9 Hrs)

INTRODUCTION: Machine learning applications – Basic definitions- types of learning: unsupervised learning – Reinforcement Learning – Supervised Learning – Learning a class from examples – hypothesis space and inductive bias- Vapnik-Chervonenkis (VC) Dimension – Probably Approximately Correct (PAC) Learning – Noise – Learning multiple classes – Model selection and Generalization-Evaluation and Cross validation.

UNIT II (9 Hrs)

LINEAR REGRESSION: Introduction to decision trees - Learning decision trees-Issues-PruningOverfitting - k-Nearest neighbour-Feature selection: Metrics-Feature Reduction: Dimensionality reduction – Subset selection – Principal componnent analysis – Factor analysis – Multidimensional scaling – Linear discriminant analysis.

UNIT III (9 Hrs)

BAYESIAN LEARNING: Bayes theorem-Maximum Likelihood-Bayes optimal classifier-Gibbs Algorithm-Na¨ıve Bayes Classifier- Bayesian Belief networks-Clustering: Mixture Densities – K Means Clustering – Expectation Maximization – Hierarchical clustering.

UNIT IV (9 Hrs)

LINEAR DISCRIMINATION: Linear Discrimination – Linear Model – Geometry of the Linear Discriminant – Pairwise Separation – Gradient Descent – Logistic Discrimination – Discrimination by Regression – Multilayer Perceptrons: Introduction – Perceptron – Training a Perceptron – Learning Boolean Functions – Multilayer Perceptrons – Backpropagation Algorithm.

UNIT V (9 Hrs)

KERNEL MACHINES: SVM-Optimal Separating Hyperplane – kernel trick –Hidden Markov Models – Evaluation-Model selection –Introduction to Ensembles- Bagging – Boosting.

Text Books:

1. Ethem Alpaydin, ”Introduction to Machine Learning”, 3rd Edition, PHI, 2014.
2. Tom M. Mitchell, Machine Learning, Mc Graw Hill, 2003.

References:

1. David Brown, ”Artificial Intelligence”, Kindle Edition, 17 Books Ltd., 2020.

ONLINE/ NPTEL COURSES:

1. https://archive.nptel.ac.in/courses/106/106/106106139/

AMPC503 CLOUD COMPUTING

L	T	P	C
3	0	0	3

Course Pre-requisite:

- knowledge in Computer Organization and Operating systems.

Course Objectives:

- To familiarize the core concepts of cloud computing, including its characteristics, service and deployment models.
- To design, deploy and manage virtualized resources in cloud environments including virtual machines, storage, and networking components.
- To comprehend secure and perform identity management in the cloud and popular Cloud Service Providers.

Course Outcomes:

- To impart the principles and paradigm of Cloud Computing and understand the Service Model with reference to Cloud Computing.
- To understand the Cloud Computing architecture and implementation.
- To realize the role of Virtualization Technologies and acquire knowledge of how hypervisors are used in Virtual Machines.
- To comprehend Secure and perform identity management in the Cloud and to access and use the services in the Cloud.
- To understand the popular Cloud Service Providers.

UNIT I (9 Hrs)

INTRODUCTION TO CLOUD COMPUTING : Overview, Roots of Cloud Computing - Layers and Types of Cloud - Desired Features of a Cloud - Benefits and Disadvantages of Cloud Computing - Cloud Infrastructure Management: Infrastructure as a Service Providers, Platform as a Service Providers - Challenges and Risk - Assessing the role of Open Standards.

UNIT II (9 Hrs)

CLOUD ARCHITECTURE, SERVICES AND APPLICATIONS : Exploring the Cloud Computing Stack - connecting to the Cloud - Infrastructure as a Service - Platform as a Service - SaaS Vs. PaaS, Using PaaS Application Frameworks - Software as a Service - Identity as a Service - Compliance as a Service.

UNIT III (9 Hrs)

ABSTRACTION AND VIRTUALIZATION : Introduction to Virtualization Technologies - Load Balancing and Virtualization - Understanding Hyper visors - Understanding Machine Imaging - Porting Applications - Virtual Machines Provisioning and Manageability Virtual Machine Migration Services - Virtual Machine Provisioning and Migration in Action - Provisioning in the Cloud Context.

UNIT IV (9 Hrs)

MANAGING & SECURING THE CLOUD : Administrating the Clouds - Cloud Management Products - Emerging Cloud Management Standards - Securing the Cloud - Securing Data - Establishing Identity and Presence.

UNIT V (9 Hrs)

CASE STUDIES : Using Google Web Services - Using Amazon Web Services - Using Microsoft Cloud Services.

Text Books:

1. Buyya R., Broberg J. and Goscinski A., ”Cloud Computing- Principles and Paradigm”, John Wiley & Sons, 1st Edition, 2013.
2. Sosinsky B., ”Cloud Computing Bible”, Wiley Edition, 1st Edition, 2011.
3. Miller Michael, ”Cloud Computing- Web Based Applications that Change the Way You Work and Collaborate Online”, Pearson Education India.

References:

1. Smooth S.and Tan N., ”Private Cloud Computing”, Morgan Kauffman , 1st Edition, 2011.
2. Linthicium D., ”Cloud Computing and SOA Convergence in Enterprise”, Pearson Education India.

ONLINE/ NPTEL COURSES:

Cloud Computing: https://nptel.ac.in/courses/106105167

AMPC504 OPTIMIZATION TECHNIQUES IN MACHINE LEARNING

L	T	P	C
3	0	0	3

Course Pre-requisite:

- Basics of Machine Learning and Operations Research.

Course Objectives:

- To familiarize and dealing with changing data, identify and interpret potential unintended effects of data in project. Also to operationalize and maintain applied machine learning model.

Course Outcomes:

- To understand and analyze how to deal with changing data.
- To understand and interpret potential machine learning strategy.
- To understand and define procedures to operationalize and maintain the applied machine learning model.
- To understand how to optimize the use of Machine Learning in real-life problems.
- To understand basic concepts of mathematics to formulate an optimization problem.

UNIT I (9 Hrs)

INTRODUCTION : Optimization, Formulation of LPP, Solution of LPP: Simplex method, Basic Calculus for optimization: Limits and multivariate functions, Derivatives and linear approximations: Singlevariate functions and multivariate functions.

UNIT II (9 Hrs)

MACHINE LEARNING STRATEGY : ML readiness, Risk mitigation, Experimental mindset, Build/buy/partner, setting up a team, Understanding and communicating change.

UNIT III (9 Hrs)

RESPONSIBLE MACHINE LEARNING : AI for good and all, Positive feedback loops and negative feedback loops, Metric design and observing behaviours, Secondary effects of optimization, Regulatory concerns.

UNIT IV (9 Hrs)

MACHINE LEARNING IN PRODUCTION AND PLANNING : Integrating info systems, users break things, time and space complexity in production, when to retain the model? Logging ML model versioning, Knowledge transfer, Reporting performance to stakeholders.

UNIT V (9 Hrs)

CARE AND FEEDING OF YOUR MACHINE LEARNING MODEL : MLPL Recap, Post deployment challenges, QUAM monitoring and logging, QUAM Testing,QUAM maintenance, QUAM updating, Separating Datastack from Production, Dashboard Essentials and Metrics monitoring.

Text Books:

1. Suvrit Sra, Sebastian Nowozin and Stephen J. Wright, "Optimization for Machine Learning", MIT Press, 2011.
2. Mykel J. Kochenderfer and Tim A. Wheeler, "Algorithms for Optimization", 1st Edition, MIT Press, 2019.
3. Jeeva Jose, "Introduction to Machine Learning", Khanna Book Publishing, 1st Edition, 2020.
4. Rajiv Chopra, "Machine Learning", Khanna Book Publishing, 1st Edition, 2021.

References:

1. Cong Fang, Huan Li, and Zhouchen Lin, "Accelerated Optimization for Machine Learning: First-Order Algorithms", Springer, 2020.
2. https://www.coursera.org/learn/optimize-machine-learning-model-performance

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/106106245

AMPC505 AI AND CYBER SECURITY

L	T	P	C
3	0	0	3

Course Pre-requisite:

- Basics of AI.

Course Objectives:

- To learn building smart cybersecurity systems with the power of machine learning and deep learning to protect corporate assets.

Course Outcomes:

- To understand prediction of security threats using artificial intelligence.
- To understand and develop intelligent systems that can detect unusual and suspicious patterns and attacks.
- To understand and test the effectiveness of AI cybersecurity algorithms and tools.
- To understand and learn about the role of machine learning and neural networks.
- To understand and develop intelligent systems that can detect unusual and suspicious patterns and attacks.

UNIT I (9 Hrs)

INTRODUCTION: Applying AI in cybersecurity - Evolution in AI: from expert systems to data mining - Types of machine learning- Algorithm training and optimization - AI in the context of cybersecurity - Python for AI and cybersecurity - Python libraries for cybersecurity.

UNIT II (9 Hrs)

CYBERSECURITY THREATS AND AI: Detecting Email Cybersecurity Threats with AI - Detecting spam with Perceptrons - Spam detection with SVMs - Phishing detection with logistic regression and decision trees - Spam detection with Naive Bayes - Malware Threat Detection: Malware analysis - Different malware families - Decision tree malware detectors - Detecting metamorphic malware with HMMs.

UNIT III (9 Hrs)

ANOMALY DETECTION WITH AI: Network anomaly detection techniques - How to classify network attacks - Detecting botnet topology - Different ML algorithms for botnet detection - Protecting Sensitive Information and Assets: Securing User Authentication - Authentication abuse prevention - Account reputation scoring - User authentication with keystroke recognition - Biometric authentication with facial recognition.

UNIT IV (9 Hrs)

FRAUD PREVENTION WITH CLOUD AI SOLUTIONS: Fraud detection algorithms - Predictive analytics for credit card fraud detection - IBM Watson Cloud solutions - Importing sample data and running Jupyter Notebook in the cloud.

UNIT V (9 Hrs)

GANS - ATTACKS AND DEFENSES: GANs in a nutshell - GAN Python tools and libraries - Network attack via model substitution - IDS evasion via GAN - Facial recognition attacks with GAN.

Text Books:

1. Alessandro Parisi, “Hands-On Artificial Intelligence for Cybersecurity”, Packt Publishing, 1st Edition, 2019.

References:

1. Ishaani Priyadarshini and Rohit Sharma, ”Artificial Intelligence and Cybersecurity”, CRC Press, 1st Edition, 2022.

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/106105078

AMBS506 DISCRETE MATHEMATICS

L	T	P	C
3	1	0	4

Course Pre-requisite:

- Mathematics I, II.

Course Objectives:

- To learn the fundamentals of set operations, Cartesian products, binary equivalence relations, functions, and their properties.
- To learn the fundamental concepts of Combinatorics and Graph theory.

Course Outcomes:

- To analyse and comprehend Cantor's diagonal argument and understand the Power Set theorem.
- To apply the Chinese Remainder Theorem to solve systems of congruences and real-world problems.
- To solve the problems on combinatorial concepts such as permutations, combinations and matching algorithms to graph theory problems.
- To interpret and evaluate formulas using interpretations in first-order logic.
- To analyse the homomorphism and isomorphism between algebraic structures and Calculate expectations, variances, probabilities in Bernoulli trials and conditional probability scenarios using Bayes' Theorem.

UNIT I (12 Hrs)

SET, RELATIONS, FUNCTIONS: Operations and Laws of Sets, Cartesian Products,Binary Relation and functions, Partial Ordering Relation - Equivalence Relation - Image and Size of a Set - Sum and Product of Functions - Bijective functions - Inverse and Composite Function - Finite and infinite Sets - Countable and uncountable Sets-Cantor's diagonal argument and The Power Set theorem.

UNIT II (12 Hrs)

PROOF STRATEGIES AND MODULAR ARITHMETIC: Proof Methods and Strategies- Forward Proof - Proof by Contradiction - Proof by Contraposition - Proof of Necessity and Sufficiency - Case analysis - Induction -Extended Euclid's Greatest Common Divisor algorithm - The Fundamental Theorem of Arithmetic - Modular arithmetic - Coprimality (or Euler's totient function)- Chinese Remainder Theorem.

UNIT III (12 Hrs)

COMBINATORICS AND GRAPHS: Permutation and Combination - Inclusion-Exclusion - pigeon-hole principle -generating functions - Recurrence - Connected components - Paths - Cycles - Trees - Hamiltonian/Eulerian Walks - Coloring - Planarity - Matching.

UNIT IV (12 Hrs)

LOGIC: Languages of Propositional logic and First-order logic - expressing natural language sentences in languages of propositional and first-order logic - expressing natural language predicates in the language of first-order logic. Semantics of First-order logic-interpretation and its use in evaluating a formula.

UNIT V (12 Hrs)

ALGEBRA: Group, Permutation Groups, Cosets, Normal Subgroups, Ring, Field, Finite fields, Fermat's little theorem, Homomorphisms, Isomorphisms.

Text Books:

1. Rosen, K. H, Discrete Mathematics and Its Applications, 8^{th} Edition, 2019.
2. Liu, C.L. and Mohapatra, D.P., Elements of Discrete Mathematics, Tata McGraw-Hill, 2008.
3. Huth, M.and Ryan M., Logic in Computer Science: Modelling and Reasoning about Systems, Cambridge University Press, 2^{nd} Edition, 2004.

References:

1. Mitzenmacher.M, and Upfal.E, Probability and computing: Randomization and probabilistic techniques in algorithms and data analysis, Cambridge University Press, 2017.
2. Shoup.V, A computational introduction to number theory and algebra, Cambridge University Press, 2009.
3. Bona.M, A Walk Through Combinatorics: An Introduction to Enumeration and Graph Theory, 2006.
4. Herstein.I.N, Topics in algebra, John Wiley and Sons, 2006.

ONLINE/ NPTEL COURSES::

1. Discrete Mathematics: https://nptel.ac.in/courses/106103205
2. Introduction-Discrete Mathematics: https://nptel.ac.in/courses/106108227

3. Discrete Mathematics: https://nptel.ac.in/courses/111106086

AMAU507 INDIAN CONSTITUTION

L	T	P	C
3	0	0	0

Course Pre-requisite:

- Knowledge of roles and rights of citizens and powers of governments and its organs.

Course Objectives:

- To acquaint the students with basic principles of the Constitution of India and its working.

Course Outcomes:

- To understand the constitution of India and its salient features.
- To understand the fundamental rights and duties.
- To understand and discuss India's Parliamentary System of Governance.
- To understand the Directive Principles of State Policy.
- To understand and abide the rules of the Indian constitution and to appreciate different culture among the people.

UNIT I (9 Hrs)

THE CONSTITUTION - INTRODUCTION :

- The History of the Making of the Indian Constitution.
- Preamble and the Basic Structure, and its interpretation.
- Fundamental Rights and Duties and their interpretation.
- State Policy Principles.

UNIT II (9 Hrs)

UNION GOVERNMENT :

- Structure of the Indian Union.
- President – Role and Power.
- Prime Minister and Council of Ministers.
- Lok Sabha and Rajya Sabha.

UNIT III (9 Hrs)

STATE GOVERNMENT :

- Governor – Role and Power.
- Chief Minister and Council of Ministers.
- State Secretariat.

UNIT IV (9 Hrs)

LOCAL ADMINISTRATION :

- District Administration.
- Municipal Corporation.
- Zila Panchayat.

UNIT V (9 Hrs)

ELECTION COMMISION :

- Role and Functioning.
- Chief Election Commissioner.
- State Election Commission.

Text Books:

1. Rajeev Bhargava, ”Ethics and Politics of the Indian Constitution”, Oxford University Press, New Delhi, 2008.
2. B.L.Fadia Sahitya Bhawan, ”The Constitution of India”, New Edition, 2017.
3. DD Basu Lexis Nexis, ”Introduction to the Constitution of India”, 23rd Edition, 2018.

References:

1. https://www.constitution.org/cons/india/const.html
2. http://www.legislative.gov.in/constitution-of-india
3. https://www.sci.gov.in/constitution
4. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india

AMPL501 DATA SCIENCE AND MACHINE LEARNING LAB

L	T	P	C
0	0	4	2

Course Pre-requisite:

- Basics concepts of Data Science and ML.

Course Objectives:

- To learn the the fundamentals of data science and Big Data.

Course Outcomes:

- To apply data visualization in big-data analytics.
- To utilize EDA, inference and regression techniques.
- To utilize Matrix decomposition techniques to perform data analysis.
- To apply data pre-processing techniques.
- To implement Machine Learning Algorithms.

LIST OF EXPERIMENTS

TOTAL PERIODS:45

1. Python Introduction:
    - Loops and Conditions.
    - Functions, Classes and Modules.
    - Exceptions, Database access.
2. Set up a pseudo-distributed, single-node Hadoop cluster backed by the Hadoop Distributed File System, running on Ubuntu Linux. After successful installation on one node, configuration of a multi-node Hadoop cluster (one master and multiple slaves).
3. Map Reduce application for word counting on Hadoop cluster.
4. Unstructured data into NoSQL data and do all operations such as No SQL query with API.
5. Implement K-means clustering using map reduce.

6. Implement PageRank Computation.
7. Implement Mahout machine learning library to facilitate the knowledge build up in bigdata analysis.
8. develop Recommendation Systems using Hadoop/mahout libraries.
9. Creation and Loading different datasets in Python.
10. Implementation of SVM Algorithm.
11. Implementation of Neural Networks.
12. Write a program to implement simple Linear Regression and plot the graph.
13. Implement Naive Bayes Classification.
14. Implement KNN Classification.

AMPL502 CLOUD COMPUTING LAB

L	T	P	C
0	0	4	2

Course Pre-requisite:

- Basics concepts of Programming.

Course Objectives:

- To have knowledge on Cloud Computing management and security.
- To have knowledge on Cloud services in daily real time projects.

Course Outcomes:

- To adapt different types of virtualization and increase resource utilization.
- To build a private cloud using open source technologies.
- To Analyze security issues on cloud.
- ToDevelop real world web applications and deploy on commercial cloud.
- To Demonstrate various service models.

LIST OF EXPERIMENTS

TOTAL PERIODS:45

1. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8.
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs.
3. Install Google App Engine. Create hello world app and other simple web applications using python/java.
4. Use GAE launcher to launch the web applications.
5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
6. Find a procedure to transfer the files from one virtual machine to another virtual machine.

7. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
8. Install Hadoop single node cluster and run simple applications like wordcount.

AMPROJ503 MINOR PROJECT

L	T	P	C
0	0	3	3

Course Pre-requisite:

- Knowledge in Software Engineering and Programming.

Course Objectives:

- To design and develop software application using software engineering principles.

Course Outcomes:

- To expertise software development lifecycle Models.
- To develop the software requirements specification for the project.
- To use UML diagrams for analysis and design.
- To use the suitable architectural styles and design patterns.
- To develop the test cases and deploy the software.

SUGGESTED APPLICATIONS FOR MINOR-PROJECT

1. Passport automation system.
2. Book bank system.
3. Exam registration system.
4. Stock maintenance system.
5. Online course reservation system.
6. Airline/Railway reservation system.
7. Software personnel management system.
8. Credit card processing.
9. Recruitment system.
10. Foreign trading system.
11. Conference management system.
12. BPO management system.

13. Library management system.
14. Student information system.
15. Quiz App.
16. Restaurant Website Application.

GUIDELINES

1. Identify a software system that needs to be developed.
2. Document the Software Requirements Specification (SRS) for the identified system.
3. Identify use cases and develop the Use Case model.
4. Identify the conceptual classes and develop a Domain Model and also derive a Class Diagram from that.
5. Using the identified scenarios, find the interaction between objects and represent them using UML Sequence and Collaboration Diagrams
6. Draw relevant State Chart and Activity Diagrams for the same system.
7. Implement the system as per the detailed design
8. Test the software system for all the scenarios identified as per the usecase diagram
9. Improve the reusability and maintainability of the software system by applying appropriate design patterns.
10. Implement the modified system and test it for various scenarios
11. Preparation of Project Report.

SEMESTER – VI

AMPC601 DEEP LEARNING

L	T	P	C
3	0	0	3

Course Pre-requisite:

- Artificial Neural Networks.

Course Objectives:

- To introduce the fundamentals of deep learning and various DL Models.

Course Outcomes:

- To understand the fundamentals of deep learning and the main research activities in this field.
- To understand Deep Learning Architectures and Optimization Techniques.
- To understand, implement, apply and test Auto-Encoder and regularization.
- To understand the methods suitability for building new learning models.
- To design and develop deep learning applications.

UNIT I (9 Hrs)

INTRODUCTION: History of Deep Learning - McCulloch Pitts Neuron - Multilayer Perceptrons (MLPs) - Representation Power of MLPs - Sigmoid Neurons - Feed Forward Neural Networks - Back propagation.

UNIT II (9 Hrs)

ACTIVATION FUNCTIONS AND PARAMETERS: Gradient Descent (GD) - Momentum Based GD - Nesterov Accelerated GD - Stochastic GD - Component Analysis and interpretations - Singular Value Decomposition - Parameters v/s Hyper-parameters.

UNIT III (9 Hrs)

AUTO-ENCODERS AND REGULARIZATION: Auto encoders and relation to PCA - Regularization in auto encoders - Denoising auto encoders - Sparse auto encoders - Regularization: Bias Variance Tradeoff - L2 regularization - Early stopping - Dataset augmentation - Encoder Decoder Models - Attention Mechanism - Attention over images - Batch Normalization.

UNIT IV (9 Hrs)

DEEP LEARNING MODELS: Introduction to CNNs - Architecture - Convolution/ pooling layers - CNN Applications - LeNet - AlexNet - VGGNet - GoogLeNet – ResNet - Introduction to RNNs - Back propagation through time (BPTT) - Vanishing and Exploding Gradients - Truncated BPTT - GRU - LSTMs.

UNIT V (9 Hrs)

DEEP LEARNING APPLICATIONS: Image Processing - Natural Language Processing - Speech recognition - Video Analytics.

Text Books:

1. Ian Goodfellow, YoshuaBengio and Aaron Courville, ”Deep Learning”, MIT press, 2016.
2. Bengio and Yoshua, ”Learning deep architectures for AI, foundations and trends in Machine Learning”, Now Publishers Inc, 2009.

References:

1. Rajiv Chopra, ”Deep Learning”, Khanna Book Publishing, 2020.

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/106/106/106106184

AMPC602 DATA VISUALIZATION AND ANALYTICS

L	T	P	C
3	0	0	3

Course Pre-requisite:

- Mathematics, Statistics, Linear Algebra and Calculus.

Course Objectives:

- To familiarize techniques and algorithms for analytics and creating effective visualizations.

Course Outcomes:

- To understand the key techniques and theory used in visualization, including data models, graphical perception, and techniques for visual encoding and interaction.
- To understand information related to several popular data fields and associated analysis tasks such as multivibrate data, networks, text, and cartography.
- To understand the big data and utilise examples from certain business fields.
- To understand the ways to use additional technologies like Hadoop and HDFS, as well as NOSQL big data management.
- To understand the way to analyse data.

UNIT I (9 Hrs)

INTRODUCTION: Data for Graphics - Design principles - Value for visualization - Categorical – Time series -Statistical data graphics - Introduction to Visualization Tools.

UNIT II (9 Hrs)

GRAPHICS PIPELINE AND AESTHETICS AND PERCEPTION : Introduction - Primitives: vertices - edges - triangles - Model transforms: translations - Rotations - Scaling - View transform - Perspective transform - Window transform - Graphical Perception - Theory - Experimentation - Application - Graphical Integrity - Layering and Separation - Color and Information - Using Space.

UNIT III (9 Hrs)

VISUALIZATION DESIGN : Visual Display of Quantitative Information - Data-Ink Maximization - Graphical Design - Exploratory Data Analysis - Heat Map.

UNIT IV (9 Hrs)

MULTIDIMENSIONAL DATA AND INTERACTION : Query, Analysis and Visualization of Multi-Dimensional Relational Databases, Interactive Exploration, tSNE, Interactive Dynamics for Visual Analysis, Visual Queries, Finding Patterns in Time Series Data, Trend visualization, Animation, Dashboard, Visual Storytelling.

UNIT V (9 Hrs)

COLLABORATION : Graph Visualization and Navigation, Online Social Networks, Social Data Analysis, Collaborative Visual Analytics, Text, Map, Geospatial data.

Text Books:

1. J. Koponen, J. Hildén,"Data Visualization Handbook", CRC Press, 2019.
2. Matthew O. Ward, Georges Grinstein and Daniel Keim, "Interactive Data Visualization: Foundations, Techniques, and Applications", 2nd Edition, CRC Press, 2015.
3. M. Lima, "The Book of Trees: Visualizing Branches of Knowledge Princeton Architectural" Press, 2014.
4. R. Tamassia, "Handbook of Graph Drawing and Visualization", CRC Press, 2013.

References:

1. E. Tufte, "The Visual Display of Quantitative Information",Graphics Press, 2nd Edition, 2001.
2. Jeeva Jose, "Beginner's Guide for Data Analysis using R Programming", Khanna Publishing, 2019.
3. S. Murray, "Interactive Data Visualization for the Web", O'Reilly Press, 2nd Edition, 2017.

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/110106064

AMPC603 NATURAL LANGUAGE PROCESSING

L	T	P	C
3	0	0	3

Course Pre-requisite:

- Artificial Intelligence and Neural Networks

Course Objective:

- To read, understand and decode human words in a valuable manner.

Course Outcomes:

- To understand given text with basic Language features.
- To design an innovative application using NLP components.
- To implement a rule based system to tackle morphology/syntax of a language.
- To design a tag set to be used for statistical processing for real-time applications.
- To compare and contrast the use of different statistical approaches for different types of NLP applications.

UNIT I (9 Hrs)

INTRODUCTION: Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM - Regular Expressions, Finite-State Automata – English Morphology-Transducers for lexicon and rules- Tokenization, Detecting and Correcting Spelling Errors-Minimum Edit Distanceg.

UNIT II (9 Hrs)

WORD LEVEL ANALYSIS: Unsmoothed N-grams- Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging- Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

UNIT III (9 Hrs)

SYNTACTIC ANALYSIS: Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG- Probabilistic CYK-Probabilistic Lexicalized CFGs - Feature structures, Unification of feature structures.

UNIT IV (9 Hrs)

SEMANTICS AND PRAGMATICS: Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis-Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

UNIT V (9 Hrs)

DISCOURSE ANALYSIS AND LEXICAL RESOURCES: Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer- Lemmatizer-Penn Treebank, Brill's Tagger-WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

Text Books:

1. Daniel Jurafsky, James H. Martin—Speech and Language Processing: "An Introduction to Natural Language Processing, Computational Linguistics and Speech", Pearson Publication, 2014.
2. Steven Bird, Evan Klein and Edward Loper, "Natural Language Processing with Python", O'Reilly Media, 1st Edition, 2009.
3. S.N.Sivanandham and M Paulraj, "Introduction to Artificial Neural Networks", Vikas Pubishing, 2023.

References:

1. Breck Baldwin, "Language Processing with Java and LingPipe Cookbook", Atlantic Publisher, 2015.
2. Richard M Reese, "Natural Language Processing with Java", O'Reilly Media, 2015.
3. Nitin Indurkhya and Fred J. Damerau, "Handbook of Natural Language Processing", Chapman and Hall/CRC Press,2nd Edition, 2010.
4. Tanveer Siddiqui, U.S. Tiwary, Natural Language Processing and Information Retrieval, Oxford University Press, 2008.

ONLINE/ NPTEL COURSES:

1. Applied Natural Language Processing : https://nptel.ac.in/courses/106106211
2. Natural Language Processing : https://nptel.ac.in/courses/106105158

AMPC604 INTERNET OF THINGS

L	T	P	C
3	0	0	3

Course Pre-requisite:

- Computer Networks.

Course Objectives:

- Understanding core technology, applications, sensors used and IOT architecture along with the industry perspective. Principles and operations of different types of sensors commonly used on mobile platform will be taught in a manner that by the end of the course the students will be able to design and implement real time solutions using IOT.

Course Outcomes:

- To understand core technology, applications, sensors used and IOT architecture along with the industry perspective.
- To understand Raspberry's working and implementation.
- To understand various communication protocols used in IoT.
- To understand various IOT technologies in real-life applications.
- To understand the Internet's revolution on mobile devices networked cloud and sensors.

UNIT I (9 Hrs)

INTRODUCTION TO IoT: What is IoT, how does it work? Difference between Embedded device and IoT device, Properties of IoT device, IoT Ecosystem, IoT Decision Framework, IoT Solution Architecture Models, Major IoT Boards in Market.

UNIT II (9 Hrs)

SETTING UP RASPBERRY/ARDUINO TO CREATE SOLUTIONS: Explore Raspberry Pi, setting up Raspberry Pi, showing working of Raspberry Pi using SSH Client and Team Viewer, understand Sensing actions, understand Actuators and MEMS.

UNIT III (9 Hrs)

COMMUNICATION PROTOCOLS USED IN IoT: Types of wireless communication, Major wireless Short- range communication devices, properties, comparison of these devices (Bluetooth, WIFI, ZigBee, 6LoWPAN), Major wireless Long-range communication devices, properties, comparison of these devices (Cellular IoT, LPWAN).

UNIT IV (9 Hrs)

IoT APPLICATIONS: Industrial Internet 4.0, Applications such as: Smart home, wearables, smart city, smart grid, connected car, connected health (digital health, telehealth, telemedicine), smart retail.

UNIT V (9 Hrs)

SENSORS: Applications of various sensors: Google Maps, Waze, WhatsApp, Ola Positioning sensors: encoders and accelerometers, Image sensors: cameras, Global positioning sensors: GPS, GLONASS, IRNSS, Galileo and indoor localization systems, Motion and Orientation Sensors: Accelerometer, Magnetometer, Proximity Sensor, Gyroscope Calibration, noise modeling and characterization and noise filtering and sensor data processing. Privacy and Security.

Text Books:

1. Vijay Madisetti and Arshdeep Bahga, ”Internet of Things (A Hands-on Approach)”, 1st Edition, VPT, 2014.
2. Francis da Costa, ”Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1stEdition, Apress Publications, 2014.
3. CunoPfister, ”Getting Started with the Internet of Things”, O Reilly Media, 2011.
4. Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., ”Smart Sensors and Systems”, Springer International Publishing, 2015.

References:

1. Adrian McEwen, ”Designing the Internet of Things”, Wiley Publishers, 2013, ISBN: 978-1-118-43062-0.
2. Daniel Kellmereit, ”The Silent Intelligence: The Internet of Things”. 2013, ISBN 0989973700.

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/106105166

AMPL601 DEEP LEARNING LAB

L	T	P	C
0	0	4	2

Course Pre-requisite:

- Knowledge in Artificial Neural networks.

Course Objectives:

- To introduce the fundamentals of deep learning and the main research activities.

Course Outcomes:

- To understand the fundamentals of deep learning Models.
- To understand Deep Learning Architectures and optimization techniques.
- To implement CNN using Tensor Flow.
- To implement RNN using Tensor Flow.
- To develop image classification applications using CNN.

LIST OF EXPERIMENTS

TOTAL PERIODS:45

1. Implement Multi-Layer Perception (MLP).
2. Implementation of following deep learning algorithms in Python using TensorFlow: Convolution Neural Network.
3. Implementation of following deep learning algorithms in Python using TensorFlow:Recurrent Neural Network.
4. Implement Sentence generation using RNN.
5. Perform sentence classification using RNN.
6. Perform Machine Translation using RNN.
7. Implement Chat Application.

AMPL602 DATA VISUALIZATION AND ANALYTICS LAB

L	T	P	C
0	0	4	2

Course Pre-requisite:

- Mathematics and statistics.

Course Objectives:

- To acquire knowledge on techniques and algorithms for creating effective visualizations.

Course Outcomes:

- To perform EDA.
- To understand the key techniques and theory used in visualization, including data models, graphical perception, and techniques for visualization.
- To understand the way to analyse data using statistics.

LIST OF EXPERIMENTS

TOTAL PERIODS:45

1. Visualize unstructured data.
2. Visualization of Spatial Data.
3. Introduction to Tableau and Aggregation Methods in Tableau.
4. Visual Encodings and Basic Dashboards in Tableau.
5. Interactive Plots in Python.
6. Hierarchical and Topographical Data Visualizations in Tableau.
7. Calendar Heatmaps and Flow Data Visualizations in Python.
8. Time Series Data Visualization in Python.
9. Dashboards, Actions and Story Telling in Tableau.
10. Perform EDA on a Data set.

AMPL603 INTERNET OF THINGS LAB

L	T	P	C
0	0	4	2

Course Pre-requisite:

- Basic knowledge in computer networks and working of sensors.

Course Objectives:

- To understand Real World IoT Design Constraints and Automation.

Course Outcomes:

- Ability to develop small applications using IoT.

LIST OF EXPERIMENTS

TOTAL PERIODS:45

1. Displaying Time over 4-Digit 7-Segment Display using Raspberry Pi.
2. Raspberry Pi Based Oscilloscope
3. Controlling Raspberry Pi.
4. Setting up Wireless Access Point using Raspberry Pi
5. Fingerprint Sensor interfacing with Raspberry Pi
6. Raspberry Pi GPS Module Interfacing.
7. IoT based Web Controlled Home Automation using Raspberry Pi
8. Visitor Monitoring with Raspberry Pi and Pi Camera.
9. Interfacing Raspberry Pi with RFID.
10. Building Google Assistant with Raspberry Pi.
11. Installing Windows 10 IoT Core on Raspberry Pi.

SEMESTER –VII

AMPC701 COMPUTER VISION

L	T	P	C
3	0	0	3

Course Pre-requisite:

- Knowledge of Image Processing.

Course Objectives:

- To provide the fundamental concepts related to Image processing and object detection.

Course Outcomes:

- To understand basic geometric primitives and transformations.
- To understand and implement the image processing techniques.
- To understand and apply 2D a feature-based image alignment, segmentation and motion estimations.
- To understand various Deep Learning techniques.
- To understand the various object detection techniques.

UNIT I (9 Hrs)

INTRODUCTION: Computer vision - A brief history - Image formation - Geometric primitives and transformations - Photometric image formation - The Digital Camera.

UNIT II (9 Hrs)

IMAGE PROCESSING: Point operators - Linear filtering - Non-linear filtering - Fourier transforms - Pyramids and wavelets - Geometric transformations.

UNIT III (9 Hrs)

MODEL FITTING & OPTIMIZATION: Scattered data interpolation - Variational methods and regularization -Markov random fields.

UNIT IV (9 Hrs)

DEEP LEARNING: Supervised learning - Unsupervised learning - Deep neural networks - Convolutional networks - More complex models.

UNIT V (9 Hrs)

IMAGE-BASED RENDERING AND RECOGNITION: Instance recognition - Image classification - Object detection - Semantic segmentation - Video understanding - Vision and language.

Text Books:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2nd Edition, 2022.
2. D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Pearson Education, 2nd Edition, 2015.

References:

1. Richard Hartley and Andrew Zisserman, "Multiple View Geometry in Computer Vision", Cambridge University Press,2nd Edition, March 2004.
2. Christopher M. Bishop; "Pattern Recognition and Machine Learning", Springer, 2006
3. E. R. Davies, "Computer and Machine Vision", 4th Edition, Academic Press, 2012.

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/108103174

AMPROJ705 CAPSTONE PROJECT I

L	T	P	C
0	0	4	6

Course Pre-requisite:

- Mini project.

Course Objectives:

- To gain domain knowledge, technical skills to solve potential business/research problems.and Prepare the project reports and presentation.

Course Outcomes:

- To gain Domain knowledge and technical skill set required for solving industry / research problems.
- To provide solution architecture, module level designs, algorithms.
- To implement, test and deploy the solution for the target platform.
- To prepare detailed technical report, demonstrate and present the work.
- To publish work in reputed indexing journal or patent.

Guidelines:

The students shall individually / or as group work(3 to 4 members) on business/research domains and related problems approved by the Department / organization that offered the project.

The student can select any topic which is relevant to his/her specialization of the programme. The student should continue the work on the selected topic as per the formulated methodology.

At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work, results and discussion, conclusion and references should be prepared as per the format prescribed by the University and submitted to the Head of the department.

The students will be evaluated based on the report and viva-voce examination by a panel of examiners as per the Regulations.

SEMESTER VIII

AMPROJ803 CAPSTONE PROJECT - II

L	T	P	C
0	0	4	10

Course Pre-requisite:

- Project - I

Course Objectives:

- To gain the domain knowledge and technical skills to solve potential business/ research problems.
- To gather system requirements and design suitable software solutions and test and evaluate them.
- To work in small teams and understand the processes and practices in the industry/ research problems.
- To implement, test and deploy solutions for target platforms.
- To prepare project reports and presentations.

Course Outcomes:

- To gain domain knowledge and technical skill set required for solving industry / research problems.
- To provide solution architecture, module level designs, algorithms.
- To implement, test and deploy the solution for the target platform.
- To prepare detailed technical report, demonstrate and present the work.

Project Guidelines:

The students shall individually / or as group work(3 to 4 members) on business/research domains and related problems approved by the Department / organization that offered the project. The student can select any topic which is relevant to his/her specialization of the programme. The student should continue the work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report which contains clear definition of the identified problem, detailed literature review related to the area of work, methodology for carrying out the work, design and implement, the solution, tabulated test results and discussion, conclusion and references should be prepared as per the format prescribed by the University and submitted to the Head of the department. The students will be evaluated based on the report and viva-voce examination by a panel of examiners as per the Regulations.

APPENDIX – I

HONOR COURSES

Code No.	Name of the Subjects	L	T	P	C
AMHR001	Python Programming and Data Visualization	3	1	0	4
AMHR002	Data Visualization Tools	3	1	0	4
AMHR003	Drone Technologies	3	1	0	4
AMHR004	Introduction to Robotics	3	1	0	4
AMHR005	Cognitive Science	3	1	0	4

AMHR001 PYTHON PROGRAMMING AND DATA VISUALIZATION

L	T	P	C
3	1	0	4

Course Pre-requisite:

- Programming knowledge in any Object Oriented language.
- Basic Understanding of Interaction design.

Course Objectives:

- To understand the basic concepts of Python in Data visualization technique and preparing and Pre-processing data.

Course Outcomes:

- To understand the basic concepts of Python.
- To understand repairing and pre-processing data.
- To understand the Objectives of Data Visualization.
- To understand professional data visualization techniques.
- To understand the fundamentals of Universal design.

UNIT I (12 Hrs)

INTRODUCTION: Python Concepts, DataStructures, Interpreter – Program Execution – Statements – Expressions – Flow Controls – Functions - Numeric Types – Sequences-Strings, Tuples, Lists and-Class Definition – Constructors – Inheritance – Overloading –Text&Binary Files - Reading and Writing.

UNIT II (12 Hrs)

INTRODUCTION IN DATA VISUALIZATION: History of Visualization – Need for Visualization - Interactive Visualization – Web Specific Components – Common Types of Data Visualization – Data Visualization and Infographics – Dashboards.

UNIT III (12 Hrs)

VISUALIZATION IN PYTHON: Visualization - Matplotlibpackage – PlottingGraphs – ControllingGraph – AddingText – MoreGraphTypes – Gettingandsetting values – Patches.

UNIT IV (12 Hrs)

DATA ABSTRACTION: Data Set types – Attribute Types – Semantics. Task Abstraction : Actions – Targets. Charts – Data Preprocessing - Choosing the optimal charts – Making charts effective – Context in Visualization - Analyzing Visual Patterns – Beautiful vs Useful Design - Cognitive Load Theory - Responsive Design principles.

UNIT V (12 Hrs)

PERCEPTION AND VISUALIZATION: Perception and Visualization – Perceptual processing – Metrics - The Visualization Process – Visual Variables – Taxonomies. Visualization validation : Threats to Validity – Validation approaches.

Text Books:

1. Mark Lutz, Programming Python, O'Reilly Media, 4th Edition, 2010.
2. Mark Lutz, Learning Python, O'Reilly Media, 5th Edition, 2013.
3. Tim Hall and J-P Stacey, Python 3 for Absolute Beginners, Apress, 1st Edition, 2009.
4. Magnus Lie Hetland, Beginning Python: From Novice to Professional, Apress, 2nd Edition, 2005.
5. Shai Vaingast, Beginning Python Visualization - Crafting Visual Transformation Scripts, Apress, 2nd Edition, 2014.
6. Matthew O.Ward Interactive Data Visualization: Foundations, Techniques, and Applications AK Peters / CRC Press.
7. Mico Yuk. Data Visualization For Dummies 3. Tamara Munzner. Visualization Analysis and Design AK Peters Publications.

References:

1. Wes Mc Kinney, "Python for Data Analysis", O'Reilly Media,2012.
2. White and Hadoop, "The Definitive Guide", 3rd Edition - O'Reilly ,2012.
3. Brandon Rhodes and John Goerzen, "Foundations of Python Network Programming", Apress, 2nd Edition,2010.

ONLINE/ NPTEL COURSES:

1. https://archive.nptel.ac.in/courses/106/106/106106212/

AMHR002 DATA VISUALIZATION TOOLS

L	T	P	C
3	1	0	4

Course Pre-requisite:

- Data Visualization.

Course Objectives:

- To create beautiful, interactive, browser-based data visualization using Tableau, Qlik and D3 tools.

Course Outcomes:

- To understand data analysis and visualizations.
- To learn the dataset with elements of a webpage, and modify the elements based on the data.
- To build interactive Dashboards and Visualizations.
- To understand Mapping data values onto pixels and colors with D3's scale objects.
- To Create a dynamic dashboard combining multiple worksheets.

UNIT I (12 Hrs)

INTRODUCTION: Introduction to Data Visualization Tools - Benefits of Data Visualization Tools - Data Visualization Tools - Google Data Studio - Qlikview - Tableau - Power BI - Features of Data Visualization Tool - Salient features of tools - Data Access from Data Sources - Data Transformation - Extraction, Transformation and Load (ETL) - Messy data - Data formats and schemas - Data blending or fusion - Methods for data cleansing - Data profiling - Open source data-cleansing tools.

UNIT II (12 Hrs)

INTRODUCTION TO DATA VISUALIZATION AND TABLEAU: Introduction to Tableau - Tableau Products Suite - Tableau File Types - Connecting to Data Sources: Working on Excel Data – Connecting to a Text Data Source - Handling R Data - Connecting to MS Access Database - Creating Basic Charts and Graphs: Creating a Pie Chart - Creating a Bar Chart - Creating a Line Graph - Discovering Scatter Plot.

UNIT III (12 Hrs)

DATA MANAGEMENT: Handling Filter Data - Discovering Context Filter - Implementing Sorting - Nested Sort - Understanding Grouping of Data - Manipulating Sets - Creating Parameters - Working with Dates: Discrete and Continuous.

UNIT IV (12 Hrs)

DATA VISUALIZATION AND QLIK: Performance and Tuning and Scalability - Qlik View Data Modeling - Best Practices for Loading - Advanced Expressions - Advanced Scripting - Styling up - Buidling Dashboards - Security - Data Visualization Strategy - Sales Perspective - Financial Perspective - MArketing PErspective.

UNIT V (12 Hrs)

DATA VISUALIZATION AND D3: Introduction to D3 - The Basic Setup - The New York Metropolitan Transit Authority Data Set - The Enter Selection - Building a Simple Subway Train Status Board - Graphing Mean Daily Plaza Traffic – Scales, Axes, and Lines - Bus Breakdown, Accident, and Injury - Graphing Turnstile Traffic - Interaction and Transitions - A Subway Wait Assessment UI Interactions - Subway Wait Assessment UI Transitions - Layout - Subway Connectivity - Scheduled Wait Time Distribution

Text Books:

1. Seema Acharya, “Data Visualization with Tableau”, Packt Publishing, 2018.
2. Miguel Ángel García, Barry Harmsen,Stephen Redmond and Karl Pover , “QlikView: Advanced Data Visualization.
3. Mike Dewar, ”Getting Started with D3”, O’Reilly Media, 2012.

References:

1. Andrew Rininsland and Swizec Teller, “D3.js 4.x Data Visualization”, 3rd Edition, Kindle, 2017.

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/127101012

AMHR003 DRONE TECHNOLOGIES

L	T	P	C
3	1	0	4

Course Objectives:

- To learn concepts of drone technologies.

Course Outcomes:

- To understand about a various type of drone technology, drone fabrication and programming.
- To understand the suitable operating procedures for functioning a drone.
- To understand and select appropriate sensors and actuators for Drones.
- To understand a drone mechanism for specific applications
- To understand and Create the programs for various drones.

UNIT I (12 Hrs)

INTRODUCTION TO DRONE TECHNOLOGY: Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability.

UNIT II (12 Hrs)

DRONE DESIGN, FABRICATION AND PROGRAMMING: Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts - Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.

UNIT III (12 Hrs)

DRONE FLYING AND OPERATION Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity -Removable storage devices- Linked mobile devices and applications.

UNIT IV (12 Hrs)

DRONE COMMERCIAL APPLICATIONS Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing.

UNIT V (12 Hrs)

FUTURE DRONES AND SAFETY: The safety risks- Guidelines to fly safely - Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms.

Text Books:

1. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", John Wiley & Sons, Inc., 2021.
2. Terry Kilby and Belinda Kilby, "Make:Getting Started with Drones ", Maker Media, Inc, 2016.

References:

1. John Baichtal, "Building Your Own Drones: A Beginners" Guide to Drones, UAVs, and ROVs", Que Publishing, 2016.
2. Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2018.

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/101104073

AMHR004 INTRODUCTION TO ROBOTICS

L	T	P	C
3	1	0	4

Course Pre-requisite:

- Mathematical Foundation of Computer Science and Basics of Machine Learning.

Course Objectives:

- To understand agents.
- To learn the principles and applications of agents.
- To design, build and program simple autonomous robots.
- To learn the working of robots.

Course Outcomes:

- Perform designing of various robotic arms.
- Implement robot programs.
- Apply and design robots.
- Understand applications of agents.

UNIT I (12 Hrs)

AGENTS, PARADIGMS, SENSORS: Intelligent agents-Search overview-Adversarial searchConstraint satisfaction- Paradigms: Hierarchical, Reactive- Types of Sensors-Vision

UNIT II (12 Hrs)

KNOWLEDGE REPRESENTATION, REASONING AND PLANNING: Predicate logic-Fuzzy logic - Classical planning-Planning and acting in real world-Navigation

UNIT III (12 Hrs)

LEARNING: Decision making-Learning from examples-Knowledge in learning-Learning probabilistic models-Reinforcement learning-Deep learning

UNIT IV (12 Hrs)

ROBOT PROGRAMMING: Features of various programming methods, Robot Task planning: concept, different methods, robot learning, Mobile Robot: Introduction, obstacle Representatives, Motion Planning in fixed and Changing structure - Simple Programs.

UNIT V (12 Hrs)

INDUSTRIAL APPLICATIONS AND CASE STUDIES: Application of robots: Material handling - Machine loading and unloading – Assembly – Inspection –Recent developments in Robotics- Safety Considerations.

Text Books:

1. Stuart J Russell and Peter Norvig, ”Artificial Intelligence – A Modern Approach”, PHI, 3rd Edition,2010.
2. Robin.R.Murphy, ”Introduction to AI Robotics”, MIT press, 2000.

References:

1. Kortenkamp, D., Bonasso, R. P., & Murphy, R. (Eds.), ”Artificial intelligence and mobile robots”, Menlo Park, CA: AAAI Press, 1998.
2. Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, ”Industrial Robotics, Technology programming and Applications”, McGraw Hill, 2012.
3. M. P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey, Industrial Robotics: Technology, Programming, and Applications”, McGraw Hill, 1st Edition, 1986.

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/107106090

AMHR005 COGNITIVE SCIENCE

L	T	P	C
3	1	0	4

Course Pre-requisite:

- Basic computer knowledge.
- Basic electronics knowledge.

Course Objectives:

- To learn the basics of Cognitive Science with focus on acquisition.
- To representation, and use of knowledge by individual minds, brains, and machines.
- To study the mind and intelligence, embracing psychology, artificial intelligence, neuroscience and linguistics.
- To understand the role of neuro science in the cognitive field.
- To gain knowledge about tools.

Course Outcomes:

- List Cognitive Science with focus on acquisition.
- Describe the representation, and use of knowledge by individual minds, brains, and machines.
- Perform neuroscience and linguistics based experiments.
- Implement the knowledge of neuro science in the cognitive field.
- Evaluate real world problem with this tool.

UNIT I (12 Hrs)

INTRODUCTION TO COGNITIVE SCIENCE: The Cognitive view –Some Fundamental Concepts – Computers in Cognitive Science – Applied Cognitive Science – The Interdisciplinary Nature of Cognitive Science.

UNIT II (12 Hrs)

COGNITIVE PSYCHOLOGY: Cognitive Psychology – The Architecture of the Mind The Nature of Cognitive Psychology- A Global View of The Cognitive Architecture- Propositional RepresentationSchematic Representation- Cognitive Processes, Working Memory, and Attention- The Acquisition of Skill- The Connectionist Approach to Cognitive Architecture.

UNIT III (12 Hrs)

LANGUAGE ACQUISITION, SEMANTICS AND PROCESSING MODEL: Milestones in Acquisition – Theoretical Perspectives- Semantics and Cognitive Science – Meaning and Entailment –Reference – Sense – Cognitive and Computational Models of Semantic Processing –Information Processing Models of the Mind- Physical symbol systems and language of thought- Applying the Symbolic Paradigm- Neural networks and distributed information processing- Neural network models of Cognitive Processes.

UNIT IV (12 Hrs)

INTEGRATION CHALLENGE: Cognitive Science and Integration Challenge – Tackling the Integration Challenge.

UNIT V (12 Hrs)

TOOLS: Working with Concept Maps – Scribe Note making tools.

Text Books:

1. Jose Luis Bermudez, “Cognitive Science: An Introduction to the Science of the Mind”, Cambridge University Press, New York, 2014.

References:

1. Allen Neil Stillings, Steven E. Weisler, Christopher H. Chase and Mark H. Feinstein, “Cognitive Science: An Introduction”, 2nd Edition, MIT press, 1995.

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/109103134

APPENDIX – II

MINOR COURSES

Code No.	Name of the Subjects	L	T	P	C
AMMR001	FOUNDATIONS OF DATA SCIENCE	3	1	0	4
AMMR002	FOUNDATIONS OF AI	3	1	0	4
AMMR003	APPLICATIONS OF AI	3	1	0	4
AMMR004	BUSINESS INTELLIGENCE & ANALYTICS	3	1	0	4
AMMR005	FOUNDATIONS OF ML	3	1	0	4

AMMR001 FOUNDATIONS OF DATA SCIENCE

L	T	P	C
3	1	0	4

Course Pre-requisite:

- Knowledge in Computer Programming.
- Basics of Computers.

Course Objectives:

- To gain knowledge in the basic concepts of Data Analysis and acquire skills in data preparatory and preprocessing steps using the tools and packages in Python for data science.

Course Outcomes:

- To understand and apply the skills of data inspecting and cleansing.
- To understand the relationship between data dependencies using statistics.
- To understand and handle data using primary tools used for data science in Python.
- To understand about data describing and visualization using tools.
- To understand the knowledge in matplotlib.

UNIT I (12 Hrs)

INTRODUCTION: Need for data science – Benefits and Uses – Facets of Data – Data Science Process – Setting Goal – Retrieving Data – Cleansing - integrating - Transforming data – Exploratory Data Analysis – Build the Models – Presenting and Building applications.

UNIT II (12 Hrs)

FREQUENCY DISTRIBUTIONS: Outliers – Relative Frequency Distributions – Cumulative Frequency Distributions – Frequency Distributions for nominal data – Interpreting Distributions – Graphs – Averages – Mode – Median – Mean.

UNIT III (12 Hrs)

PYTHON FOR DATA HANDLING: Basics of Numpy Arrays – Aggregations – Computations on Arrays – Comparisons - Masks, Boolean logic – Fancy Indexing – Structured Arrays – Data manipulation with Pandas – Data Indexing and Selection.

UNIT IV (12 Hrs)

DESCRIBING DATA II: Normal distributions – Z Scores – Normal Curve Problems – Finding Proportions – Finding Scores – More about Z Scores – Correlation – Scatter Plots – Correlation Coefficient for Quantitative Data – Computational Formula for Correlation Coefficient – Regression – Regression Line – Least Squares Regression Line.

UNIT V (12 Hrs)

PYTHON FOR DATA VISUALIZATION: Visualization with matplotlib – Line Plots – Scatter Plots – Visualizing Errors – Density and Contour Plots – Histograms - Binnings and Density – Three Dimensional Plotting – Geographic Data – Data Analysis using State Models and Seaborn – Graph plotting using Plotly.

Text Books:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. (first two chapters for Unit I)
2. Robert S. Witte and John S. Witte, "Statistics",Wiley Publications, 11th Edition, 2017. (Chapters 1–7 for Units II and III)
3. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016. (Chapters 2–4 for Units IV and V)

References:

1. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/106106179

AMMR002 FOUNDATIONS OF AI

L	T	P	C
3	1	0	4

Course Pre-requisite:

- Basic Programming Concepts.

Course Objectives:

- To learn the basic concepts and techniques of Artificial Intelligence.

Course Outcomes:

- To understand AI algorithms for solving practical problems.
- To understand and differentiate between Human Intelligence and AI
- To understand Propositional and Predicate Logics.
- To understand knowledge representaion and Reasoning.
- To understand planning problems.

UNIT I (12 Hrs)

INTRODUCTION: Artificial Intelligence and its applications - Artificial Intelligence Techniques -Level of models - Criteria of Success - Intelligent Agents - Nature of Agents - Learning Agents- AI Techniques - Advantages and Limitations of AI - Impact and Examples of AI - Application domains of AI - AI Ladder.

UNIT II (12 Hrs)

PROBLEM SOLVING TECHNIQUES: State space search - Control Strategies - Heuristic Search - Problem Characteristics - Production System Characteristics - Generate and test - Hill climbing - Best First Search - A* search - Constraint Satisfaction Problem - Mean-end Analysis - Min-Max Search - Alpha-Beta Pruning - Additional refinements - Iterative Deepening - Local Search Algorithms & Optimization Problems: Hill climbing - Search, Simulated Annealing Search, Local Beam Search.

UNIT III (12 Hrs)

LOGIC: Propositional logic - Predicate logic - Resolution - Resolution in Proportional Logic and Predicate Logic - Clause form - Unification Algorithm.

UNIT IV (12 Hrs)

KNOWLEDGE REPRESENTATION AND REASONING: Mapping between facts and representations - Approaches to knowledge representation - Procedural vs Declarative Knowledge - Forward vs Backward Reasoning - Matching - Conflict Resolution - Non-monotonic Reasoning, Default reasoning, Statistical Reasoning, Fuzzy Logic Weak and Strong Filler Structures - Semantic Nets - Frame - Conceptual Dependency - Scripts.

UNIT V (12 Hrs)

PLANNING: The Planning problem - Planning with State Space Search - Partial Order Planning - Planning Graphs - Planning with Propositional Logic - Analysis of Planning approaches - Hierarchical planning - Conditional Planning - Continuous and Multi Agent planning.

Text Books:

1. M.C. Trivedi, ”A Classical Approach to Artificial Intelligence”, Khanna Book Publishing, 2019.
2. Stuart Russel, ”Artificial Intelligence: A modern approach”, Pearson Education, 2010.
3. Rich and Knight, ”Artificial Intelligence”, The McGraw Hill, 2017.

References:

1. Nils and Nilson, ”Artificial Intelligence: A new synthesis”, Elsevier, 1997.

ONLINE/ NPTEL COURSES:

1. https://archive.nptel.ac.in/courses/112/103/112103280/

AMMR003 APPLICATIONS OF AI

L	T	P	C
3	1	0	4

Course Pre-requisite:

- Fundamentals of AI.

Course Objectives:

- To understand and use AI techniques for generating efficient, intelligent behaviour in applications such as health care, gameing, finance and robotics.

Course Outcomes:

- To understand and identify the tasks that can be tackled using AI techniques.
- To understand and apply appropriate AI technique for the problem under investigation.
- To understand and create efficient and robust AI algorithms for game tasks.
- To understand and apply natural language processing to extract information from unstructured medical data.
- To Understand the business model of robo/AI-advisors.

UNIT I (12 Hrs)

INTRODUCTION: Artificial Intelligence and its applications, Artificial Intelligence Techniques, Level of models, criteria of success, Intelligent Agents, Nature of Agents, Learning Agents. AI Techniques, advantages, and limitations of AI, Impact and Examples of AI, Application domains of AI. The AI Ladder - The Journey for Adopting AI Successfully, Advice for a career in AI, Hotbeds of AI Innovation.

UNIT II (12 Hrs)

AI IN HEALTHCARE: Disease detection with computer vision: Medical Image Diagnosis, Eye Disease and Cancer Diagnosis - Image segmentation on MRI images: Medical Image Segmentation, MRI Data and Image Registration - Linear prognostic models: Medical Prognosis, Atrial fibrillation - Medical Treatment Effect Estimation: Analyze data from a randomized control trial, Average treatment effect.

UNIT III (12 Hrs)

AI IN GAMING: Introduction to Game AI, kind of AI used in game development, model of game AI, AI engine structure, Kinematic movement algorithms, Basic Path finding Algorithms in game development, decision trees and state machines for game development - Survival Models and Time: Survival Model, Survival function, collecting time data.

UNIT IV (12 Hrs)

AI IN FINANCE: Fintech Innovations - Series Map and Learning Goals - Introduction to InsurTech, Investment & Market Size of the InsurTech Industry- Robo Advising: Expected Returns, Standard Deviations, and Correlation, Building an Efficient Portfolio, Diversified Investments, Exchange Traded Funds, Robo-Advisors.

UNIT V (12 Hrs)

AI FOR ROBOTICS: Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents. PROBLEM SOLVING: Solving problems by searching –Informed search and exploration–Constraint satisfaction problems– Adversarial search, knowledge and reasoning– knowledge representation – first order logic.

Text Books:

1. Ian Millington and John Funge, ”Artificial Intelligence for Games”, CRC Press; 2nd Edition, 2009.
2. Georgios N. Yannakakis and Julian Togelius, ”Artificial Intelligence and Games”, Springer International Publishing, 2018.
3. Eric Topol, ”Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again”, Basic Books, 1st Edition, 2019.
4. Artificial Intelligence in Finance, Yves Hilpisch, O’Reilly Media, Inc., 2020.
5. Machine Learning for Finance: Principles and Practice for Financial Insiders, Jannes Klaas, Packt Publishing Limited, 2019.
6. Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again, Eric Topol, Basic Books, 1st Edition, 2019.
7. Machine Learning and AI for Healthcare: Big Data for Improved Health Outcomes, Arjun Panesar, Apress, 1st Edition, 2019.

References:

1. David Jefferis, “Artificial Intelligence: Robotics and Machine Evolution”, Crabtree Publishing Company, 1992.
2. Artificial Intelligence in Healthcare, 2020, ISBN 978-0-12-818438-7, Elsevier Inc.

ONLINE/ NPTEL COURSES:

1. https://archive.nptel.ac.in/courses/106/106/106106238/

AMMR004 BUSINESS INTELLIGENCE & ANALYTICS

L	T	P	C
3	1	0	4

Course Pre-requisite:

- Knowledge in DBMS.

Course Objectives:

- To understand the business analytics Life Cycle.
- To comprehend the process of acquiring Business Intelligence.
- To understand various types of analytics for Business Forecasting and the supply chain management for Analytics.

Course Outcomes:

- To understand the real world business problems and model with analytical solutions.
- To understand and identify the business processes for extracting Business Intelligence.
- To understand and apply predictive analytics for business fore-casting.
- To understand and apply analytics for supply chain and logistics management.
- To understand and use analytics for marketing and sales.

UNIT I (12 Hrs)

INTRODUCTION TO BUSINESS ANALYTICS: Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration.

UNIT II (12 Hrs)

BUSINESSS INTELLIGENCE: Data Warehouses and Data Mart - Knowledge Management – Types of Decisions – Decision Making Process - Decision Support Systems – Business Intelligence – OLAP – Analytic functions.

UNIT III (12 Hrs)

BUSINESS FORECASTING: Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models – Data Mining and Predictive Analysis Modeling – Machine Learning for Predictive analytics.

UNIT IV (12 Hrs)

HR AND SUPPLY CHAIN ANALYTICS: Human Resources – Planning and Recruitment – Training and Development - Supply chain network - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain.

UNIT V (12 Hrs)

MARKETING & SALES ANALYTICS: Marketing Strategy, Marketing Mix, Customer Behavior – selling Process – Sales Planning – Analytics applications in Marketing and Sales

Text Books:

1. R. Evans James, "Business Analytics", Pearson, 3rd Edition, 2019.
2. R N Prasad and Seema Acharya, "Fundamentals of Business Analytics", Wiley, 2nd Edition, 2016.
3. Philip Kotler and Kevin Keller, "Marketing Management", PHI, 15th Edition, 2016.

References:

1. VSP RAO, "Human Resource Management", 3rd Edition, Excel Books, 2010.
2. Mahadevan B, "Operations Management -Theory and Practice",3rd Edition, Pearson Education, 2018.

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/110105089

AMMR005 FOUNDATIONS OF ML

L	T	P	C
3	1	0	4

Course Pre-requisite:

- Knowledge in Programming languages (C,C++,python) .

Course Objectives:

- To introduce the fundamental concepts of machine learning and its applications.

Course Outcomes:

- To understand the basic concepts of Bayesian theory and normal densities.
- To understand different classification algorithms used in machine learning.
- To understand and implement clustering and component analysis techniques.
- To understand, design and implement deep learning architectures for solving real life problems.
- To understand and combine the evidence from two or more models/methods for designing a system.

UNIT I (12 Hrs)

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 (12 Hrs)

CLASSIFICATION ALGORITHMS: Perceptron and backpropagation neural network - k-nearestneighbor rule. Support vector machine: multicategory generalizations – Regression Decision trees: classification and regression tree – random forest.

UNIT III (12 Hrs)

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 –auto associative neural network.

UNIT IV (12 Hrs)

SUPERVISED AND UNSUPERVISED: Convolution neural network (CNN) - Layers in CNN - CNN architectures. Recurrent Neural Network -Applications: Speech-to-text conversion-image classificationtime series prediction.

UNIT V (12 Hrs)

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", John Wiley & Sons, Singapore, 2nd Edition, 2012.
2. Francois Chollet, " Deep Learning with Python", Manning Publications, Shelter Island, New York, 2018.
3. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, 3rd Edition 2014.
4. C. M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.

References:

1. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/106106139

APPENDIX - III

LIST OF PROFESSIONAL ELECTIVES

Code No.	Name of the Subjects	L	T	P	C
AMPE001	Statistical Thinking for Data Science	3	0	2	3
AMPE002	Responsible AI	3	0	2	3
AMPE003	Data Visualization	3	0	2	3
AMPE004	Big Data Analytics	3	0	2	3
AMPE005	Soft Computing	3	0	2	3
AMPE006	IoT Analytics	3	0	2	3
AMPE007	Image and Video Processing	3	0	2	3
AMPE008	Explainable AI	3	0	2	3
AMPE009	Autonomous Systems	3	0	2	3
AMPE010	Bioinformatics	3	0	2	3
AMPE011	Reinforcement Learning	3	0	2	3
AMPE012	Adversarial AI	3	0	2	3
AMPE013	Computational Neuroscience	3	0	2	3
AMPE014	AI in Gaming	3	0	2	3
AMPE015	AI in Healthcare	3	0	2	3
AMPE016	AI in Finance	3	0	2	3

AMPE001 STATISTICAL THINKING FOR DATA SCIENCE

L	T	P	C
3	0	2	3

Course Pre-requisite:

- Knowledge in statistics and Computer Programming.

Course Objectives:

- This course will provide the students a statistical foundation for data science. They will be able to exercise statistical thinking in collecting, modelling and analyzing data.

Course Outcomes:

- To understand the statistical foundation for data science.
- To understand statistical thinking in collecting, modelling and analyzing data.
- To understand the capacity to see various forms of Data.
- To understand how to use R for different types of data.
- To understand and be able to use the information for tools that describes and visualise data.

UNIT I (9 Hrs)

EXPLORATORY DATA ANALYSIS: Elements of Structured Data - Rectangular Data - Estimates of Location - Estimates of Variability - Exploring the Data Distribution - Exploring Binary and Categorical Data - Correlation - Exploring Two or More Variables.

UNIT II (9 Hrs)

DATA AND SAMPLING DISTRIBUTIONS: Random Sampling and Sample Bias - Selection Bias - Sampling Distribution of a Statistic - The Bootstrap - Confidence Intervals - Normal Distribution - Long-Tailed Distributions - Student's t-Distribution - Binomial Distribution - Chi-Square Distribution - F-Distribution - Poisson and Related Distributions.

UNIT III (9 Hrs)

STATISTICAL EXPERIMENTS AND SIGNIFICANCE TESTING: A/B Testing - Hypothesis Tests - Resampling - Statistical Significance and p-Values - t-Tests - Multiple Testing - Degrees of Freedom - ANOVA - Chi-Square Test - Multi-Arm Bandit Algorithm - Power and Sample Size.

UNIT IV (9 Hrs)

REGRESSION AND PREDICTION: Simple Linear Regression - Multiple Linear Regression - Prediction Using Regression - Factor Variables in Regression - Interpreting the Regression Equation - Regression Diagnostics - Polynomial and Spline Regression.

UNIT V (9 Hrs)

CLASSIFICATION: Naive Bayes - Discriminant Analysis - Logistic Regression - Evaluating Classification Models - Strategies for Imbalanced Data.

Laboratory/ Practicals:

1. Installing R and R studio.
2. Understanding R fundamentals.
3. Data cleaning and manipulation using R.
4. Data Visualisation using R.
5. Statistical Analysis using R.

Text Books:

1. Peter Bruce and Andrew Bruce, ”Practical Statistics for Data Scientists”, O’Reilly, 2017.
2. Tamhane, Ajit C., and Dorothy D. Dunlop. ”Statistics and Data Analysis: From Elementary to Intermediate”, Prentice Hall, 1st Edition, 1999.
3. Jeeva Jose, ”Beginner’s Guide for Data Analysis using R Programming”, Khanna Book Publishing House, 1st Edition, 2019.
4. V.K. Jain, ”Data Sciences & Analytics”, Khanna Book Publishing House 2021.

References:

1. Timothy C. Urdan, Routledge, ”Statistics in Plain English”, 2010.

ONLINE/ NPTEL COURSES:

1. https://archive.nptel.ac.in/courses/106/106/106106179
2. https://www.digimat.in/nptel/courses/video/106106179

AMPE002 RESPONSIBLE AI

L	T	P	C
3	0	2	3

Course Objectives:

- To know about the responsibility of artificial intelligence (AI) to make it more useful for society and humanity.

Course Outcomes:

- To understand the aspects of responsible AI such as fairness, accountability, bias, privacy etc.
- To understand and assess the fairness and ethics of AI modules.
- To understand and enforce fairness in models and remove bias in data.
- To understand and preserve the privacy of individuals while learning from them.
- To understand and develop responsible AI modules for given practical problems and estimate the trade-off with accuracy.

UNIT I (9 Hrs)

INTRODUCTION TO RESPONSIBLE AI: Need for ethics in AI. AI for Society and Humanity, Fairness and Bias, Sources of Biases, Exploratory data analysis, limitation of a dataset, Preprocessing, inprocessing and postprocessing to remove bias, Group fairness and Individual fairness, Counterfactual fairness.

UNIT II (9 Hrs)

AI STANDARDS AND REGULATION: International ethical initiatives-Ethical harms and concerns, Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems.

UNIT III (9 Hrs)

INTERPRETABILITY AND EXPLAINABILITY: Interpretability through simplification and visualization, Intrinsic interpretable methods, Post Hoc interpretability, Explainability through causality, Model agnostic Interpretation.

UNIT IV (9 Hrs)

ETHICS AND ACCOUNTABILITY: Auditing AI models, fairness assessment, Principles for ethical practices, Privacy preservation: Attack models, Privacy-preserving Learning, Differential privacy, Federated learning.

UNIT V (9 Hrs)

CASE STUDY: Recommendation systems, Medical diagnosis, Hiring/ Education, Computer Vision, Natural Language Processing

Laboratory/ Practicals:

1. Implement Transparency of Autonomous Systems.
2. Implement Post Hoc Interpretability.
3. Implement Intrinsic Interpretable Methods.
4. Implement Model Agnostic Interpretation.
5. Implement Federated learning.

Text Books:

1. Virginia Dignum, "Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way", Springer Nature, 2019.
2. Christoph Molnar, "Interpretable Machine Learning",Lulu, 1st Edition, 2019.

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/106105077

AMPE003 DATA VISUALIZATION

L	T	P	C
3	0	2	3

Course Pre-requisite:

- Knowledge in Database Management System.

Course Objectives:

- The students will be able to represent any type of dataset in visual form. They will also be able to draw insights from the data. They will also learn about different python visualization libraries.

Course Outcomes:

- To understand data visualizations in order to derive more meaning out of data.
- To understand python visualization libraries.
- To understand data visualization on different types of data.
- To understand data visualization and perceive hidden meanings from data.
- To understand and use the information in Visualization libraries.

UNIT I (9 Hrs)

THE COMPUTER AND THE HUMAN: Overview of Visualization, 2-D Graphics, SVG example, 2-D Drawing, 3-D Graphics, Photorealism, Non-Photorealism, the human retina: Perceiving Two Dimensions, Perceiving Perspective.

UNIT II (9 Hrs)

PLOTS AND CHARTS: Visualization Tools - Line plots, area plots, histogram, bar charts, pie charts, scatter plots, bubble plots, waffle charts, word clouds.

UNIT III (9 Hrs)

VISUALIZATION OF NUMERICAL DATA: Introduction, Data, Mapping, Charts, Glyphs, parallel coordinates, Parallel coordinates, Stacked graphs, Tufte's Design Rules, Using Color.

UNIT IV (9 Hrs)

VISUALIZATION OF NON-NUMERICAL DATA: Graphs and Networks, Embedding Planar Graphs, Graph Visualization, Tree Maps, Principal Component Analysis, Multidimensional Scaling.

UNIT V (9 Hrs)

PYTHON VISUALIZATION LIBRARIES: matplotlib, pandas, seaborn, ggplot, plotly.

Laboratory/ Practicals:

1. Understanding the basic python visualization tools.
2. Implement different types of charts anad graphs.
3. Implement visualization of numerical data.
4. Implement visualization of non-numerical data.
5. Implement basic functions of matplotlib, pandas, seaborn, ggplot, pyplot.

Text Books:

1. Jeeva Jose, ”Taming Python by Programming”, Khanna, 1st Edition, 2017.
2. Kyran Dale, ”Data Visualization with Python and JavaScript: Scrape, Clean, Explore & Transform Your Data”, O’Reilly, 2016.
3. Jeeva Jose, ”Introduction to Computing & Problem Solving with Python”, Khanna Publishing House, Kindle Edition, 2016.
4. Mario Döbler, ”Data Visualization with Python: Create an impact with meaningful data insights using interactive and engaging visuals”, Packt Publishers, 2019.
5. Kirthi Raman, ”Mastering Python Data Visualization”, Packt Publishers, 2015.

References:

1. Alex Campbell, ”Data Visualization”, Alex, 1st Edition, 2022.

ONLINE/ NPTEL COURSES:

1. https://archive.nptel.ac.in/courses/106/106/106106212

AMPE004 BIG DATA ANALYTICS

L	T	P	C
3	0	2	3

Course Pre-requisite:

- Database Management System, Computer Networks.

Course Objectives:

- The explain the concepts related to Big Data and methods used to mine Data Streams.

Course Outcomes:

- To understand and apply big data flow to actual projects as well as apply data analytics life cycle to big data projects.
- To understand proper methods and instruments for resolving issues with large data.
- To understand and describe big data and use cases from selected business domains.
- To understand NoSQL big data management.
- To understand the use of Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.

UNIT I (9 Hrs)

INTRODUCTION TO BIG DATA: Introduction to BigData Platform, Traits of Big data, Challenges of Conventional Systems, Web Data, Evolution of Analytic Scalability, Analysis vs Reporting, Statistical Concepts: Sampling Distributions, Re-Sampling, Statistical Inference, Prediction Error.

UNIT II (9 Hrs)

DATA ANALYTIC METHODS: Regression Modelling, Multivariate Analysis, Bayesian Modelling, Inference and Bayesian Networks, Support Vector and Kernel Methods, Analysis of Time Series: Linear Systems Analysis, Nonlinear Dynamics, Rule Induction, Neural Networks: Learning and Generalization.

UNIT III (9 Hrs)

FREQUENT ITEM SETS AND CLUSTERING: Mining Frequent item sets: Market Based Model, Apriori Algorithm, Handling Large Data Sets in Main Memory, Limited Pass Algorithm, Counting Frequent item sets in a Stream, Clustering Techniques: Hierarchical, K-Means, Frequent Pattern based Clustering Methods.

UNIT IV (9 Hrs)

MINING DATA STREAMS: Introduction to Streams Concepts: Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream: Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Oneness in a Window, Decaying Window, Real time Analytics Platform(RTAP) Applications, Case Studies, Real Time Sentiment Analysis, Stock Market Predictions.

UNIT V (9 Hrs)

FRAMEWORK, TECHNOLOGIES, TOOLS AND VISUALIZATION: Map Reduce: Hadoop, Hive, MapR, Sharding, NoSQL Databases: S3, Hadoop Distributed File Systems, Visualizations: Visual Data Analysis Techniques, Interaction Techniques; Systems and Analytics Applications, Analytics using Statistical packages, Industry challenges and application of Analytics.

Laboratory/ Practicals:

1. Describe big data and use cases from selected business domains.
2. Implement NoSQL big data management.
3. Install, configure, and run Hadoop and HDFS.
4. Perform map-reduce analytics using Hadoop.
5. Perform Distributed File System using Hadoop.

Text Books:

1. Bart Baesens, ”Analytics in a Big Data World: The Essential Guide to data Science and its Applications”, Wiley publications, 2014.
2. V.K. Jain, ”Big Data & Hadoop”, Khanna Book Publishing Co., Delhi. (ISBN978-93-82609-131),2017.
3. Michael Berthold, David J. Hand, ”Intelligent Data Analysis”, Springer, 2003.
4. Anand Rajaraman and Jeffrey David Ullman, ”Mining of Massive Datasets”, Cambridge University Press, 2020.

References:

1. Tom Plunkett, Mark Hornick, ”Using R to Unlock the Value of Big Data: Big Data Analytics with OracleR Enterprise and Oracle R Connector for Hadoop”, McGraw-Hill/Osborne Media, Oracle press, 2013.
2. Anand Rajaraman and Jefrey David Ulman, ”Mining of Massive Datasets”, Cambridge University Press, 2012.

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/106104189

AMPE005 SOFT COMPUTING

L	T	P	C
3	0	2	3

Course Pre-requisite:

- Basics of Computational Intelligence and Programming Languages.

Course Objectives:

- To impart knowledge about the Soft Computing technologies and applications.

Course Outcomes:

- To Understand, Identify and describe soft computing techniques and their roles in building intelligent machines.
- To apply soft computing methodology for solving real-world problem.
- To understand, analyse and compare solutions obtained using various soft computing approaches for a given problem.
- To understand the genetic algorithms.
- To understand fuzzy logic.

UNIT I (9 Hrs)

INTRODUCTION TO NEURAL NETWORKS: Structure and working of Biological Neural Network, Fundamentals of Artificial Neural Networks & Applications, Characteristics of Artificial Neural Networks, History of neural network research, characteristics.

UNIT II (9 Hrs)

ARCHITECTURE OF NEURAL NETWORKS : Models of neuron McCulloch – Pitts model, Perceptron, Adaline model, Basic learning laws, Topology of neural network architecture, Multilayer Neural Networks, Learning Methods, Backpropagation, Counter propagation.

UNIT III (9 Hrs)

INTRODUCTION OF FUZZY LOGIC AND NEURO FUZZY SYSTEMS: Introduction, Fuzzy sets, Fuzzy model, Fuzzy rule generation Fuzzy inference system, Defuzzification, Architecture of a Neuro-Fuzzy system and its applications.

UNIT IV (9 Hrs)

EVOLUTIONARY ALGORITHM: GA, GP.

UNIT V (9 Hrs)

APPLICATIONS: Applications of NN, FL, EA and Hybrid systems.

Laboratory/ Practicals:

1. Implement NN.
2. Implement GA.
3. Implement Neuro Fuzzy Systems.

Text Books:

1. Jang, ”Neuro fuzzy and soft computing”, Pearson Education, 1996.
2. Vojislav Kecman, ”Learning and Soft Computing”, Pearson Education, 2001.
3. Ikvinderpal Singh, ”Soft Computing”, Khanna Book Publishing, 2015.

References:

1. Klir and Yuan, ”Fuzzy Sets and Fuzzy Logic”, PHI, 1995
2. Fu,”Neural Network in computer Intelligence”, TMH, 2003
3. Dario Floreano, ”Bio-Inspired Artificial Intelligence”, PHI, 2008

ONLINE/ NPTEL COURSES:

1. https://archive.nptel.ac.in/courses/106/105/106105173/

AMPE006 IOT ANALYTICS

L	T	P	C
3	0	2	3

Course Pre-requisite:

- Knowledge of IoT.

Course Objectives:

- To make better business decisions and acquire greater control of IoT infrastructure. To learn about extracting actionable intelligence from the flood of IoT data.

Course Outcomes:

- To understand about “Internet of Things” in different contexts.
- To understand the key components that make up an IoT system.
- To understand the difference between the levels of the IoT stack and be familiar with the key technologies and protocols employed at each layer of the stack.
- To understand and apply the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis.
- To understand where the IoT concept fits within the broader ICT industry and possible future trends.

UNIT I (9 Hrs)

INTRODUCTION: IoT Analytics and Challenges - IoT Devices and Networking Protocols - IoT devices - Networking basics - IoT networking connectivity protocols - IoT networking data messaging protocols - Message Queue Telemetry Transport (MQTT) - Hyper-Text Transport Protocol (HTTP) - Constrained Application Protocol (CoAP) - Data Distribution Service (DDS).

UNIT II (9 Hrs)

IOT ANALYTICS FOR THE CLOUD: Elastic analytics - Cloud security & Analytics - AWS Cloud Analytics - AWS Cloud Formation - AWS Virtual Private Cloud (VPC) setup - Data processing - Big data technology - Hadoop - Apache Spark for data processing - Lambda architectures.

UNIT III (9 Hrs)

EXPLORING IOT DATA: Exploring & Visualizing Data - Data quality Techniques - Basic Time series analysis - Attributes - R - Solving industry- specific analysis problems - Decorating Data - External Datasets – Adding External Datasets - Internal datasets - Adding Internal Datasets.

UNIT IV (9 Hrs)

VISUALIZATION AND DASH BOARDING: Designing Visuals - Questions method - Visual Analysis for IoT data - Creating dashboard -Creating and visualizing Alerts - Geospatial Analytics - Vector-based methods - Raster-based methods - Geospatial data - Data Science for IoT Analytics - Machine learning (ML) - Generalization - Validation methods.

UNIT V (9 Hrs)

MODEL USING R: ROC curves - Area Under the Curve (AUC) - Random forest models using R - Gradient Boosting Machines (GBM) using R - Anomaly detection using R - Forecasting using ARIMA - Deep learning - Organize Data for Analytics - Linked Analytical Datasets - Managing data lakes.

Laboratory/ Practicals:

1. Implement Data Distribution Service.
2. Implement AWS Virtual Private Cloud (VPC).
3. Implement External and Internal Datasets.
4. Implement Vector-based methods and Raster-based methods.
5. Implement forecasting using ARIMA.

Text Books:

1. Andrew Minteer , “Analytics for the Internet of Things (IoT)”, Packt Publishing , 1st Edition Edition, 2017.

ONLINE/ NPTEL COURSES:

1. https://archive.nptel.ac.in/courses/106/105/106105166/

AMPE007 IMAGE AND VIDEO PROCESSING

L	T	P	C
3	0	2	3

Course Pre-requisite:

- Signals and Systems.

Course Objectives:

- The students will be able to work with images and videos in several ways. These methods can be used as pre-processing steps for complex models.

Course Outcomes:

- To understand images and videos representation in a detailed manner.
- To understand ML techniques for image processing in different scenarios.
- To understand various object detection and image segmentation algorithms.
- To understand various image restoration techniques and algorithms.
- To understand and Analyze the image compression systems.

UNIT I (9 Hrs)

IMAGE REPRESENTATION AND ANALYSIS: Introduction to computer Vision, Numerical representation of images, Image augmentation, enhancement, processing, color transforms, geometric transforms, feature recognition and extraction.

UNIT II (9 Hrs)

IMAGE SEGMENTATION: Object detection, breaking image into parts, finding contours and edges of various objects in image, Background subtraction for video.

UNIT III (9 Hrs)

OBJECT MOTION AND TRACKING: Tracking a single point over time, motion models to define object movement over time, analyze videos as sequences of individual image frames, methods to track a set of features over time, matching features from image frame to other, tracking a moving car using optical flow.

UNIT IV (9 Hrs)

ROBOTIC LOCALIZATION: Bayesian statistics to locate a robot in space, sensor measurements to safely navigate an environment, Gaussian uncertainty, histogram filter for robot localization in python.

UNIT V (9 Hrs)

IMAGE RESTORATION: Degradation model, noise models, estimation of degradation function by modeling, restorationusing Weiner filters and Inverse filters.

Laboratory/ Practicals:

1. Implement various forms of image representation.
2. Implement various image segmentation algorithms.
3. Implement object motion and tracking.
4. Implement object localization.
5. Implement image restoration.

Text Books:

1. Bali & Bali, ”Audio Video Systems”, Khanna Book Publishing 2020.
2. Alan C. Bovik, ”Handbook of Image and Video Processing”, Academic Press, 2000.
3. Ashwin Pajankar, ”Python 3 Image Processing”, BPB Publication, 2019.

References:

1. Thomas B. Moeslund, ”Introduction to Video and Image Processing”, Springer, Kindle Edition, 2012.

ONLINE/ NPTEL COURSES:

1. https://archive.nptel.ac.in/courses/117/105/117105135/
2. https://www.coursera.org/learn/image-processing

AMPE008 EXPLAINABLE AI

L	T	P	C
3	0	2	3

Course Pre-requisite:

- Knowledge of AI.

Course Objectives:

- To learn the concepts of Explainable AI (XAI) and provides a snapshot of interpretable AI techniques that reflects the current discourse and provides directions of future development of Intelligent Systems.

Course Outcomes:

- To understand the explainability methods in different types of models.
- To understand the explainability of Image data.
- To understand the model agnostic and the model specific explainability methods.
- To understand and learn how to evaluate the quality of explanations.
- To deploy the technology in real time applications.

UNIT I (9 Hrs)

INTRODUCTION: Explainable AI – Challenges - Interpretability and Explainability - Explainability Consumers - Types of Explanations - Themes - Tabular Data - Tree-Based Models - Partial Dependence Plots (PDPs).

UNIT II (9 Hrs)

IMAGE DATA: Integrated Gradients (IG) - XRAI - Grad-CAM - LIME - Guided Grad-CAM - Text Data - Building Models - Layer-Wise Relevance Propagation (LRP) - Attacks on Machine Learning: Attack Timing - The Attacker - Attacker Goals.

UNIT III (9 Hrs)

EXPLAINABILITY TECHNIQUES: Input Attribution – Design – Modalities – Evaluation - Interacting with Explainable AI - Presenting Explanations - Data Poisoning Attacks: Modeling Poisoning Attacks - Poisoning Attacks on Binary - Poisoning Attacks for Unsupervised Learning - Poisoning Attack on Matrix Completion.

UNIT IV (9 Hrs)

PITFALLS: Assuming Causality - Intent to a Model - Additional Explanations - Explainability in Mind - ML Life Cycle - AI Regulations and Explainability - Attacking and Defending Deep Learning : Neural Network Models - Attacks on Deep Neural Networks - Making Deep Learning Robust.

UNIT V (9 Hrs)

EXPLAINABLE AI: Natural and Semantic Explanations – Interrogative Explanations - Targeted Explanations - ML Consumers - Taxonomy of Explainability - XAI Techniques - Advanced and Emerging Techniques - Interacting with Explainability.

Laboratory/ Practicals:

1. Implement LIME.
2. Implement Poisoning Attacks.
3. Implement Poisoning attack on Matrix Completion.
4. Implement Deep Learning Robust.
5. Implement Neural Network Models.

Text Books:

1. Michael Munn and David Pitman, “Explainable AI for practitioners”, O’Reilly Media, 1st Edition, 2022.
2. Ronald J. Brachman, and Peter Stone, “Adversarial Machine Learning”, Morgan & Claypool, 1st Edition, 2018. (Unit II, III & IV)

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/106105077

AMPE009 AUTONOMOUS SYSTEMS

L	T	P	C
3	0	2	3

Course Pre-requisite:

- Basic Knowledge in Electrical Engineering/Electronics/Control Systems.

Course Objectives:

- To provide a complete understanding of autonomous systems. and enable students to design and implement an autonomous vehicle.

Course Outcomes:

- To uderstand the basics of Autonomous Systems.
- To understand the functional architecture of AVS.
- To understand, design and implement an autonomous vehicle.
- To understand the navigation and path planning technology of AV.
- To understand the concepts related to drone design.

UNIT I (9 Hrs)

INTRODUCTION: What are autonomous systems? AI in autonomous systems, Autonomous systems vs robots.

UNIT II (9 Hrs)

FUNCTIONAL ARCHITECTURE: Major functions in an autonomous vehicle system, Motion Modelling - Coordinate frames and transforms, point mass model.

UNIT III (9 Hrs)

MODELLING IN AUTONOMOUS SYSTEMS: Vehicle modelling (kinematic and dynamic bicycle model - two-track models), Sensor Modelling - encoders, inertial sensors, GPS.

UNIT IV (9 Hrs)

SLAM: Localization and mapping fundamentals, LIDAR and visual SLAM, Navigation - Global path planning, Local path planning, Vehicle control - Control structures, PID control, Linear quadratic regulator, Sample controllers.

UNIT V (9 Hrs)

DRONES: overview, definition, applications, components platforms, propulsion, on-board flight control, payloads, communications, concepts of flight, regulatory norms and regulations, Machine learning and deep learning for autonomous driving, Case study.

Laboratory/ Practicals:

1. Design and build systems that will use sensors, communication protocol and actuators.
2. Design and implement basic algorithms for autonomous vehicles.
3. Design and implement basic algorithms for autonomous robots.
4. Design and implement Global and Local Path Planning algorithms.
5. Design and implement basic algorithms for drones.

Text Books:

1. Pratihar, Dilip Kumar,"Intelligent Autonomous Systems Foundations and Applications", Springer, 2010.
2. Szabolcs Michael de Gyurky, Mark A. Tarbell, "The Autonomous System: A Foundational Synthesis of the Sciences of the Mind", Wiley, 2013.
3. Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu and Jean-Luc Gaudiot, "Creating Autonomous Vehicle Systems", Morgan & Claypool Publishers , 2018.

References:

1. Siegwart, Nourbakhsh, and Scaramuzza, "Introdution to Autonomous Mobile Robots", 2nd Edition, 2018.

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/112104308

AMPE010 BIOINFORMATICS

L	T	P	C
3	0	2	3

Course Pre-requisite:

- Basics in Biology - Molecular, genetics.

Course Objectives:

- To enable students to understand and carry out biological data analytics.

Course Outcomes:

- To understand the concepts and applications of bio-informatics and file formats for biological sequences.
- To understand and evaluate the various biological sequence databases.
- To understand and carry out sequence alignment and sequence comparison.
- To understand the concept of MSA.
- To understand the prediction methods using DNA and Protein sequences.

UNIT I (9 Hrs)

INTRODUCTION: History, scope and important contributions, aims and tasks of Bioinformatics, applications of Bioinformatics, challenges and opportunities, introduction to NCBI data model, various file formats for biological sequences.

UNIT II (9 Hrs)

BIOLOGICAL DATABASES AND DATA SEARCH METHODS: Significance, Features, Classifications of Biological DB - Structure of DB - Primary, Secondary, FASIA, BLASI, Types, PRograms - Genbank - DNA Databank, EMBL, UNIPROJ, SWISSPROJ, JREMBL, PDB, Persits, Prints, Blocks, Pfam.

UNIT III (9 Hrs)

SEQUENCE COMPARISON METHODS: Methods for comparison of two sequences, Needleman Wush and Smith Waterman algorithms. Analysis of computational complexities, merits and demerits of these algorithms, theory of scoring matrices and their use for sequence comparison.

UNIT IV (9 Hrs)

SEQUENCE ALIGNMENT METHODS: Sequence analysis of biological data, significance of sequence alignment, pair wise sequence alignment methods, use of scoring matrices and gap penalties in sequence alignments, multiple sequence alignment methods, tools and applications of multiple sequence alignment.

UNIT V (9 Hrs)

PREDICTIVE METHODS USING DNA AND PROTEIN SEQUENCES: Gene prediction strategies, protein prediction strategies, molecular visualization tools, phylogenetic analysis: concept of trees, phylogenetic trees and multiple alignments.

Laboratory/ Practicals:

1. Hands-on with Nucleic acid databases (NCBI, DDBJ, EMBL), Protein databases (Primary, Composite and Secondary).
2. Hands-on with Specialized Genome databases (SGD, TIGR, ACeDB), Structure databases (CATH, SCOP, PDBsum).
3. Hands-on with methods for searching sequence databases.
4. Hands-on with sequence comparison and sequence alignment methods.
5. Hands-on with predictive methods.

Text Books:

1. Andreas D Baxevanis & B F Francis, ”Bioinformatics-A practical guide to analysis of Genes and Proteins”, John Wiley, 2010.
2. T K Attwood, D J Parry-Smith, ”Introduction to Bioinformatics”, Pearson Education, 2005.
3. Neil C. Jones, Pavel A. Pevzner, ”An Introduction to Bioinformatics Algorithms”, MIT Press, 2005.

References:

1. Gary Benson Roderic, ”Algorithms in Bioinformatics”, Springer, 2004.
2. Manoj Darbari, ”Foundations of Bioinformatics”, Khanna Book Publishing Co., 2013.

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/102106065

AMPE011 REINFORCEMENT LEARNING

L	T	P	C
3	0	2	3

Course Pre-requisite:

- Linear algebra, multivariable calculus.
- Basic machine learning knowledge.

Course Objectives:

- To learn the concepts of RL tasks and the core principles behind the RL, including policies, value functions.

Course Outcomes:

- To understand the elements and framework of RL.
- To understand and work with tabular methods to solve classical control problems.
- To understand and work with approximate solutions.
- To understand and recognize current advanced techniques and applications in RL.
- To understand and explore imitation learning tasks and solutions in real time.

UNIT I (9 Hrs)

INTRODUCTION: Basics of RL, Elements of Reinforcement Learning, RL Framework- Markov Decision Process, Bellman Equation, Linear sequential decision making, Exploration vs. Exploitation, Limitation and Scope, An Extended Example: Tic-Tac-Toe.

UNIT II (9 Hrs)

RL TABULAR SOLUTION MODELS: Multi-armed Bandits , Temporal difference learning, Monte carlo methods, Dynamic Programming.

UNIT III (9 Hrs)

RL APPROXIMATE METHODS: On-policy prediction, linear methods, off-policy methods, policy gradient methods.

UNIT IV (9 Hrs)

RECENT ADVANCES IN RL: Meta-learning, Multi-Agent Reinforcement Learning, Partially Observable Markov Decision Process, Ethics in RL, Applying RL for real-world problems

UNIT V (9 Hrs)

APPLICATION AND CASE STUDY: TD-Gammon, Samuel's Checkers Player, Watson's Daily-Double Wagering, Optimizing Memory Control, Mastering the Game of Go.

Laboratory/ Practicals:

1. Implement Markov Decision Process.
2. Implement Bellman Equation.
3. Implement Monte Carlo Methods.
4. Implement RL approximate methods.
5. Implement CS using RL.

Text Books:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An introduction", 2nd Edition, MIT Press, 2019
2. Li, Yuxi. "Deep reinforcement learning" arXiv preprint arXiv:1810.06339, 2018.
3. Wiering, Marco, and Martijn Van Otterlo. "Reinforcement learning" Adaptation, learning, and optimization 12, 2012.

References:

1. Russell, Stuart J., and Peter Norvig, "Artificial intelligence: A Modern Approach", Pearson, 2020.
2. Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. "Deep learning", MIT press, 2016.

ONLINE/ NPTEL COURSES:

1. Prof.Balaraman Ravindran, "Reinforcement Learning".

AMPE012 ADVERSARIAL AI

L	T	P	C
3	0	2	3

Course Pre-requisite:

- Knowledge of Mathematics.

Course Objectives:

- To introduce the vulnerabilities of deep learning, demonstrating methods for defending against attacks and evaluating the attack-and-defense scenarios alongside real-world examples.

Course Outcomes:

- To demonstrate understanding statistical anamoly detectors.
- To understand the different attacks and defence mechanism classifiers.
- To understand Backdoor data poisoning, an emerging form of adversarial attack against deep neural network using image classifiers.
- To understand the vulnerability of 3D point cloud (PC) classifiers in safety-critical. applications.
- To understand the backdoor attack and defence for deep regression, REA attack and defence for classifiers.

UNIT I (9 Hrs)

INTRODUCTION: Overview of adversarial learning - Deep learning - Basics of detection and mixture models.

UNIT II (9 Hrs)

ADVERSARIAL INPUTS: Test-time evasion attacks (Adversarial Inputs) - Backdoors and before/during training defenses - Post-Training Reverse-Engineering defense (PT-RED) against Imperceptible Backdoors.

UNIT III (9 Hrs)

ENGINEERING DEFENCES: PT-RED against patch - Incorporated Backdoors - Transfer post-training reverse-engineering defense - T-PT-RED against Backdoors.

UNIT IV (9 Hrs)

BACKDOORS: Universal Post-Training Backdoor defenses - Test-time detection of backdoor triggers - Backdoors for 3D Point Cloud (PC) classifiers.

UNIT V (9 Hrs)

ROBUST DEEP REGRESSION: Active learning - Error generic data poisoning defense - Reverse-engineering attacks (REAs) on classifiers.

Laboratory/ Practicals:

1. Implement Gaussian Mixture Models.
2. Implement PT-RED against Imperceptible Backdoors.
3. Implement PT-RED against Incorporated Backdoors.
4. Implement 3D Point cloud classifiers.
5. Implement REA on classifiers.

Text Books:

1. David J. Miller, Zhen Xiang and George Kesidis, "Adversarial Learning and Secure AI", Cambridge University Press, 1st Edition, 2023.

ONLINE/ NPTEL COURSES:

1. https://archive.nptel.ac.in/courses/106/105/106105078/

AMPE013 COMPUTATIONAL NEUROSCIENCE

L	T	P	C
3	0	2	3

Course Pre-requisite:

- Basic Biology, Chemistry and Physics.

Course Objectives:

- The students should be able to explore the computational principles governing various aspects of vision, sensory-motor control, learning, and memory. They should learn representation of information by spiking neurons, processing of information in neural networks, and algorithms for adaptation and learning.

Course Outcomes:

- To understand how the brain processes information.
- To understand the mathematical and computational models used in neuroscience.
- To understand how to use Python to analyze various neural encoding models.
- To understand and use supervised leaning with neurons classifiers.
- To understand and use Unsupervised Learning.

UNIT I (9 Hrs)

INTRODUCTION & BASIC NEURO-BIOLOGY: Computational Neuroscience: Descriptive Models, Computational Neuroscience: Mechanistic and Interpretive Models, The Electrical Personality of Neurons, Making Connections: Synapses, Timeto Network: Brain Areas and their Function.

UNIT II (9 Hrs)

NEURAL ENCODING MODELS: Neural Encoding: Simple Models, Feature Selection, Variability, Vectors and Functions, Convolutions and Linear Systems, Change of Basis and PCA.

UNIT III (9 Hrs)

EXTRACTING INFORMATION FROM NEURONS & NEURAL CODING: Neural Decoding and Signal Detection Theory, Population Coding and Bayesian Estimation, Reading Minds: Stimulus Reconstruction, Information and Entropy, Calculating Information in Spike Trains, Coding Principles.

UNIT IV (9 Hrs)

COMPUTING IN CARBON AND COMPUTING WITH NETWORKS: Modelling Neurons, Spikes, Simplified Model Neurons, A Forest of Dendrites, modelling Connections Between Neurons, Introduction to Network Models, The Fascinating World of Recurrent Networks.

UNIT V (9 Hrs)

PLASTICITY IN THE BRAIN & LEARNING: Synaptic Plasticity, Hebb's Rule, and Statistical Learning, Introduction to Unsupervised Learning, Sparse Coding and Predictive Coding Learning from Supervision and Rewards Neurons as Classifiers and Supervised Learning, Reinforcement Learning: Predicting Rewards, Reinforcement Learning: Time for Action.

Laboratory/ Practicals:

1. Implement Neural encoding methods using Python.
2. Implement information extraction from neurons using Bayesian estimation.
3. Implement synaptic plasticity using Artificial Neural Networks (ANN).
4. Implement Neuron classification using Supervised learning algorithms.
5. Implement Neuron classification using Reinforcement learning algorithms.

Text Books:

1. Ian Millington and John Funge, "Artificial Intelligence for Games", CRC Press, 2nd Edition, 2009.
2. Georgios N. Yannakakis and Julian Togelius, "Artificial Intelligence and Games", Springer International Publishing, 2018.

References:

1. Thomas Trappenberg, "Fundamentals of Computational Neuroscience", OUP Oxford, 2nd Edition, 2009.

ONLINE/ NPTEL COURSES:

1. https://archive.nptel.ac.in/courses/102/106/102106023/
2. https://nptel.ac.in/courses/102105100

AMPE014 AI IN GAMING

L	T	P	C
3	0	2	3

Course Pre-requisite:

- Knowledge in AI.
- Programming and an understanding of game architecture.

Course Objectives:

- The students should be able to understand and use AI techniques for generating efficient, intelligent behaviour in games.

Course Outcomes:

- To understand identify tasks that can be tackled using AI techniques.
- To understand the most relevant AI approach for the issue at hand.
- To understand the way to develop effective and reliable AI algorithms for game tasks.
- To understand and apply learning mechanisms to gaming problems.
- To understand and analyze cutting-edge state-of-the-art artificial intelligence techniques from the industry and academia to solve computer game design problems.

UNIT I (9 Hrs)

INTRODUCTION: Introduction to Game AI, kind of AI used in game development, model of game AI, AI engine structure.

UNIT II (9 Hrs)

MOVEMENT ALGORITHMS AND STEERING BEHAVIOUR: kinematic movement algorithms, problems related to the steering behaviour of objects and Solutions.

UNIT III (9 Hrs)

PATH FINDING: Basic Path finding Algorithms in game development, Path finding for complex solutions.

UNIT IV (9 Hrs)

DECISION-MAKING AND UNCERTAINTY: decision trees and state machines for game development, models for implementing knowledge uncertainty, such as fuzzy logic and Markov systems.

UNIT V (9 Hrs)

INTRODUCTION TO LEARNING MECHANISMS: Board game theory and discusses the implementation of some key algorithms, such as minimax and negamax, Random Number Generation and Minim axing, algorithms for implementing action prediction, decision learning and reinforcement learning.

Laboratory/Practicals:

1. Implement kinematic movement algorithms.
2. Implement coordinated movement algorithms.
3. Implement path finding algorithms for AI agents.
4. Implement a state machine for any game development.
5. Implement minimax and negmax algorithms.

Text Books:

1. Ian Millington and John Funge, ”Artificial Intelligence for Games”, CRC Press; 2nd Edition, 2009.
2. Georgios N. Yannakakis and Julian Togelius, ”Artificial Intelligence and Games”, Springer International Publishing, 2018.

References:

1. Ian Millington, ”AI FOR GAMES”, CRC Press, 3rd Edition, 2019.

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/106105077

AMPE015 AI IN HEALTH CARE

L	T	P	C
3	0	2	3

Course Pre-requisite:

- Knowledge in AI.
- Basic Neural Network Structures.

Course Objectives:

- To understand transforming the practice of Health Care.
- To apply machine learning to concrete problems in Health Care.

Course Outcomes:

- To understand and apply on tree-based machine learning to estimate patient survival rates.
- To understand Picture classification and segmentation models.
- To understand the way to extract information from unstructured medical data using Natural Language Processing.
- To understand different types of prognosis models related to different diseases.
- To understand and analyze data from the randomized control trail.

UNIT I (9 Hrs)

DISEASE DETECTION WITH COMPUTER VISION: Medical Image Diagnosis, Eye Disease and Cancer Diagnosis, Building and Training a Model for Medical Diagnosis, Training, prediction, and loss, Image Classification and Class Imbalance, Generating More Samples, Model Testing.

UNIT II (9 Hrs)

EVALUATING MODELS: Sensitivity, Specificity, and Evaluation Metrics, Accuracy in terms of conditional probability, Confusion matrix, ROC curve and Threshold. **IMAGE SEGMENTATION ON MRI IMAGES:** Medical Image Segmentation, MRI Data and Image Registration, Segmentation, 2D U-Net and 3D U-Net Data augmentation and loss function for segmentation, Different Populations and Diagnostic Technology, External validation.

UNIT III (9 Hrs)

LINEAR PROGNOSTIC MODELS: Medical Prognosis, Atrial fibrillation, Liver Disease Mortality, Risk of heart disease, Evaluating Prognostic Models, Concordant Pairs, Risk Ties, Permissible Pairs.

UNIT III (9 Hrs)

PROGNOSIS WITH TREE-BASED MODELS: Decision trees for prognosis, fix overfitting, Different distributions, Missing Data example, Imputation.

UNIT IV (9 Hrs)

SURVIVAL MODELS AND TIME: Survival Model, Survival function, collecting time data, Estimating the survival function. Linear and Tree-Based Models - Hazard Functions, Relative risk, Individual vs. baseline hazard, Survival Trees, Nelson Aalen estimator.

UNIT V (9 Hrs)

MEDICAL TREATMENT EFFECT ESTIMATION: Analyze data from a randomized control trial, Average treatment effect, Conditional average treatment effect, T-Learner, S-Learner, C-for-benefit.

Laboratory/ Practicals:

1. Hands on with building and training a model for medical image diagnosis.
2. Hands on with medical image segmentation (2D U-Net and 3D U-Net Data augmentation).
3. Hands on with linear prognosis models for liver and heart diseases.
4. Hands on with tree-based prognosis models and computing accuracy.
5. Hands on building a risk model based on prognosis models.

Text Books:

1. Eric Topol, ”Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again”, Basic Books, 1st Edition 2019.
2. Arjun Panesar, ”Machine Learning and AI for Healthcare: Big Data for Improved Health Outcomes”, Apress, 1st Edition, 2019.
3. ”Artificial Intelligence in Healthcare”, ISBN 978-0-12-818438-7, Elsevier Inc., 2020.

References:

1. Dr Parag Suresh Mahajan MD, ”Artificial Intelligence in Healthcare”, MedMantra LLC, 1st Edition, 2021.

ONLINE/ NPTEL COURSES:

1. https://archive.nptel.ac.in/courses/106/106/106106238/
2. https://www.coursera.org/learn/ai-for-medical-diagnosis
3. https://www.coursera.org/learn/ai-for-medical-prognosissyllabus
4. https://www.coursera.org/learn/ai-for-medical-treatmentsyllabus

AMPE016 AI IN FINANCE

L	T	P	C
3	0	2	3

Course Pre-requisite:

- Basic knowledge in AI and Finance.

Course Objectives:

- To learn the evolution of AI-driven online wealth management platforms and robo-advisors.

Course Outcomes:

- To understand the strengths and weaknesses of human financial advisors and investors.
- To understand the business model of robo/AI-advisors.
- To understand how InsurTech is redefining the insurance industry using AI techniques.
- To understand stock selection and asset management related to financial world.
- To understand Automated Portfolio Optimization in Financial aspects.

UNIT I (9 Hrs)

INTRODUCTION: Fintech Innovations: Series Map and Learning Goals, Introduction to InsurTech, Investment and Market Size of the InsurTech Industry, Real Estate Tech, Residential Real Estate Tech Startups, Commercial Real Estate Tech.

UNIT II (9 Hrs)

ROBO ADVISING: Expected Returns, Standard Deviations, and Correlation, Building an Efficient Portfolio, Diversified Investments, Exchange Traded Funds, Robo-Advisors, Pure Advisors vs Robo- Advisors, Customer support using robo advisors.

UNIT III (9 Hrs)

STOCK SELECTION AND ASSET MANAGEMENT: Fundamental Analysis: The Passive Benchmark, Manager Performance, Stock Selection Screening: Discovering Signals and Data Issue, Neural Networks, Smart Beta, Wealth Management: Automated Portfolio Optimization, Portfolio Rebalancing Recommendations.

UNIT IV (9 Hrs)

COMPLIANCE AND FRAUD DETECTION: Behavioural Profiling Analytics in Fraud Detection, Distinguishing Specialized from Generic Behaviour Analytics.

UNIT V (9 Hrs)

CASE STUDIES: Fetch.ai, platforms or apps using AI for financial aspects.

Laboratory/Practicals:

1. Implement Expected Returns about finance in AI.
2. Implement Diversified Investments using AI.
3. Implement Stock Selection Screening.
4. Implement Neural Networks algorithms.
5. Implement Fraud Detection Algorithms.

Text Books:

1. Yves Hilpisch, ”Artificial Intelligence in Finance”, O’Reilly Media, Inc., 2020.
2. Jannes Klaas,” Machine Learning for Finance: Principles and Practice for Financial Insiders”, Packt Publishing Limited, 2019.

References:

1. Edward P. K. Tsang, ”AI for Finance”, 1st Edition, 2023, ISBN 9781032384436.

ONLINE/ NPTEL COURSES:

1. https://www.coursera.org/learn/invest-techsyllabus
2. https://www.coursera.org/learn/wharton-ai-application-insurtech-real-estate- technologysyllabus
3. https://www.coursera.org/learn/innovation-strategy-fintech

APPENDIX - IV

LIST OF OPEN ELECTIVES

Code No.	Name of the Subjects	L	T	P	C
AMOE001	Predictive Analytics	3	0	0	3
AMOE002	Robotics	3	0	0	3
AMOE003	Machine Learning with Python	3	0	0	3
AMOE004	AI for Everyone	3	0	0	3
AMOE005	Artificial Neural Networks	3	0	0	3

AMOE001 PREDICTIVE ANALYTICS

L	T	P	C
3	0	0	3

Course Pre-requisite:

- Basics of Programming.

Course Objectives:

- The learn data requisition and data-driven predictive tasks.

Course Outcomes:

- To understand interactive data visualizations that will make meaningful predictions.
- To understand simple regressions and classifications on datasets using machine learning libraries.
- To understand the usage of different python libraries.
- To understand reation of data models that are appropriate for the predictive analysis process.
- To understand and create software solutions that are in line with the predictive analytics.

UNIT I (9 Hrs)

INTRODUCTION: Data Analytics - Need - Applications - Reading CSV Files, Processing Structured Data in Python, Extracting Simple Statistics from Datasets - Data Filtering and Cleaning, Processing Text and Strings in Python, Processing Times and Dates in Python.

UNIT II (9 Hrs)

PYTHON LIBRARIES AND TOOLKITS: Matrix Processing and Numpy, Introduction to Data Visualization, Introduction to Matplotlib, urllib and BeautifulSoup.

UNIT III (9 Hrs)

GRADIENT DESCENT: Classification in Python, Introduction to Training and Testing, Gradient Descent in Python.

UNIT IV (9 Hrs)

REGRESSION: Meaningful Predictive modelling, Regression Diagnostic, Over- and Under-Fitting.

UNIT V (9 Hrs)

CLASSIFICATION: Logistic Regression - Classification Diagnostics: Accuracy Precision and Recall. Codebase for Evaluation and Validation, Model Complexity and Regularization, Evaluating Classifiers for Ranking.

Text Books:

1. Dean Abbott, Applied Predictive Analytics: ”Principles and Techniques for the Professional Data Analyst”, 1st Edition, Wiley, 2014.
2. Foster Provost and Tom Fawcett, ”Data Science for Business: What You Need to Know about Data Mining and Data-Analytic”, Wiley, 1st Edition, 2013.

References:

1. Eric Siegel, ”Predictive Analytics”, Wiley, 2nd Edition, 2016.

ONLINE/ NPTEL COURSES:

1. https://www.coursera.org/learn/basic-data-processing-visualization-python
2. https://www.coursera.org/learn/design-thinking-predictive-analytics-data-products
3. https://www.coursera.org/learn/meaningful-predictive-modeling

AMOE002 ROBOTICS

L	T	P	C
3	0	0	3

Course Pre-requisite:

- Basic knowledge in AI.

Course Objectives:

- To understand the basic concepts and applications of robotics.

Course Outcomes:

- To understand the basics of robotics.
- To understand game playing concepts involving robotics and AI.
- To understand robot-driven systems.
- To understand real-world applications of Robotics.
- To understand the use of fundamental AI algorithms in Robotics.

UNIT I (9 Hrs)

INTRODUCTION: Introduction to Robotics Fundamentals of Robotics, Robot Kinematics: Position Analysis, Dynamic Analysis and Forces, Robot Programming languages and systems: Introduction, the three levels of robot programming, requirements of a robot programming language, problems peculiar to robot programming languages.

UNIT II (9 Hrs)

AI IN ROBOTICS: History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents Robot Classification - Architecture of Robotic Systems - Components of Robot Driven Systems.

UNIT III (9 Hrs)

GAME PLAYING: AI and game playing, plausible move generator, static evaluation move generator, game playing strategies, problems in game playing.

UNIT IV (9 Hrs)

FUNDAMENTALS OF ROBOTICS: Robot Classification, Robot Specification, notation, kinematic representations and transformations, dynamics techniques; trajectory planning and control.

UNIT V (9 Hrs)

APPLICATIONS: Health Care, Agriculture, Security, Industries.

Text Books:

1. Peter Corke, Robotics, "Vision and Control: Fundamental Algorithms in MATLAB",1st Edition, Springer, 2011.
2. Peter McKinnon, "Robotics: Everything You Need to Know About Robotics from Beginner to Expert",1st Edition, 2016.
3. Robin R. Murphy, "Introduction to AI Robotics", 2nd Edition, MIT press, 2001.
4. Francis X. Govers, "Artificial Intelligence for Robotics: Build intelligent robots that perform human tasks using AI techniques",1st Edition, Packt Publishers, 2018.

References:

1. David Jefferis, "Artificial Intelligence: Robotics and Machine Evolution",1st Edition, 1992.
2. Brooks, Rodney. "Achieving Artificial Intelligence through Building Robots", 1st Edition,1986.

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/112105249

AMOE003 MACHINE LEARNING WITH PYTHON

L	T	P	C
3	0	0	3

Course Pre-requisite:

- Knowledge of Programming Languages, Probability and Statistics.

Course Objectives:

- The teach the basics of ML and explain basic predictive models in ML.

Course Outcomes:

- To understand python and be able to handle various datasets in python.
- To understand basic machine learning algorithms.
- To understand different classification and clustering algorithms for problem solving.
- To understand the way to use Python to develop simple machine learning algorithms.
- To understand the way to use machine learning techniques on data by using a suitable programming language.

UNIT I (9 Hrs)

INTRODUCTION TO PYTHON: Data Types, Operators, Expression, Indexing & Slicing, Strings, Conditionals, Functions, Control Flow, Nested Loops, Sets & Dictionaries.

UNIT II (9 Hrs)

INTRODUCTION TO MACHINE LEARNING: Machine Learning Vs Statistical Modelling, Supervised vs Unsupervised Learning, Supervised Learning Classification, Unsupervised Learning, Reinforcement Learning, Applications, Python libraries suitable for Machine Learning: Pandas, Numpy, Scikit-learn, visualization libraries: matplotlib etc.

UNIT III (9 Hrs)

REGRESSION: Simple Linear Regression, Multiple Linear Regression, Non-linear Regression, Model Evaluation in Regression Models, Evaluation Metrics in Regression Models.

UNIT IV (9 Hrs)

CLASSIFICATION: Introduction to Classification, K-Nearest Neighbour, Decision Trees, Logistic Regression, Support Vector Machines, Logistic regression vs Linear regression, Evaluation Metrics in Classification.

UNIT V (9 Hrs)

UNSUPERVISED LEARNING: Intro to Clustering, K-Means Clustering, Hierarchical Clustering, Density-Based Clustering, Content-based recommender systems, Collaborative Filtering.

Text Books:

1. Tom M. Mitchell, "Machine LEarning",McGraw Hill, 1st Edition, 2017.
2. Aurelien Geron, "Hands–On Machine Learning with Scikit–Learn and TensorFlow 2e: Concepts, Tools, and Techniques to Build Intelligent Systems", O'Reilly, 2017.
3. Sebastian Raschka , Vahid Mirjalili, "Python Machine Learning" - Packt Publishers, 3rd Edition, 2019.

References:

1. Andreas C. Müller, Sarah Guido, "Introduction to Machine Learning with Python: A Guide for Data Scientists" 1st Edition, O'Reilly, 2016.

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/106105152

AMOE004 AI FOR EVERYONE

L	T	P	C
3	0	0	3

Course Objectives:

- To learn the basics of AI, its applications and use cases.

Course Outcomes:

- To understand the basic concepts of AI and machine learning.
- To understand the working of self-driving systems.
- To understand how to build different AI projects.
- To understand the AI approaches used in various domains.
- To understand the impact of AI on Society.

UNIT I (9 Hrs)

INTRODUCTION: Machine Learning, What is data, The terminology of AI, What makes an AI company, What machine learning can and cannot do, Non-technical explanation of deep learning, basics of neural networks, Examples of AI, Application domains of AI.

UNIT II (9 Hrs)

BUILDING AI PROJECTS: Workflow of a machine learning project, Workflow of a data science project, how to use data, How to choose an AI project, Working with an AI team, How to process and visualize data, Technical tools for AI teams, use of python in AI related projects.

UNIT III (9 Hrs)

BUILDING AI IN YOUR COMPANY: Case study: Smart speaker, Case study: Self-driving car, Example roles of an AI team, AI pitfalls to avoid, Survey of major AI application areas.

UNIT IV (9 Hrs)

AI AND SOCIETY: A realistic view of AI, Discrimination / Bias, Adversarial attacks on AI, Adverse uses of AI, AI and developing economies, AI and jobs.

UNIT V (9 Hrs)

CASE STUDIES: AI case studies related various domains.

Text Books:

1. Stuart Russell, Peter Norvig, ”Artificial Intelligence: A Modern Approach”, 3rd Edition, Prentice Hall, 2010.
2. Routledge, ”Artificial Intelligence: The Basics by Kevin Warwick”, Routledge, 3rd Edition, 2011.

References:

1. Jeff Heaton, ”Artificial Intelligence for Humans”, CreateSpace Independent Publishing, Kindle Edition, 2015.

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/112105249

AMOE005 ARTIFICIAL NEURAL NETWORKS

L	T	P	C
3	0	0	3

Course Pre-requisite:

- Fundamentals of Artificial Intelligence.

Course Objectives:

- To Understand the basics of ANN and comparison with Human brain, various architectures of building an ANN, knowedge of reinforcement learning, provide knowledge of unsupervised learning using neural networks.

Course Outcomes:

- To understand role of neural networks in cognitive modeling.
- To understand the concepts and techniques of neural networks through the study of the most important neural network models.
- To learn the applications of neural networks.
- To understand basic deep neural networks.
- To understand probabilistic NN.

UNIT I (9 Hrs)

INTRODUCTION: Biological Neuron – Artificial Neural Model - Types of activation functions – Architecture: Feed forward and Feedback - Convex Sets - Convex Hull and Linear Separability, Non-Linear Separable Problem - XOR Problem - Perceptions - Multilayer Networks.

UNIT II (9 Hrs)

TRAINING NEURAL NETWORKS: Perceptron learning and Non Separable sets, alpha-Least Mean Square Learning, MSE Error surface, Steepest Descent Search, Multilayered Network Architecture - Back propagation Learning Algorithm - Practical consideration of BP algorithm.

UNIT III (9 Hrs)

PROBABILISTIC NN Hopfixed Net - Boltzman MAchine - RBMs - Signoid Net - Applications.

UNIT IV (9 Hrs)

SELF-ORGANIZATION FEATURE MAP: Maximal Eigenvector Filtering, Extracting Principal Components - Generalized Learning Laws, Vector Quantization Self-organization FeatureMaps - Application of SOM.

UNIT V (9 Hrs)

COMMON DEEP NEURAL ARCHITECTURES: CNN, RNN, Deep Belief Network, Applications.

Text Books:

1. Charu C. Aggarwal, "Neural Networks and Deep Learning", Springer, 1st Edition,2018
2. Satish Kumar, "Neural Networks A Classroom Approach", McGraw Hill Education (India) Pvt. Ltd, 2010.
3. Christopher M. Bishop, "Pattern Recognition And Machine Learning", Springer, 1st Edition, 2016.
4. Aaron Courville, Ian Goodfellow and Yoshua Bengio, "Deep Learning", MIT Press, 1st Edition, 2016.

References:

1. J.M. Zurada, "Introduction to Artificial Neural Systems", Jaico Publications 1994.
2. B. Yegnanarayana, "Artificial Neural Networks", PHI, New Delhi 2004.

ONLINE/ NPTEL COURSES:

1. https://nptel.ac.in/courses/112105249