COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF COMPUTER APPLICATIONS
KOCHI – 682 022, KERALA, INDIA

M.Sc. Computer Science with Specialization in Artificial Intelligence
SYLLABUS
(2023)

REGULATION FOR POST GRADUATE PROGRAMMES UNDER CHOICE BASED CREDIT SYSTEM (CBCS) OFFERED BY THE UNIVERSITY DEPARTMENTS/SCHOOLS/CENTRES

(To be effective from 2021 admissions)

1. SCOPE

1.1 These Regulations shall apply to all M. Sc., MA, MBA and MCA, programmes conducted by the Departments/Schools of the Cochin University of Science and Technology with effect from 2021 admissions.

1.2 The provisions herein supersede all other Regulations with respect to such PG programmes unlessotherwise provided.

2. DEFINITIONS

2.1 **Academic Committee** means the committee constituted by the Vice-Chancellor under thisregulation to monitor the conduct of the programmes.

2.2 **Core course** means a course that the student admitted to a particular programme must successfully complete in order to receive the Degree and which cannot besubstituted by any other course.

2.3 **Elective course** means a course, which can be substituted by equivalent courses from the same or other Departments/Schools.

2.4 **Audited course** means a course which can be opted by a student but which will not accrue any credit.

2.5 **Department/School** means Departments/Schools instituted in the University as per Statutes and Act.

2.6 **All PG programmes following this regulation will be of Second Level.**

3. ELIGIBILITY FOR ADMISSION

As per the eligibility criteria prescribed by the University from time to time.

4. ADMISSIONS

As per the Regulations prescribed by the University from time to time.

After completing the admissions, each student shall be assigned a Unique Registration Number,in a format suggested by the university, by the concerned department which will be valid throughouthis/her programme of study in the University.

5. COURSE REGISTRATION

5.1 Every Department/School shall have Faculty Members as Student Advisors. Each student will be assigned to an Advisor/Mentor, within one week from the commencement of the course, by the Department council. He/She will advise the student about the academic programme and counsel the student on the choice of courses for the coming semester depending on the student's academic background and objective. The student will then register for the courses he plans to take for the semester before the classes begin and within the time prescribed by the University. The student should have completed the prescribed prerequisites if any for a course before registration. The Advisor/Mentor can be a contract/adjunct faculty. The student has to be closely monitored and motivated by the Advisor. The Advisor/Mentor should have up-to-date knowledge on the performance of the students as he/she go through the programme and must keep frequent contact with the students. In addition, one faculty coordinator will be assigned to an incoming batch of students to each Programme by the Department council. The faculty-coordinator will synchronize the activities of the batch. The mentor may induct in the student with his research activities. The Department should document the mentor- mentee interaction systematically.

The Department offering any course shall prescribe the maximum number of students that can be admitted taking into consideration the facilities available. Core courses of any programmes are to be compulsorily offered by the respective Department that offers the programme.

In any Department, preference shall be given to those students for whom the course is a core-course.

A student can drop an elective/audit course(s) within ***10*** working days after the commencement of the classes.

5.2 University shall make available to all students through CUSAT website a Bullet in listing all the courses offered in every semester specifying the credits, prerequisites, list of topics, the course intends to cover, the instructor who is giving the courses, the time and place of the classes for the courses. Each course shall have a code consisting of first two digits indicating the year of revision of syllabus/curriculum, following three characters/digits denoting the Department and the next four digits of which the first digit will be 2 indicating the level of the course, second indicating the Semester and third and fourth digits the serial number of the course. However in such Departments having more than one Masters programme of the same level, of the three characters/digits denoting the Department, the third one will represent the course of study.

6. COURSE STRUCTURE

6.1 The CBCS system will be fully internal in all sense. There shall be three kinds of courses: Core, Elective and Audit courses. Normally all core courses shall have two / three / four credits except in cases where only project/dissertation including seminars are involved in a semester in which case the minimum credit shall be sixteen. Elective courses, if any offered through Massive Open On line Course (MOOC) can have two/three/four credits. Any such online courses should bepre- approved by the Department Council before the beginning of a semester to ensure quality and suitability.

In the case of online courses attended by the student, a proof of satisfactory completion and marks/grade issued by the authority who conducted the course must be submitted to the Head of theDepartment. Head/mentor/advisor may conduct a viva on the subject of the online course if found necessary.

6.2 The minimum number of the Credit in a semester shall not be less than 16. For Departmentsunder Science faculty conducting Integrated Programmes, the minimum total credits required for the last four semesters of integrated programmes should be 80 and it should be the same as total credits required for two year M.Sc. Programmes.

6.3 The Department Council shall make recommendations on the content of core and elective courses including the detailed syllabus pertaining to each programme offered by the Department to the University to be approved by the concerned Board of Studies, Faculty and Academic Council. The Department Council shall have the freedom to design and introduce new electives and audited courses, to modify/redesign existing electives and to replace any existing electives withnew or modified/redesigned electives to facilitate better exposure and training for the students. Prior approval from the Board of Studies and Academic Council is not required for such modifications in the electives, but shall be done only with the approval of the Academic Committee. Such changes shall be placed in the Board of Studies, Faculty and Academic Council
in the next meeting for ratification.

6.4 The general structure of the programme shall be as given below:

A minimum 75 % attendance is compulsory. Heads of Department can give five percent condonation with the approval of Department Council. The Vice- Chancellor shall have the power to condone shortage of attendance upto 10% on medical grounds on the recommendations of the Head of Department. However, such condonation for shortage of attendance shall be given only once during the entire programme of study.

	MA/ M.Sc other than from the Faculty of Science	M.Sc from the Faculty of Science	MBA (Full Time)	MBA (Part Time) *	MCA
Programme duration	4 Sem	4 Sem	4 Sem	6 Sem	4 Sem
Accumulated minimum credit required for successful completion of the programme	72	80	102	102	72

Note: *MBA (Part Time) Programme is stretched to 6 semesters with the same content as the full-time programme with 4 semesters.

Each semester shall have a minimum of 16 weeks duration and one credit shall be given for one- hour lecture or 2 hours of practical work per week. No regular student shall register for more than 24 credits per semester and less than 16 credits per semester. In the case of MBA (Part Time) programme, the minimum and maximum credits per semester will be 12 and 19 respectively.

6.5 A student shall compulsorily register and complete atleast one Online course/ Interdisciplinary Elective (IE) course/ Industry based course (one of the Electives) from other Departments/Schools/Industry before registering for the final semester of the Programme. However, MBA (PT) programme may be exempted from this clause. For the 'Industry based course' one faculty member from the department will be responsible along with the industry partner in designing course and evaluating the student and awarding the grade.

Each department shall encourage the students to register for MOOC/ SWAYAM/ NPTEL Courses during the second or third semester.. The Students in consultation with the course adviser or the Department council have to register for the course. **The conduct of such courses will be done as per regulations appended as Annexure I.**

6.6 At the end of the second semester, students should be encouraged to go for an internship or carry out a mini project in the area of their interest. For the internship/mini project, a candidate canhave an internal guide and external guide (Institution /Industry).

7. EVALUATION

7.1 The entire system of evaluation is internal. The evaluation scheme for each semester contains two parts, a continuous assessment and a semester end examination. The continuous assessment shall consist of minimum of two tests and assignments/seminars/quizzes etc. which shall be notifiedto the students at the beginning of the semester. The marks obtained in the continuous assessment shall be displayed on the notice board and grievances if any may be addressed to the Head of the Department. The Department Council shall finalise the marks of the continuous assessment of each course after addressing such grievances.

The semester end examination will be of 3 hours duration and shall cover the entire syllabusof the course. Equal weightage shall be given for the continuous assessment and the semester endcomponents.

All practical examinations will be internally evaluated as per the procedures laid down bythe Department Councils concerned.

7.2 The question paper for the semester end examination shall be set by the concerned teacher inadvance, which shall be scrutinized by the respective department council or by a committee consisting of the HOD and faculty members offering courses in that semester to ensure that questions are within the scope of the syllabus and that the entire syllabus of the course is fairly covered in the question paper. Modifications can be suggested by the council if necessary and such suggestions shall be incorporated in the final version of the question paper.

There shall be only a single evaluation for the semester end examination. Immediately after the examination is over, the Head of the Department shall make arrangements to complete the evaluation and finalize the results within 10 working days from the date of the last examination. The marks and grade in all the courses obtained by the students have to be displayed in the notice board and the answer scripts can be shown to the students for scrutiny if requested.

7.3 For each course there shall be a separate minimum of 50% marks for both the semester end examination and the continuous assessment part. A student who fails to obtain 50% marks in the continuous assessment part of a course will have tore-register and repeat the course at a suitable later time when the course is offered again (if the failed course is a core course) or re-register for the same or a different course (if the failed course is an elective).

7.4 The Department shall publish the marks obtained by the students, in the continuous assessment and semester end examination. If the student has any grievance, he/she can approach the concerned teacher and submit his/her grievance with supporting documents/arguments. The teacher and the HOD will examine the case and decide on his/her grievance. If the student is not convinced with the decision, he/she can approach the appellate authority, which is the department council, in writing and the council shall examine the same and take a final decision which has to be intimated to the student in writing. **The decision of the appellate authority shall be final**. Finalized continuous assessment marks should be uploaded in the University Examination web portal at least 5 working days before the commencement of the end semester examinations.

7.5 The final marks and grades obtained by the students shall be published in the notice board. Those who fail in the end-semester examination of any core or elective course shall approach the concerned teacher if necessary, for a re-examination. Within ten days of the display of the results in the notice board, the department shall conduct an additional semester end examination for these candidates. This reexamination is only to provide the student a chance to pass the examination by completing the course successfully. If he/she completes the course successfully making use of this additional chance, he/she will be awarded only a 'D' grade enabling the candidate to be declared successful in that course. If he/she cannot make it up, he/she may repeat the semester endexamination of that course in the next available chance. If the student re- registers and repeats the course, he/she may be awarded the actual grade he/she obtains. The maximum duration for completing any PG degree programme will be 4 years except for MCA/MBA (PT) for which it will be 6 years from the date of commencement of first semester. The marks of the end-semester examinations should be uploaded in the University Examination web portal.

7.6 The result of the examinations will be finalized and published by the department council, which will act as the passing board and the minutes shall be sent to the controller of examinations for issue of semester grade transcript.

8. SEMESTER GRADE-TRANSCRIPT

8.1 The University under its seal shall issue a semester Grade transcript to the students on completionof each semester. The semester Grade transcript shall contain the following:

a. Title of the course taken as core, elective and audit. (An audit course shall be listed only if the student has secured a pass).

b. Title of the online course.

c. Title of the Major project if any.

d. The credits associated with and the grades awarded for each course.

e. The number of credits (core and elective separately) earned by the student and the GradePoint Average.

f. The total credits (core and elective) earned till that semester.

8.2 The following grading system shall be adopted for all the programmes. The following grades willbe awarded based on the overall performance in each subject.

Range of Marks	Grades	Weightage
90 and above	S-Outstanding	10
80 to 89	A-Excellent	9
70 to 79	B-Very good	8
60 to 69	C-Good	7
50 to 59	D-Satisfactory	6
Below 50%	F-Failed	0

Overall performance at the end of the semester will be indicated by Grade Point Average(GPA) calculated as follows.

$$GPA = \frac{G1C1+G2C2+G3C3+ \ldots\ldots\ldots\ldots\ldots GnCn}{C1+C2+C3+ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots Cn}$$

'G' refers to the grade weightage and 'C' refers to the credit value of corresponding course undergone by the student. At the end of the final semester Cumulative Grade Point Average (CGPA) will be calculated based on the above formula, considering the Credits and Grades earned during the entire programme of study.

Classification for the Degree/Diploma will be given as follows based on the CGPA:

First Class with distinction	8 and above
First Class	6.5 and above
Second Class	6 and above

8.3 The Semester Grade transcript issued at the end of the final semester shall contain the details of all the courses taken which shall include the titles of the courses, the credits associated with each course, the CGPA and the class.

8.4 **The CGPA to percentage conversion may be done via the formula%marks = (CGPA-0.5)*10.**

9. MONITORING AND MANAGEMENT OF PROGRAMMES

9.1 Every post graduate programme conducted in the Departments shall be Monitored by the Department Council subject to these regulations. Such monitoring shall include design of programmes, prescribing the mode of conduct of the programmes and monitoring the evaluation process of students.

10. ACADEMIC COMMITTEE

10.1 There shall be an Academic Committee constituted by the Vice-Chancellor to monitor and co-ordinate the working of the CBCS System. The committee can approve the elective courses suggested by the respective departments, and ensure that the syllabi of such elective courses are passed by respective Board of Studies and Academic Council.

10.2 The Committee shall consist of:

a The Pro-Vice-Chancellor - Chairman

b The Registrar - Secretary

c The Controller of Examinations

d One Teacher from each Department

10.3 A Senior Professor nominated by the Vice-Chancellor from among the members of theCommittee shall be the Vice-Chairman of the Committee.

10.4 The term of the office of the committee shall be two years, but the committee once constitutedshall continue in office until a reconstituted committee assumes office.

11. **TRANSITORY PROVISION**

Not withstanding anything contained in these regulations, the Vice-Chancellor shall, for a period of one year from the date of coming into force of these regulations, have the power to provide by order that these regulations shall be applied to any programme with such modifications as may be necessary.

12. **REPEAL**

The Regulations now in force, in so far as they are applicable to programmes offered in the University Departments and to the extent they are inconsistent with the existing regulations, and the regulations relating to the CBCS System in their application to any programme offered in a University Department, the latter shall prevail.

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DEPARTMENT OF COMPUTER APPLICATIONS
COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY,
KOCHI 682022

VISION

To become a centre of excellence in Computer Applications and impart innovation-oriented education for building globally competent and socially committed professionals.

MISSION

M1: To develop technically competent professionals and equip them for research, innovations, higher studies and entrepreneurship.

M2: To mould software professionals with ethical values for developing technologies emphasizing on societal and industrial needs.

M3: To provide a globally recognized academic environment through industry – academia collaborations, digital learning and state of the art skill development.

M4: To foster students by enriching universal human values to work in multidisciplinary domains exhibiting leadership qualities and teamwork.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PE01: Apply principles of mathematics and computing to design, develop and test softwares for quality, security and utility.

PE02: Work in a multidisciplinary team to understand software requirements and engage in applying technologies for solving complex computing problems.

PE03: Engage in lifelong learning to keep pace with the changing landscape of technologies for professional advancement.

PE04: Communicate effectively and demonstrate professional ethics with societal responsibilities.

PROGRAMME ARTICULATION MATRIX

	M1	M2	M3	M4
PEO1	**X**	**X**		
PEO2	**X**	**X**	**X**	**X**
PEO3			**X**	**X**
PEO4		**X**	**X**	

PROGRAMME OUTCOMES (PO)

PO1: Computational Knowledge: Apply knowledge of computing fundamentals, computing specialisation, mathematics and domain knowledge appropriate for the computing specialization to the abstraction and conceptualisation of computing models from defined problems and requirements.

PO2: Problem Analysis: Identify, formulate, research literature, and solve complex computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences and relevant domain disciplines.

PO3: Design/Development of Solutions: Design and evaluate solutions for complex computing problems, and design and evaluate systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

PO4:Conduct Investigations of Complex Computing Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.

PO6: Professional Ethics: Understand and commit to professional ethics and cyber regulations responsibilities, and norms of professional computing practice.

PO7: Life-long learning: Recognise the need and have the ability to engage in independent learning for continual development as a computing professional.

PO8: Project management and finance: Demonstrate knowledge and understanding of the computing and management principles and apply these to one's own work, as the member and leader in a team to manage projects and in multidisciplinary environments.

PO9: Communication Efficacy: Communicate effectively with the computing community, and with society at large, about complex computing activities by being able to comprehend

and write effective reports, design documentation, make effective presentations and give and understand clear instructions.

PO10: Societal and Environmental Concern: Understand and assess societal, environmental, health, safety, legal and cultural issues within local and global context, and the consequential responsibilities to professional computing practice.

PO11: Individual and Teamwork: Function effectively as an individual and as a member or leader in diverse teams and multidisciplinary environments.

PO12: Innovation and Entrepreneurship: Identify a timely opportunity and use innovation to pursue that opportunity to create value and wealth for the betterment of the individual and the society at large.

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO-1: To provide a strong foundation to apply the concepts and practical knowledge in analysis, design, and development of Artificial Intelligence, Machine Learning and Cognitive Engineering to solve real world problems and to meet the challenges of the future.

PSO-2: To develop computational knowledge and project development skills using innovative tools and techniques and to enrich their abilities to qualify for Employment, Higher studies and Research in the areas related to Deep Learning, Machine learning, Artificial Intelligence with ethical values.

Mapping of PSO with PEO

PSO	PEO1	PEO2	PEO3	PEO4
PSO1	X			
PSO2		X	X	X

M.Sc. COMPUTER SCIENCE with specialization in
ARTIFICIAL INTELLIGENCE
(2023)

Semester- I								
Course Code	**Course Name**	**Marks**			**Credit**	**Hours**		
		CA	**ES**	**Total**		**L**	**T**	**P**
23-344-0101	Mathematics for Artificial Intelligence	50	50	100	4	3	1	0
23-344-0102	Python Programming	50	50	100	4	3	1	0
23-344-0103	Data Structures and Algorithms	50	50	100	4	3	1	0
23-344-0104	Statistics for Artificial Intelligence	50	50	100	4	3	1	0
23-344-0105	Advanced Computer Networks	50	50	100	4	3	1	0
23-344-0106	Python Programming Lab	50	50	100	2	0	0	4
23-344-0107	Data Structure Lab using C	50	50	100	2	0	0	4
Total					24	28		

Semester – II								
Course Code	**Course Name**	**Marks**			**Credit**	**Hours**		
		CA	**ES**	**Total**		**L**	**T**	**P**
23-344-0201	Computing Paradigms	50	50	100	4	3	1	0
23-344-0202	Advanced Database Technologies	50	50	100	4	3	1	0
23-344-0203	Ethics in Artificial Intelligence	50	50	100	4	3	1	0
23-344-0204	Artificial Intelligence and Machine Learning	50	50	100	4	3	1	0
	Elective I	50	50	100	3	3	0	0
23-344-0206	Data Management Lab	50	50	100	2	0	0	4
23-344-0207	Minor Project	50		50	2	0	0	4
Total					23	27		

Semester- III								
Course Code	**Course Name**	**Marks**			**Credit**	**Hours**		
		CA	**ES**	**Total**		**L**	**T**	**P**
23-344-0301	Deep Learning	50	50	100	4	3	1	0
	Elective II / MOOC I	50	50	100	3	3	0	0
	Elective III / MOOC II	50	50	100	3	3	0	0
	Elective IV / MOOC III	50	50	100	3	3	0	0
	Elective V(IE)	50	50	100	3	3	0	0
23-344-0306	Seminar	50		50	2	0	0	4
23-344-0307	Minor Project	50		50	2	0	0	4
Total					20	24		

Semester- IV								
Course Code	**Course Name**	**Marks**			**Credit**	**Hours**		
		CA	**ES**	**Total**		**L**	**T**	**P**
23-344-0401	Internship/Project Work and Course Viva	50	50	100	16	0	0	32
Total					16	32		

CA- Continuous Assessment

ES- End Semester

IE- Interdisciplinary Elective

List of Electives

Elective I

23-344-0211 Fuzzy and Nature Inspired Computation
23-344-0212 Internet of Things
23-344-0213 Digital Image Processing
23-344-0214 Big Data Analytics
23-344-0215 Information Security
23-344-0216 Linux and Shell Programming

Elective II

23-344-0311 Reinforcement Learning
23-344-0312 Blockchain Technology
23-344-0313 Computer Vision
23-344-0314 Medical Image Analysis
23-344-0315 Social Network Analysis
23-344-0316 Computer Forensics
23-344-0317 Design Thinking

Elective III

23-344-0318 Explainable Artificial Intelligence
23-344-0319 Quantum Computing
23-344-0320 Human Computer Interaction
23-344-0321 Natural Language Processing
23-344-0322 Pattern Recognition
23-344-0323 Data Analytics for Healthcare
23-344-0324 Ethical Hacking
23-344-0325 Software Quality Assurance

Elective IV

23-344-0326 Affective Computing
23-344-0327 Cyber Physical Systems
23-344-0328 Bioinformatics
23-344-0329 Speech Processing
23-344-0330 Virtual Reality and Augmented Reality
23-344-0331 Mobile Application Development

MOOC

23-344-0332 MOOC I
23-344-0333 MOOC II
23-344-0334 MOOC III

23-344-0101 - Mathematics for AI

(March 2023)

Course Outcomes:

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

CO1	Explain sets and operations on sets	(Cognitive level: Understand)
CO2	Solve the system of Linear equations and find the Inverse and Rank of a Matrix	(Cognitive level: Apply)
CO3	Calculate Eigenvalues and Eigenvectors using Linear transformation and power methods	(Cognitive level: Apply)
CO4	Solve problems using Derivatives and Partial Derivatives by applying rules of differentiation	(Cognitive level: Apply)
CO5	Solve Recurrence relations by Substitution and Generating Functions	(Cognitive level: Apply)

Mapping of course outcomes with programme outcomes - **Low=1, Medium=2, High=3**

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

UNIT I

Sets, Operations on sets, Venn Diagrams, Multi Sets, Binary Relations, Equivalence Relations, Ordering Relations, Operations on Relations, Partial Orders. Proof by Mathematical Induction.

UNIT II

Linear Algebra – System of Linear equations, Solving System of Linear equations , Linear Independence, Vectors, Scalars, Addition, Scalar multiplication, dot product, normal and orthonormal vectors, vector norm, vector space, linear combination, basis of vectors, vector projection, cosine similarity.

UNIT III

Matrices, determinants, inverse of matrix**,** System of equations, Linear transformation - rank and nullity, Consistency, and inconsistency of linear system of equations, rank nullity theorem, Echelon form of a matrix and Row reduced echelon form of matrix. Corelation coefficient, Eigen values and Eigenvectors.

UNIT IV

Differentiation - Limits and continuity rules of differentiation, Derivatives, Scalar derivatives, Differentiation of univariate functions, Partial differentiation and gradients, Gradient of vector valued function. Gradient of matrices. Optimization using gradient functions, Constrained optimization, and Lagrange multipliers. Convex optimization.

UNIT V

Generating Functions of Sequences, Calculating Coefficients of Generating Functions, Recurrence Relations, Solving Recurrence Relations by Substitution and Generating Functions, The Method of Characteristic Roots, Solutions of Inhomogeneous Recurrence Relations.

TEXTBOOKS/REFERENCES:

1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, “Mathematics for Machine Learning”, Cambridge University Press, 2020.

2. Kenneth H. Rosen, “Discrete Mathematics and Its Applications”, 7th Ed, McGrawHill, 2012.

3. Bernard Kolman, Robert Busby and Sharon Cutler Ross, “Discrete Mathematical Structures for Computer Science”, 6th Ed, PHI, 2013.

4. Erwin Kreyszig, Advanced Engineering Mathematics, 10thEdition., John Wiley & Sons,(2014).

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23-344-0102 - Python Programming

(March 2023)

Course Outcomes:

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

CO1	Apply various control structures and data structures in Python.	(Cognitive level: Apply)
CO2	Implement object-oriented concepts in python, using functions and exception handling.	(Cognitive level: Apply)
CO3	Use NumPy for data analysis	(Cognitive level: Apply)
CO4	Use Pandas for data analysis.	(Cognitive level: Apply)
CO5	Show data analysis using matplotlib .	(Cognitive level: Apply)

Mapping of course outcomes with programme outcomes - **Low=1, Medium=2, High=3**

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

UNIT I

Introduction to computer programming: Python as a programming language. Python Data Types, Variables, operators, Assignments, Comments, Expressions, Control Structures, Looping and Branching. List: Basic List Operations, List Iteration and Comprehensions,

Indexing, Slicing, Two Dimensional Lists, Iterating through Two Dimensional Lists. Dictionaries: Basic Dictionary Operations, Changing Dictionaries in Place, Methods, Tuples and Sets (Properties, Operators, and Methods).

UNIT II

User-Defined Functions, Lambda Function, Zip Function, Parameter Passing (thrusting mutable and immutable parameters). Recursion, Memory Management During Recursive Function Calls. Global versus Local Namespaces. Objects and Classes, Defining a Class in Python, Constructors. Classes as Namespaces, Inheritance: Multiple and Multilevel Inheritance, Modifying Built in Classes Using Inheritance, Operator Overloading (Integer Class Operators only) Using Inheritance. Errors and Exceptions: Exception Types, Exception Handling using Try & Except. User Defined Exceptions.

UNIT III

The NumPy Library, Ndarray, Basic Operations- Creating Arrays-array(), arrange(), reshape(),sum(), min() and max() methods, Item wise arithmetic operations, Indexing, Slicing and Iterating, Conditions and Boolean Arrays, Shape Manipulation, Array Manipulation, Structured Arrays, Reading and Writing Array Data on Files . The Pandas Library - An Introduction, Introduction to Pandas Data Structures, Other Functionalities on Indexes, Operations between Data Structures, Function Application and Mapping, Sorting and Ranking, Correlation and Covariance, “Not a Number” Data, Hierarchical Indexing and Levelling.

UNIT IV

Reading and Writing Data-Reading and Writing HTML Files, Reading Data from XML, Reading and Writing Data on Microsoft Excel Files, JSON Data. Reading and Writing Data with a NoSQL Database: MongoDB. Graphical User Interfaces: Tkinter Widgets – Label, Text, Entry, Button, Canvas & Frames, Event-Based tkinter Widgets, Designing GUIs, OOP for GUIs.Turtle Graphics: Familiarization of various Turtle Graphics Methods, Moving and Repositioning Pointer, Drawing Geometric Shapes, Coloring of Drawings. Simple animations using Open CV.

UNIT V

Data Visualization with matplotlib - The matplotlib Library, matplotlib Architecture, pyplot, kwargs in plot, Adding Further Elements to the Chart and Saving Charts, Handling Date Values, Line Chart, Histogram, Bar Chart, Pie Charts, Advanced Charts, mplot3d, Multi Panel Plots.

TEXTBOOKS/REFERENCES

1. Mark Lutz, ‘Learning Python’, 5th Edition, O'Reilly Media, Inc. 2013

2. LjubomirPerkovic, “Introduction to Computing Using Python: An Application Development Focus”, Wiley, 2012.

3. Charles Dierbach, “Introduction to Computer Science Using Python: A Computational Problem-Solving Focus”, Wiley, 2013.

4. Kenneth A Lambert., Fundamentals of Python : First Programs, 2/e, Cengage Publishing,2016

Web Resource:

1. https://onlinecourses.nptel.ac.in/noc19_cs41/preview

2. https://nptel.ac.in/courses/106106212

3. https://www.coursera.org/specializations/python-3-programming

4. https://www.coursera.org/specializations/python

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23-344-0103 - Data Structures and Algorithms

(March 2023)

Course Outcomes:

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

CO1	Perform complexity analysis of algorithms.	(Cognitive level: Understand)
CO2	Implement advanced versions of Queue, tree and heap data structures.	(Cognitive level: Apply)
CO3	Implement data structures for disjoint sets.	(Cognitive level: Apply)
CO4	Apply the advanced data structures in domain specific application areas.	(Cognitive level: Apply)
CO5	Implement various algorithm design techniques for specific applications.	(Cognitive level: Apply)

Mapping of course outcomes with programme outcomes - **Low=1, Medium=2, High=3**

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

UNIT I

Algorithm Analysis - Mathematical Background – Time and Space Complexity of Algorithms – Computational and Asymptotic Complexity, Best average and Worst case Analysis, Asymptotic Notations – Big O, Big ɵ and Big ω, Running time calculations – General Rules, Solutions for the Maximum Subsequence Sum Problem, Logarithms in Running time.

UNIT II

Queues - Single and Double Ended Priority Queues, Trees - Threaded Binary Trees, Forests and binary search trees, Counting Binary Trees, Red-Black Trees, Splay Trees, Suffix Trees, Digital Search Trees, Tries- Binary Tries, Multiway Tries.

UNIT III

Heaps - Binomial Heaps, Fibonacci Heaps, Data Structures for Disjoint Sets, Disjoint-set operations, Linked-list representation of disjoint sets, Disjoint-set, forests, Analysis of union by rank with path compression.

UNIT IV

Ford-Fulkerson method-analysis of Ford-Fulkerson, Edmonds-Karp algorithm, Maximum bipartite matching, Bi-connected Components, Finding strong components. Computational Geometry- Line segment properties, Finding the convex hull, Finding the closest pair of points.

UNIT V

Algorithm Design Techniques - Greedy Algorithm – Scheduling problem, Huffman codes, approximate bin packing, Divide and Conquer – Closest points problem, Selection problem, Dynamic Programming – All pairs shortest path.

TEXT BOOK

1. Ellis Horowitz, Sartaj Sahni, Susan Anderson Freed, Fundamentals of Data Structures in C, Second Edition, University Press, 2008.
2. Thomas Cormen, Charles E. Leiserson, Ronald Rivest, Introduction to algorithm,3rd edition, PHI Learning.
3. Mark Allem Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson.

REFERENCE BOOKS

1. Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum, Data Structures using C and C++, Second Edition, PHI Learning Private Limited, 2010
2. Ellis Horowitz and Sartaj Sahni, Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms,Universities Press, 2nd Edition, Hyderabad .

3. Sara Baase & Allen Van Gelder , Computer Algorithms – Introduction to Design and Analysis, Pearson Education
4. Algorithm Design: Jon Kleinberg and Eva Tardos, Addison Wesley

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23-344-0104 - Statistics for Artificial Intelligence

(March 2023)

Course Outcomes:

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

CO1	Apply Bayes theorem and various discrete and continuous distributions for solving real life problems	(Cognitive level : Apply)
CO2	Apply various data analysis techniques to draw conclusions from data	(Cognitive level : Apply)
CO3	Apply statistical inference theory to derive decisions from data	(Cognitive level : Apply)
CO4	Test the given hypothesis on the basis of known criteria.	(Cognitive level : Apply)
CO5	Apply the principles of correlation and regression in practical problems.	(Cognitive level : Apply)

Mapping of course outcomes with programme outcomes - **Low=1, Medium=2, High=3**

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

UNIT I

Basics of Probability: independence of events, Conditional and joint probability, Bayes Theorem, Distributions - Binomial, Multinomial, Poisson, Normal distributions and related problems.

UNIT II

Exploratory Data Analysis (EDA), Summary Statistics for Pre-processing and Visualization. Coefficient of variation, Skewness, Kurtosis, Data visualization, Scatter diagram, Grouped data, Histograms, Ogives, Percentiles, Box Plot.

UNIT III

Inference - Statistical Inference for Categorical Data, Statistical Inference for Binomial and Multinomial Parameters, Bayesian Inference for Binomial and Multinomial Parameters. Continuous distributions and related problems.

UNIT IV

Testing of Hypothesis- Developing Initial Hypotheses, Type I and Type II errors, Testing hypotheses on means, proportions and variances. Hypothesis generation and testing – Chi square test, t-test, Test of goodness of fit, Test for Analysis of variance and correlation.

UNIT V

Regression and Estimation, Covariance and correlations, Covariance matrix, Parameter Estimation, Bayesian Linear Regression, Maximum likelihood as orthogonal projection. PCA.

TEXTBOOKS/REFERENCES

1. “Mathematics for Machine Learning”, A. Aldo Faisal, Cheng Soon Ong, and Marc Peter Deisenroth, Edition , 2020, Cambridge University Press.
2. “Practical Statistics for Data Scientists”, by Peter Bruce, Andrew Bruce, Edition 1, 2017,O’Reilly Media. Inc.
3. “Applied Multivariate Statistical Analysis”, Richard A. Johnson, Dean W. Wichern, Edition 6, 2008, Pearson.

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23-344-0105 Advanced Computer Networks

(March 2023)

Course Outcomes:

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

CO1	Describe how computer networks are organized with the concept of layered approach	(Cognitive level : Understand)
CO2	Analyze topological and routing strategies for an IP based networking infrastructure	(Cognitive level : (Analyze)
CO3	Explain protocols of computer networks, and how they can be used to assist in network design and implementation	(Cognitive level : Understand)
CO4	Explain congestion and flow control strategies	(Cognitive level : Understand)
CO5	Develop network communication services for client/server and other application layouts	(Cognitive Level: Apply)

Mapping of course outcomes with programme outcomes - **Low=1, Medium=2, High=3**

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

UNIT I

Introduction, network topologies. Layering and protocols. Physical Layer: Different types of transmission media, errors in transmission: attenuation, noise. Repeaters. Encoding (NRZ, NRZI, Manchester, 4B/5B), MAC Layer: CSMA, CSMA/CD, CSMA/CA protocols. Examples: Ethernet, including Gigabit Ethernet and WiFi (802.11), Token Ring.

UNIT II

The Services Provided by the Link Layer, Error-Detection and -Correction Techniques-Parity Checks, Checksumming Methods, Cyclic Redundancy Check (CRC), Link-Layer Addressing and ARP, Virtual Local Area Networks (VLANs), Wireless Links and Network Characteristics-CDMA, 802.11 Architecture, 802.11 MAC Protocol, IEEE 802.11 Frame.

UNIT III

IPv4 and IPv6 Addressing, IP Address – Subnetting / Super netting, Packet Forwarding with Classfull, Routing Algorithms-The Link-State (LS) Routing Algorithm, Distance-Vector (DV) Routing Algorithm, OSPF, Routing Among the ISPs: BGP-The Role of BGP, Advertising BGP Route Information, The Internet Control Message Protocol, Simple Network Management Protocol (SNMP).

UNIT IV

Transport-Layer Services, Multiplexing and Demultiplexing, Connectionless Transport-UDP Segment Structure, UDP Checksum, Go-Back-N (GBN), Selective Repeat, Connection-Oriented Transport, TCP Connection, TCP Segment Structure, Round-Trip Time Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management, Congestion Control. Protocols.

UNIT V

Principles of Network Applications, Transport Services Available to Applications, Application-Layer Protocol, Web and HTTP, Electronic Mail in the Internet-SMTP, DNS—The Internet's Directory Service, Peer-to-Peer Applications, Socket Programming.

TEXT BOOK/REFERENCE

1. Kurose and Ross, Computer Networks A systems approach , Pearson Education.
2. William Stallings, Data and Computer Communications, Pearson Education.
3. A S Tanenbaum, DJ Wetherall, Computer Networks, 5th Ed., Prentice-Hall, 2010.
4. W. R. Stevens.*TCP/IP Illustrated, Volume 1: The protocols,*Addison Wesley, 1994.
5. G. R. Wright.*TCP/IP Illustrated, Volume 2: The Implementation,*Addison Wesley, 1995.

6. W. R. Stevens.*TCP/IP Illustrated, Volume 3: TCP for Transactions, HTTP, NNTP, and the Unix Domain Protocols,*Addison Wesley, 1996.
7. B.A. Forouzan, Data communication & networking, 5th Edition, Tata Mc-Graw Hills.

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23-344-0106 - Python Programming Lab

(March 2023)

Course Outcomes:

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

CO1	Apply different data types based on the requirement	(Cognitive level: Apply)
CO2	Apply functions and object-oriented principles in programming	(Cognitive level: Apply)
CO3	Employ exception handling and database connectivity to develop robust applications in python.	(Cognitive level: Apply)
CO4	Use Pandas and Numpy for data analysis	(Cognitive level: Apply)
CO5	Show data analysis using matplotlib	(Cognitive level: Apply)

Mapping of course outcomes with programme outcomes - **Low=1, Medium=2, High=3**

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

List of Experiments:

1. Write a program to check whether the given number is divisible by 7 or not.

2. Write a Python program to construct the following pattern, using a nested for loop.

```
*
* *
* * *
* * * *
```

3. Write a program to fetch only even values from a dictionary.

4. Write a for loop that iterates over a list of strings and prints the first three characters of every word.

5. Write a program that requests a list of student names from the user and print those names that start with letters A through M.

6. Write a Python class named Circle constructed by a radius and two methods which will compute the area and the perimeter of a given circle.

7. Implement the function vowels() that takes as input a string and prints the indexes of all vowels in the string.

8. Write a Python function that takes a number as a parameter and checks if the number is prime or not.

9. Create a simple calculator.

10. Build two numpy array and perform the following
    - Search for an element in the array.
    - Join the two arrays.
    - Sort the elements in the array
    - Broadcast the value 10 in 1 to 5 array index positions.

11. Create a NumPy array and perform the following:
    - Append values to the end of an array
    - Convert array to a float type
    - Reverse array (first element becomes last)
    - Find the indices of the maximum and minimum values

12. Write the following python program:

- Write a Pandas program to add, subtract, multiple and divide two Pandas Series.
- Write a Pandas program to compare the elements of the two Pandas Series.
- Write a Pandas program to convert the first column of a DataFrame as a Series.
- Write a Pandas program to count the number of rows and columns of a DataFrame

13. Write a Pandas program to find the sum, mean, max, min value of 'Production' column of sheet_2013.xlsx file.

Year	Products	Production	Labor_Hours
2013	Lays	3000	22000
2013	Soap	2500	20000
2013	Dish Wash	1500	13000
2013	Apple Vinegar	500	2700
2013	Coffee	5000	300
2013	Salt	5000	300

14. Familiarize with Mongodb

15. Write a Python programming to display a bar chart of the popularity of programming Languages. Use a different color for each bar. Attach a text label above each bar displaying its popularity (float value).

    Sample data:
    Programming languages: Java, Python, PHP, JavaScript, C#, C++
    Popularity: 22.2, 17.6, 8.8, 8, 7.7, 6.7

16. Write a Python program to create a stacked bar plot with error bars.

    Note: Use bottom to stack the women's bars on top of the men's bars.

Sample Data:
Means (men) = (22, 30, 35, 35, 26)
Means (women) = (25, 32, 30, 35, 29)
Men Standard deviation = (4, 3, 4, 1, 5)
Women Standard deviation = (3, 5, 2, 3, 3)

17. Using the Iris data set, create a 2x2 subplot with a subplot for each of the following variables:
    sepalLength
    sepalWidth
    petalLength
    petalWidth
    Make each subplot a histogram with X bins. Give each subplot a reasonable title to understand the data in each subplot.
18. Create a GUI-based simple calculator using the Python Tkinter module.

TEXTBOOKS/REFERENCES :

1. "Python Data Analytics Data Analysis and Science Using Pandas, Matplotlib, and the Python Programming Language", by Fabio Nelli, Edition 1, 2015, Apress.

2. "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Ipython", by William McKinney, Edition 2, 2017, Shroff/O'Reilly.

3. "Data Analysis with Python: A Modern Approach", by David Taieb, Edition 1, 2018, Packt Publishing".

4. "Artificial Intelligence with Python: A Comprehensive Guide to Building Intelligent Apps for Python Beginners and Developers", by Prateek Joshi, Edition 1, 2017, Packt Publishing Limited.

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23-344-0107 - Data Structure Lab

(March 2023)

Course Outcomes:

After the completion of the course the student will be able to:

CO 1	Apply elementary data structures, non linear data structures and binary search tree using C.	(Cognitive level: Apply)
CO 2	Implement heap and graph operations using C.	(Cognitive level: Apply)
CO 3	Implement data structures for disjoint sets.	(Cognitive level: Apply)
CO 4	Apply greedy algorithms.	(Cognitive level: Apply)
CO 5	Apply dynamic programming to find the shortest path.	(Cognitive level: Apply)

Mapping of course outcomes with program outcomes - **Low=1, Medium=2, High=3**

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

Experiment No.	Experiment	Hours
1	Implementation of Polynomials and Sparse matrices using arrays	**2**
2	Implementation of Stack , Queues, Priority Queues, DEQUEUE and Circular Queues using arrays	**2**
3	Implementation of various linked list operations.	**2**
4	Implementation of stack, Queue and Trees using linked list	**2**

5	Implementation of binary trees, binary search trees, Heap and Graph using linked lists and arrays Perform creations, insertion, deletion and traversal.	**6**
6	Implement linear search and binary search algorithms.	**2**
7	Implementation of hash table using your own mapping functions and observe collisions and overflow resolving schemes.	**4**
8	The details of students (number, name, total-mark) are to be stored in a linked list. Write functions for the following operations: 1.Insert 2.Delete 3.Search 4.Sort on the basis of number 5.Display the resultant list after every operation	**2**
9	Represent any given graph and Perform 1.a depth first search 2.breadth first search	**2**
10	Write a program to find the shortest path from a given graph.	**2**
11	Write a program to obtain shortest path from a given graph based on Digkstra's algorithm.	**2**
12	Write a program to compute the number of collisions required in a long random sequence of insertions into a hash table (with some suitable hash function) using: a. Linear probing, b. Quadratic probing, c. Double hashing.	**2**

TEXTBOOKS/REFERENCES

1. Fundamentals of Data Structures in C", by Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Edition 2, 2007, Silicon Press.
2. "Introduction to Algorithms", by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Edition 3, 2009, The MIT Press.
3. "Data Structures and Algorithm Analysis in C", by Mark Allem Weiss, Edition 2, 2002, Pearson.
4. Data Structures using C and C++, by Yedidyah Langsam , Moshe J. Augenstein, Aaron M. Tenenbaum, Edition 2, 2006, Pearson.
5. Introduction to Design and Analysis, by Sara Baase & Allen Van Gelder, Edition 3, 2000, Pearson.

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23-344-0201 Computing Paradigms

Course Outcomes:

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

CO1	Explain the basics of Agile and Scrum Framework	(Cognitive level : Understand)
CO2	Apply containerization to host ML models	(Cognitive level : Apply)
CO3	Analyze the ML model's output on cloud	(Cognitive level : Analyze)
CO4	Apply best practices for deploying and maintaining ML models	(Cognitive level :Apply)
CO5	Describe parallel computing and GPU programming	(Cognitive level : Understand)

Mapping of course outcomes with programme outcomes **Low=1, Medium=2, High=3**

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

UNIT I

Introduction to software engineering, Software lifecycle development process, Introduction to Agile, The Scrum Framework, Agile architecture and design, Estimation planning, Defining the product roadmap, Agile quality management and testing, Continues delivery in DevOps, Agile risk management, Upscaling projects , practical usage of Agile.

UNIT II

Deploying ML models: Introduction to Docker, Dockerizing ML applications, Introduction to microservices, Need for microservices, Docker to Kubernetes, Kubernetes architecture, components and deployment, Containerizing the model, Deploying Model as Microservice, ML model inference, Tools for connecting to hosted ML models.

UNIT III:

Introduction to cloud computing, Key cloud services for AI/ML, Creating AI applications on cloud, Deploying ML model, ML Pipelines on cloud.

UNIT IV:

Introduction to MLOps, Data pipelines for MLOps, Kubernetes-based MLOps, Pipelines and Services, Kubeflow and MLFlow , MiniKF and Pipelines, Deployment of End-to-End Pipelines, Data pipeline tools.

UNIT V:

Introduction to parallel and high performance computing, Introduction to CUDA and CUDA toolkit, GPU programming, GPU Architecture and concepts, GPU training, Distributed GPU training, Performance optimization.

TEXTBOOK/REFERENCES

1. Software Engineering | Tenth Edition | By Pearson Paperback – 24 May 2017by Ian Sommerville.
2. Engineering MLOps: Rapidly build, test, and manage production-ready machine learning life cycles at scale Paperback – 19 April 2021 by Emmanuel Raj
3. Learning Agile: Understanding Scrum, XP, Lean, and Kanban, Andrew Stellman · Jennifer Greene
4. Bootstrapping Microservices with Docker, Kubernetes, and Terraform, Ashley Davis

5. Hands-On GPU Programming with Python and CUDA by Dr.Brain Tuomanen.
6. Parallel and High Performance Computing by ROBERT ROBEY AND YULIANA ZAMORA
7. Pragmatic AI: An Introduction to Cloud-Based Machine Learning, First Edition by Noah Gift
8. Deploy Machine Learning Models to Production: With Flask, Streamlit, Docker, and Kubernetes on Google Cloud Platform,by Pramod singh
9. Introducing MLOps.,By Mark Treveil, Nicolas Omont, Clément Stenac, Kenji Lefevre, Du Phan, Joachim Zentici, Adrien Lavoillotte, Makoto Miyazaki, Lynn Heidmann

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23-344-0202 - Advanced Database Technologies

(March 2023)

Course Outcomes:

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

CO1	Compare the architectures of distributed and parallel systems.	(Cognitive level : Analyze)
CO2	Design NoSQL databases and perform CRUD operations using NoSQL query language.	(Cognitive level : Apply)
CO3	Demonstrate the semi-structured data handling using XML and JSON.	(Cognitive level : Apply)
CO4	Developing cloud-based applications using Firebase data modeling.	(Cognitive level : Apply)
CO5	Famliarize the specialized aspects of big data with Hadoop File System and MapReduce.	(Cognitive level : Understand)

Mapping of course outcomes with programme outcomes **Low=1, Medium=2, High=3**

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

UNIT 1:

Relational database management system, Pitfalls of Relational Databases, Issues in storing unstructured data, Limitations of Sharding, Partitioning and Indexing. Issues in scalability, Parallel systems, Distributed systems - , Parallel databases, I/O parallelism, Inter and Intra Query Parallelism, Intra and inter operation parallelism, Design of parallel systems, Distributed database concepts, Distributed Data storage, Distributed Transactions, Commit Protocols, Concurrency control, Distributed Query Processing.

UNIT II:

NoSQL Databases - Evolution , Types of NoSQL databases - Document data stores, Key-Value data stores, Graph database, Column oriented database. CAP Theorem, NoSQL query languages, CQL, Pig Latin, NoSQL database design for applications- CRUD operations using NoSQL, Advantages of NoSQL databases. Clustering in NoSQL databases. Data distribution methods.

Case studies of MongoDB, VoltDB, Cassandra, Neo4J.

UNIT III:

Semi-Structured Data: XML database management system.XML databases, XML schema, Storing XML in Databases, XML and SQL. XML Query processing: XML query languages, XQuery, XPath. Approaches for XML query processing, Query processing on relational structure and storage schema. JSON: Overview, Data Types, Objects, Schema, JSON with Java/PHP/Ruby/Python.

UNIT IV:

Introduction to Firebase, Firebase Authentication, Cloud Firestore, Firestorage, Firebase Cloud Messaging, Firebase Performance Monitoring, Security Rules for Firebase, Setting up a Firebase Project, Firebase Analytics.

UNIT V:

Big Data Management: Hadoop: HDFS, Dealing with Massive Datasets-Map Reduce and Hadoop. Introduction to HBase: Overview, HBase Data Model, HBase Physical Model, HBase Architecture. HIVE: Hive Data Model, Architecture, Hive queries, Hive DDL, DML

REFERENCE BOOKS

1. A Silberschatz, H Korth, S Sudarshan, “Database System and Concepts”, fifth Edition McGraw-Hill , Rob, Coronel, “Database Systems”, Seventh Edition, Cengage Learning.

2. Guy Harrison, “Next Generation Data Bases – NoSQL, NewSQL and Big Data”, 1stEd ,Apress, 2015.
3. Authored by DT Editorial Services , “Big Data, Black Book: Covers Hadoop 2, MapReduce, Hive, YARN, Pig, R and Data Visualization WileyIndia, 2016
4. Neil Smyth, “Firebase Essentials - Android Edition”, Payload Media, Inc., 2017
5. Robin Wieruch, “The Road to Firebase”, 2018.
6. Robinson, I, Webber, J, & Eifrem E, Graph Databases, 2e, O’Reilly, 2015.

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23-344-0203 Ethics in AI

Course Outcomes:

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

CO1	Describe Ethics while developing AI based applications	(Cognitive level : Understand)
CO2	Describe challenges for incorporating ethics in AI systems	(Cognitive level : (Understand)
CO3	Apply fairness while designing AI based applications.	(Cognitive level : Analyze)
CO4	Describe AI/ML techniques for bias mitigation	(Cognitive level : Apply)
CO5	Discuss strategies and challenges of putting ethics and responsibility in practice	(Cognitive level : Create)

Mapping of course outcomes with programme outcomes - **Low=1, Medium=2, High=3**

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

UNIT I

Ethics of Artificial Intelligence - Introduction - AI, information transmission, information processing.Unfair and illegal discrimination - Cases of AI enabled discrimination, Ethical

Questions Concerning AI-Enabled Discrimination,Responses to Unfair/Illegal Discrimination.

Cases of AI-Enabled Surveillance Capitalism - Data Appropriation, Monetisation of Health Data, Unfair Commercial Practices , Cases of AI-Enabled Manipulation, The Ethics of Manipulation, Cases of AI in Potential Conflict with Human Dignity,Cases of AI for Good or Not? Ethical issues for different strengths/grades of AI and AI algorithms, Privacy - Privacy violation through AI, Data Protection and Privacy, Responses to AI-Related Privacy Threats.

UNIT II

Normative ethics proposals -advantages and disadvantages, Rule consequentialism, Deontological approaches,Care ethics,Virtue Ethics, Problems with implementation, Problems with uptake and enforcement Software qualities and normative ethics - Interpretability, transparency and normative ethics, policy making , Extensibility, usability, and communicability Ethics of AI on the Web and in Web based applications.

UNIT III

Human rights, fairness, varieties of fairness, discrimination and biases, Removing biases,Understanding and measuring Bias, Algorithms for Bias mitigation- Data Bias, Preprocessing, in-processing, post processing algorithms,legality in data collection and public use.

UNIT IV

Datasets in different domains, Roles of datasets, harms associated with data, mitigating harms. fairness and bias issues in the design of decision-making systems. Fairness and Bias Assessment Tools, AI/ML Techniques for Bias Mitigation Transform biased dataset into a more objective solution.

UNIT V

Transparency in AI , Risk associated with transparency, Accountability and automated systems, The problems of individuating responsibilities. Strategies (& Challenges) of Putting Ethics & Responsibility into Practice.

TEXT BOOKS / REFERENCES

1. Solon Barocas, Moritz Hardt, Arvind Narayanan , FAIRNESS AND MACHINE LEARNING Limitations and Opportunities, SUN, 2022

2. Trisha Mahoney, Kush R. Varshney & Michael Hind, AI Fairness - How to Measure and Reduce Unwanted Bias in Machine Learning, Oreilly, 2020
3. Ethics of Artificial Intelligence Case Studies and Options for Addressing Ethical Challenges, Springer
4. Mittelstadt, B. (2019). AI Ethics – Too Principled to Fail? SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3391293
5. Bauer, W. A. (2020). Virtuous vs. utilitarian artificial moral agents. AI and Society. https://doi.org/10.1007/s00146-018-0871-3

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23-344-0205 - Artificial Intelligence and Machine Learning

(March 2023)

Course Outcomes:

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

CO1	Explain the basic concepts of Artificial Intelligence	(Cognitive level : Understand)
CO2	Apply Constraint satisfaction problem to solve various standard problems in AI	(Cognitive level : Apply)
CO3	Compare the search strategies in AI	(Cognitive level : Analyze)
CO4	Explain the concept of Intelligent agents and Soft Computing Techniques	(Cognitive level : Understand)
CO5	Describe the generic concepts of Neural networks	(Cognitive level : Understand)

Mapping of course outcomes with programme outcomes - **Low=1, Medium=2, High=3**

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

UNIT I

Introduction to artificial intelligence - Artificial Intelligence- Definitions, Programming Methodologies, Techniques, Intelligent Systems, Propositional calculus, Predicate Calculus, Rule-Based Knowledge Representation. Unification, Resolution, Constraint Satisfaction Problem.

UNIT II

Intelligent Agents – Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The structure of Agents. The Present and Future of AI- Agent Components, Agent Architectures.

UNIT III

Heuristic search and state space search - Techniques for Heuristic Search, State Space Search-Strategies for State Space Search -Applications of Search Techniques in Game Playing- Minimax strategy and Alpha Beta Pruning, and Planning.

UNIT IV

Machine Learning - Introduction, Types of learning, Classification and Regression, Linear regression, Multiple linear regression, bias variance dichotomy, Logistic regression, Decision trees, Naive Bayes classifier, Support Vector Machines, Random forest, Association rule mining, Apriori algorithm, Principal Component Analysis, K-means clustering, various types of clustering algorithms.

UNIT V

Introduction to Neural networks, McCulloch Pits neurons, Perceptron model, Perceptron learning algorithm, Multilayer Perceptron, Deep neural networks, Forward propagation, Back propagation, loss functions – various types, activation functions and its derivatives, backpropagation and optimization functions, batch normalization, implementation.

TEXT BOOKS

1. Stuart Russell, Peter Norvig: “Artificial Intelligence: A Modern Approach “, 3rd Ed, Pearson, 2016.
2. Aurélien Géron; Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, Third Edition, SPD, 2022.
3. Michael Bowles; Machine Learning in Python: Essential Techniques for Predictive Analysis; Wiley, 2015
4. Elaine Rich, Kevin Knight, B.Nair: “ARTIFICIAL INTELLIGENCE “, 3rd Ed, Mc Graw Hill, 2017.

REFERENCES

1. Charu C. Aggarwal. “Recommender Systems. The Textbook”, Springer, 2016.
2. N.P.Padhy:Artificial Intelligence and Intelligent Systems, Oxford University Press, 2009.

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21-344-0206 - Data Management Lab

(March 2023)

Course Outcomes:

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

CO1	Employ SQL DDL/DML commands to create and query a database.	(Cognitive level : Apply)
CO2	Apply XPath and XQuery queries	(Cognitive level : Apply)
CO3	Apply Read, Write and Parsing operations on JSON data using Python and java	(Cognitive level : Apply)
CO4	Employ HIVE commands to query a database.	(Cognitive level :Apply)
CO5	Create Firebase project and register apps to it.	(Cognitive level :Apply)

Mapping of course outcomes with programme outcomes **Low=1, Medium=2, High=3**

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

List Of Experiments

I.

Create table CLIENT_MASTER with attributes Client_No as primary key, Name, City, Pincode and Bal_due.
Create table SALE_ORDER with attributes Order_No, Order_Date, Client_No, Order_Status and Dely_Date

1. List all details from the client_master table for clients whose Bal_due = 0.
2. Update table client_master, Change city of Client_no C00004 to Jaipur.
3. Retrieve records of clients residing in Mumbai.
4. Find the name and address of customer who has placed Order_No=O19003 and O19002 respectively.
5. List the client_no, name, city and pincode of clients whose Order_status is “In process”.

II.

Create a table employee with attributes Employee_id, First_name, last_name, email, phone number, hire_date,job_id, salary,manager_id,department_id.

1. Insert five rows to employee table.
2. Change the phone number of employee whose employee_id is 3.
3 Write a query to display the name (first name and last name) for those employees who gets more salary than the employee whose ID is 163.
4. Write a query to display the name (first name and last name), salary, department id, job id for those employees who works in the same designation as the employee works whose id is 169.

III.

1. Create a view of the table supplier with Supplier Number, Supplier Name and city.
2. Display the view.
3. Update the value of Supplier Name on view.
4. Display the supplier table.
5. Drop the view.

IV.

1. Create a table employee with attributes employee number, name, designation, salary, date of birth, date of joining,depno
2. Insert values into table employee
3. Create an index on name of employee table
4. Select the details from the table using name
5. Drop the index
6. Delete all rows from employee table
7. Create a sequence on employee number of employee table.
8. Insert value into employee table.
9. Display the details of employee table.

V.

1. Create table supplier with attributes supplier number as primary key, supplier name and city.
2. Create a table parts with attributes partno as primary key, partname, color, weight and city.
3. Create a table shipment with attributes sno as references supplier number of supplier table, pno references part number of parts table, quantity, sno and pno as primary key.

1. Insert values into 3 tables.
2. Change the city of suppliers whose sno is S1 to Hyderabad.
3. Update the quantity of all parts in the shipment table to quantity +10.
4. Get supplier name for all suppliers who supply part p1.
5. Get supplier number for suppliers who are located in same city as sno=S1.
6. Get supplier number for suppliers who supply at least one part supplied by sno=S2.
7. Get Sno's for suppliers who do not supply any part supplied by sno=S2.

VI.

Consider the following relations

Product (P_code, Description, Stocking_date, QtyOnHand, MinQty, Prices, Discount, V_code) .

Vendor (V_code, Name, Address, Phone).

Here a vendor can supply more than one product but a product is supplied by only one vendor. (NOTE: Identify the primary keys and foreign key from this statement)

Write SQL queries for the following:

1. List the names of all the vendors who supply more than one product.
2. List the details of the products whose prices exceed the average product price.
3. List the Name, Address and Phone of the vendors who are currently not supplying any product.

VIII.

Create a simple XML file for book management.

1. Select all the title nodes.
2. Select the title of the first book node under the bookstore element.
3. Selects the text from all the price nodes.
4. Selects all the price nodes with a price higher than 35

IX.

Create a simple XML file for food menu.

1. Display the food menu styled with an XSLT style sheet.
2. Select all the title nodes.
3. Select the title of the food with price higher than $45.
4. Selects the description of food with name French Toast.

X. Create a simple XML file for plant catalog.

1.Display the plant catalog styled with an XSLT style sheet.
2. Select all the title nodes.
3. Select the title of plant which are mostly available.
4. Select the botanical name of all the plants.

XI.

1. Create a JSON object that can have different data such as text, number, boolean etc.
2. Create a nested JSON object in which an object can have another object having different data.
3. Create a simple JSON array example having 4 objects.

XII. Create a JSON file for the below given XML.

```
<employees>
  <employee>
    <name>Raju</name>
    <email>rajuxyz@gmail.com</email>
  </employee>
  <employee>
    <name>Bob</name>
    <email>bob32@gmail.com</email>
  </employee>
  <employee>
    <name>Jai</name>
    <email>jai87@gmail.com</email>
  </employee>
</employees>
```

XIII.

Consider the customer database contains the collection invoice_ details. Using MongoDB CRUD insert the documents into the invoice_details collection.

XIV.

eid	Ename	sex	address	salary	dno
1011	Rohith	Male	Mumbai	42000	1
1012	Selvaraj	Male	Chennai	32790	4
1013	Martin	Male	Kottayam	45000	2
1014	Sindhu	Female	Kannur	50000	4
1015	Komal	Female	Pune	36000	1
1016	Rashmika	Female	Chennai	15000	3

Consider the above collection employee. Write a MongoDB query to the following.

1. Insert all the given documents to the employee collection.
2. Display the collection.
3. Display the details of employees whose salary greater than 35000.
4. Display the eid, ename of all female employees.
5. Display the name of employees working in department number 4 getting salary less than 40000.
6. Increment the salary of all employees working in the department number 1.
7. Terminate the employees whose salary less than 20000.

XV.

1. Create a Firebase project and register apps to it.
2. Insert the above employee collection into your Firebase project.
3. Add some more information to Martin and Sindhu about their dependents(such as name, relationship etc).
4. Change the salary of Rashmika to 20000.
5. Display the data in sorted order by name and id.

XVI.

Hive commands

1. Create a separate database named movielens.
2. Create tables to hold data.
3. Retrieve the data from the table.

4. Find out numbers of non-adults as per Indian standard, who has rated movies.
5. Find out the no of users with same occupation and having age more than 25 along with occupation details:

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23-344-0301 - Deep Learning

(July 2021)

Course Outcomes:

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

CO1	Discuss the basic concepts of neural networks.	(Cognitive level : Understand)
CO2	Design DNN and CNN models.	(Cognitive level : Apply)
CO3	Design RNN, LSTM, and GRU models.	(Cognitive level : Apply)
CO4	Compare the architecture differences and capabilities of pre-trained models.	(Cognitive level : Analyze)
CO5	Compare Generative models.	(Cognitive level : Analyze)

Mapping of course outcomes with programme outcomes **Low=1, Medium=2, High=3**

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

UNIT 1

Introduction to Machine Learning and Neural Networks - Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Threshold logic, Linear Perceptron, Multilayer Perceptron, Perceptron Learning Algorithm, Linear separability; loss functions – various types, regularization and hyper parameter tuning, Feed Forward Neural Networks, Forward propagation, activation functions and its derivatives, backpropagation and optimization functions, batch normalization.

UNIT II

Deep Neural Networks (DNN) and Convolutional Neural Networks (CNN) – Deep Neural Network algorithm, Initialization of network parameters, Optimization – Gradient descent, parameter updates and optimization, vanishing gradient problem, regularization techniques to handle overfitting.

Convolutional Neural Networks – Convolutional operation, padding, strided convolution, pooling, training single layered and multi layered CNNs, CNNs in image processing applications.

UNIT III

Recurrent Neural Networks (RNN) for sequence modelling – Introduction to RNN, RNN architecture, Backpropagation in basic RNN, Applications of RNN; Long Short Term Memory (LSTM) – Architecture, LSTM implementation, Case study related to NLP and time series data analysis; Gated Recurrent Unit (GRU) – difference between LSTM & GRU, architecture, implementation and applications.

UNIT IV

Pretrained models and Transfer Learning – Residual Network, Skip Connection, Alex Net, VGG16, VGG19, Inception V3, Dense Net, Architecture differences, Case study; Advantages of transfer learning, feature extraction using transfer learning, pretrained models-based image classification.

UNIT V

Advanced Deep Learning Architectures – Generative models, Restricted Boltzmann Machines (RBMs), Autoencoders, different autoencoder architectures, Generative Adversarial Networks (GAN), image generation using GANs.

TEXT BOOK/ REFERENCES

1. 1, Deep Learning with R, Abhijit Ghatak, Springer Nature Singapore Pte Ltd, 2019.
2. Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016.

3. Yuxi (Hayden), Liu and Savansh Mehta, “Hands -on Deep Learning Architectures with Python”, Packt,
4. Josh Patterson & Adam Gibson, “Deep Learning: A Practitioners Approach”, published by O’Reilly Media.
5. Nikhil Ketkar, “Deep Learning with Python”, published by Apress Media

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23-344-0401 Internship/Project Work

Course Outcomes:

After completion of this course students will be able to:

CO 1	Analyze the requirements and existing systems/literature considering realistic constraints.	(Cognitive Level: Analyse)
CO 2	Perform the system/literature analysis	(Cognitive level: Analyse)
CO 3	Develop the solution using appropriate software tools	(Cognitive level: Create)
CO 4	Test and validate the solution	(Cognitive level: Evaluate)
CO 5	Deploy the developed product/document the project	(Cognitive level: Apply)

Mapping of course outcomes with program outcomes - **Low=1, Medium=2, High=3**

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

Mark Division

Continuous Assessment by Guide	25
Internal Evaluation by Guide	25
Final Panel Evaluation	25
Demonstration and report submission	25

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Elective I

23-344-0211 Fuzzy and Nature Inspired Computation

Course Outcomes:

After completion of the course students will be able to :

CO 1	Employ the concepts of Fuzzy set theory and Rough set theory in AI	(Cognitive Level: Apply)
CO 2	Apply the concepts of Genetic algorithm in AI	(Cognitive level: Apply)
CO 3	Perform feature selection using ACO	(Cognitive level: Apply)
CO 4	Solve real world problems using PSO	(Cognitive level: Apply)
CO 5	Perform feature selection using ABC	(Cognitive level: Apply)

Mapping of course outcomes with program outcomes - **Low=1, Medium=2, High=3**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	3	3										3	
CO2	3	3	3	3	3	3	3						3	3
CO3	3	3	3	3	3	3		3					2	2
CO4	3	3	3	3	3	3	3	3		3	3		3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

UNIT I

Fuzzy Systems - Fuzzy Set theory, Fuzzy versus Crisp set, Fuzzy Relation, Fuzzification, Minmax Composition, Defuzzification Method, Fuzzy Logic, Fuzzy Rule based systems, Predicate logic, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification. Theoretical Foundations of Rough Set theory, Knowledge Base, Equivalence,

Generalization and Specialization of Knowledge, Introduction to Rough Sets, Definition of Rough Sets. Approximations of Set, Approximation of Classifications, Reduction of Knowledge, Reduct and Core of Knowledge, Reduction of Categories, Dependency of Knowledge, Knowledge Representation, Significance of Attributes, Discernibility Matrix, Applications in feature selection.

UNIT II

Genetic Algorithm - Working Principle, Various Encoding methods, Fitness function, GA Operators- Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Multi-level Optimization. GA based Backpropagation Networks: GA based Weight Determination, K - factor determination in Columns.

UNIT III

Ant Colony Optimization - Introduction to Swarm Intelligence – Essence of an Algorithm, Algorithms and Self –Organization, Links between Algorithms and Self-Organization, Characteristics of Metaheuristics; Swarm Intelligence based algorithms; Ant Colony Optimization (ACO) - Theoretical Considerations, Combinatorial optimization and metaheuristic, Stigmergy, Convergence Proofs, ACO Algorithm, ACO and Model Based Search,Variations Of ACO: Elitist Ant System (EAS), Minmax Ant System (MMAS)), ACO Algorithmfor Travelling Sales Person problem, ACO algorithm for feature selection.

UNIT IV

Particle Swarm Optimization: Principles of Bird Flocking and Fish Schooling, Evolution of PSO, Operating Principles, PSO Algorithm, Neighbourhood Topologies, Convergence Criteria, Variations of PSO. Applications.

UNIT V

Artificial Bee Colony (ABC) Optimization - Behaviour of real bees, ABC Algorithm,Variations of ABC: Abcgbest and Abcgbestdist, Case Study: Application of ABC algorithm in solving Travelling Salesman Problem, Knapsack Problem and for feature selection.

TEXT BOOK /REFERENCES

1. Swarm Intelligence Algorithms: Modifications and Applications; Adam Slowik, CRC Press, 2022.
2. Xin-SheYang, Zhihua Cui, Renbin Xiao, Amir Hossein Gandomi, Mehmet Karamanoglu, “Swarm Intelligence and Bio-Inspired Computation, Theory and Applications”, Elsevier 2013.

3. Rough Sets: Theoretical aspects of Reasoning about Data. Pawlak Z., Kluwer Academic Publishing, Dordrecht. 1991.
4. Fuzzy Logic with Engineering Applications, Timothy J. Ross, John Wiley and Sons, Second Edition, 2004

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23-344-0212 - Internet Of Things

Course Outcomes:

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

CO1	Describe general concepts of Internet of Things.	(Cognitive level : Understand)
CO2	Compare M2M and IoT Architectures.	(Cognitive level : Analyze)
CO3	Describe about various devices, sensors required for IoT applications	(Cognitive level : Understand)
CO4	Design IoT Applications using Arduino IDE.	(Cognitive level :Apply)
CO5	Develop IoT Use Cases	(Cognitive level : Apply)

Mapping of course outcomes with programme outcomes - **Low=1, Medium=2, High=3**

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

UNIT I

Introduction -Physical Design of IoT, Logical Design of IoT, IoT Levels, Deployment templates, IoT enabling technologies. IoT Applications, Sensing,Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Security aspects in IoT.

UNIT II

Networking IoT and Communication protocols – Link Layer, Network Layer, Transport layer, Application Layer.Sensor Networks and Machine to Machine communication – Differences and Similarities between M2M and IoT, Software defined networking , Network function virtualization.

UNIT III

M2M and WSN Protocols , Connectivity (6LowPAN, RPL) , Communication / Transport (WiFi, Bluetooth, LPWAN) Data Protocols (MQTT, SMQTT, CoAP,), Wireless Sensor Networks, Zigbee Architecture

UNIT IV

Building IoT - RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry PiBoard - Linux on Raspberry Pi- Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino. Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino, Implementation of IoT.

UNIT V

IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation.

TEXT BOOK/REFERENCES

1. Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things”, John Wiley &Sons, 2013.
2. Cuno Pfister, “Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud”, Maker Media, 2011.
3. Pethuru Raj and Anupama C. Raman , “The Internet of Things: Enabling Technologies, Platforms, and Use Cases", (CRC Press).
4. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", by (Universities Press)2015.
5. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.

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23 -344-0213 - Digital Image Processing

(March 2023)

Course Outcomes:

After the completion of the course the student will be able to:

CO 1	Explain Digital Image Processing.	Cognitive Level: Understand
CO 2	Apply image transforms.	Cognitive Level: Analyze
CO 3	Employ Image Restoration and Denoising.	Cognitive Level: Apply
CO 4	Compare various methods of Image Segmentation and Morphological Image Processing.	Cognitive Level: Analyze
CO 5	Apply image compression, feature extraction and classification.	Cognitive Level: Apply

Mapping of course outcomes with programme outcomes - **Low=1, Medium=2, High=3**

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

UNIT I

Introduction- Fundamental steps in image processing; Components of image processing system; Pixels; coordinate conventions; Imaging Geometry; sampling and quantization; Basic relationship between pixels; Spatial Domain; Frequency Domain; Colour Models. Image Enhancement in spatial domain-Intensity transformations; contrast stretching; histogram equalization; Correlation and convolution; Smoothing filters; sharpening filters; gradient and Laplacian; Unsharp Masking and High Boost Filtering

UNIT II

Image transforms and its properties – Unitary transform; Fourier Transforms and properties; Frequency domain filtering- Smoothing Frequency Domain Filters; Sharpening Frequency Domain Filters; Homomorphic Filtering Wavelet-based Image Processing: Wavelet, Wavelet Transform Discrete and Continuous, Wavelet- Examples, Multiresolution Analysis. Contourlet Transform, Image Pyramid.

UNIT III

Image Restoration and Denoising: Image Degradation, Image Blur-Types, Image Restoration Techniques Classification, Image Restoration Model, Linear and Nonlinear Image Restoration Techniques. Image Denoising, Noises in Image-Classification, Mean Filtering, Order Statistics-Adaptive Filters-Band reject filters, Band Pass filters, Notch Filters, Weiner filtering- Applications of Digital Image Restoration.

UNIT IV

Image segmentation: Point, Line and Edge segmentation. Edge linking and Boundary detection. Segmentation using thresholding, Region based segmentation. Morphological Image Processing-Structuring Element, Dilation, Erosion, opening and Closing, Hit or Miss transformation, Basic Morphological Algorithms

UNIT V

Image Compression: Fundamentals, Some Basic Compression Methods - Run Length Coding, Huffman Coding, Arithmetic Coding, Bit Plane Coding, Block Truncation Coding. JPEG Compression, Feature extraction and classification.

TEXTBOOKS/REFERENCES

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing (English) 3rd Edition,Pearson India, 2013.
2. A K. Jain, Fundamentals of digital image processing, Prentice Hall of India, 1989.

3. Video Processing and Communication – Yao Wang, Joem Ostermann and Ya–quin Zhang.1st Ed., PH Int
4. S Jayaraman, S Esakkirajan and T Veerakumar, Digital Image Processing, McGraw Hill Education , 2009.
5. Digital Video Processing – M. Tekalp, Prentice Hall International.

Web Resources

- https://nptel.ac.in/courses/117105079

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23-344-0214 Big Data Analytics

Course Outcomes:

After the completion of the course the student will be able to:

CO1	Solve the problems using MapReduce programming paradigm.	(Cognitive level : Apply)
CO2	Apply spark libraries for solving distributed applications.	(Cognitive level : Apply)
CO3	Analyze streaming data using Spark Streaming libraries	(Cognitive level : Analyze)
CO4	Demonstrate the usage of MongoDB, Hbase and Hive	(Cognitive level : Apply)
CO5	Explain the concepts of Spark MLlib libraries and Visualization tools	(Cognitive level : Understand)

Mapping of course outcomes with program outcomes **Low=1, Medium=2, High=3**

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

UNIT I

Introduction to Big Data: Big Data – Introduction, data life cycle, Structuring Big Data, Characteristics of Big Data, Big data applications, Technologies for handling big data – Distributed and Parallel Computing for Big Data, Introducing Hadoop – Hadoop multi node cluster architecture, Introduction to data lake, data cleansing and transformations,

Data lake reference architecture, HDFS and MapReduce. HDFS Concepts– MapReduce Execution, Algorithms using MapReduce, Limitations of Hadoop, Overcoming the limitations of Hadoop.

UNIT II

Apache Spark: Eco system, Components of the Spark unified stack-Spark SQL, Spark Streaming, Spark GraphX, Spark MLLib. Spark context, spark stage, spark executor.

Spark Architecture, RDD and RDD Operations-RDD Features and limitations, RDD-Persistence and Cashing mechanism, DAG, spark cluster management, performance tuning, DataFrames and Dataset – In-memory distributed processing using Apache Spark. Spark shell commands.

UNIT III

Streaming Data: Streaming Architectures - Lambda architecture, Kappa architecture, Spark Streaming- Streaming system components, Discretized stream processing, Spark streaming architecture, Transformations on Dstreams, Window operations, Join and output operations, Caching, Checkpointing, Structured Streaming, Managing Distributed Data Flow with Apache Kafka-Kafka Fundamentals, Use case and applications, Architecture, Kafka Topics, Producer and consumer-Producer and consumer configuration and execution, In-Sync Replicas, Kafka Consumer groups.

UNIT IV

NoSQL Databases: Types NoSQL Databases, Introduction to MongoDB, Data model design, CRUD operations on MongoDB, Projection, limiting and sorting records, indexing, Aggregation, replication and sharding, Analyzing queries, Introduction to HBase, HBase data model, regions, HBase Architecture, zookeeper,Dataflow, WAL and Memstore, HFile, CRUD operations, Meta table, Merge and compaction, Introduction to Hive – Hive data types, Hive file formats,Hive database and table operations, partitioning, Built in operators and functions, Views and indexes, Spark on Hive.

UNIT V

Analytics and Visualization: Spark MLLib for Machine Learning, ML Pipeline, Feature extraction and Transformations, Classification and Regression-Binary classification-SVM, logistic regression and linear regression, Multiclass classification – DT, Naive Bayes, Clustering- K Means, Hyperparameter Tuning and Cross-validation, Optimization. Building visualizations on Big Data- Power BI, Tableau, and Case Studies on applications of Big Data Analytics.

TEXT BOOKS/REFERENCES:

1. Bill Chambers And Matei Zaharia, “Spark: The Definitive Guide: Big Data Processing Made Simple”, O'Reilly Media, 2018
2. Tathagata Das, Jules S. Damji, Brooke Wenig, Denny Lee, “Learning Spark: Lightning-Fast Data Analytics,” Second Edition, O’Reilly Media, 2020
3. DT Editorial Services, “Big Data, Black Book : Covers Hadoop 2, MapReduce, Hive, YARN, Pig, R and Data Visualization”, DreamTech Press, 2016
4. Natraj Dasgupta, “Practical Big Data Analytics”, Packt, 2018
5. Gerard Maas, Francois Garillot “Stream Processing with Apache Spark”, O'Reilly Media, 2019
6. Bart Baesens, “Analytics in Big Data World," Wiley, 2014
7. Tom White, “HADOOP: The definitive Guide”, O Reilly 2012.
8. Kristina Chodorow and Michael Dirolf, “MongoDB: The Definitive Guide”,O'Reilly Media, 2019
9. Andy Konwinski, Holden Karau, Matei Zaharia, and Patrick Wendell, “Learning Spark: LightningFast Big Data Analysis," O Reilly, 2015.

Web Resources

1. Coursera - Introduction to Big Data with Spark and Hadoop Introduction to Big Data with Spark and Hadoop.

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23-344-0215 - Information Security

(July 2021)

Course Outcomes:

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

CO1	Explain the basic concepts of information security – Threats, Vulnerabilities and Controls.	(Cognitive level : Understand)
CO2	Solve the problems using conventional symmetric key algorithms and Asymmetric key cryptography algorithm RSA	(Cognitive level : Apply)
CO3	Compare security enabled in conventional and trusted operating systems.	(Cognitive level : Analyze)
CO4	Describe various security measures in database management systems.	(Cognitive level : Understand)
CO5	Discuss network threats and security techniques.	(Cognitive level : Understand)

Mapping of course outcomes with programme outcomes - **Low=1, Medium=2, High=3**

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

UNIT I

Introduction and Basic concepts: threats, vulnerabilities, controls; risk; Breaches;confidentiality, integrity, availability; Attacks, Exploits. Information Gathering (Social Engineering, Foot Printing & Scanning).

Open Source/ Free/ Trial Tools: nmap, zenmap, Port Scanners, Network scanners.

Modular Arithmetic Basic cryptography - Basic cryptographic terms, Historical background, Symmetric crypto Systems - Conventional systems, Asymmetric crypto primitives –RSA.

UNIT II

Explanation of Malware, Types of Malware: Virus, Worms, Trojans, Rootkits, Robots, Adware's, Spywares, Ransom wares, Zombies etc., Malware Analysis.

Open Source/ Free/ Trial Tools: Antivirus Protection, Anti Spywares, System tuning tools, AntiPhishing.

UNIT III

Security in conventional operating systems - Memory, time, file, object protection requirements and techniques Identification and authentication. Trusted operating systems.

UNIT IV

Database management systems security - Database integrity , Database secrecy , Inference control , Multilevel databases.

UNIT V

Network security - Network threats: eavesdropping, spoofing, modification, denial of service attacks, Introduction to network security techniques: firewalls, intrusion detection systems. Cyber crimes and control measures.

TEXT BOOK/ REFERENCES

1. Charles P. Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies, Security in Computing", 5 th Ed, Prentice hall, 2015.
2. Michael E. Whitman, 'Information Security: incident response and disaster recovery', Cengage Learning, 2009
3. WM. Arthur Conklin, Gregory B. White, Chuck Cotheren, Dwayne Williams, Roger Lavis,"Principles of Computer Security", 4 th Ed,Mc Graw Hill 2016.

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23-344-0216 Linux and Shell Programming

Course Outcomes

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

CO1	Explain various Linux commands that are used to manipulate system operations.	(Cognitive level : Understand)
CO2	Discuss the File Systems and Process Management of Linux.	(Cognitive level : Understand)
CO3	Implement network programming using Linux system calls.	(Cognitive level : Apply)
CO4	Use Perl/Tcl to create and run scripts.	(Cognitive level :Apply)
CO5	Implement scripts to automate tasks on Linux.	(Cognitive level :Apply)

Mapping of course outcomes with programme outcomes **Low=1, Medium=2, High=3**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO1 2	PSO1	PSO 2
CO1	3												2	2
CO2	2	2											2	2
CO3	3	2	3										2	2
CO4	3		3										2	2
CO5	2	2	3										2	2

UNIT 1

Introduction to Linux, Linux File System- index node, system calls for file management. General usage of Linux kernel & basic commands. Linux users and group, permissions for file, directory and users, searching a file & directory, zipping and unzipping concepts.

UNIT II

Processes in Linux - process fundamentals, process states, process table. Inter process communication-signals, pipes, redirecting input/output. Background processing, managing multiple processes, process scheduling.

UNIT III

Introduction to networking in Linux, Network basics & tools, File transfer protocol in Linux, Network file system, Domain Naming Services, Dynamic host configuration protocol & Network information services.

UNIT IV

Introduction to Perl scripting, working with simple values, lists and hashes, loops and decisions, regular expressions, files and data in Perl scripting, references & subroutines, running and debugging Perl, modules, object-oriented Perl.

UNIT V

Tcl/Tk Scripting - Tcl fundamentals, string and pattern matching, Tcl data structures, control flow commands, procedures and scope, reflection and debugging, script libraries, Tk fundamentals, the pack geometry manager, binding commands to X Events, buttons and menus, simple Tk widgets, entry and list box widgets, grabs and dialogs.

TEXT BOOK/ REFERENCES:

1. Red Hat Linux Bible- Cristopher Negus, Wiley Dreamtech India, 2005.
2. UNIX Shell Programming, Yeswant Kanethkar, First edition, BPB, 2003.
3. Red Hat Enterprise Linux 4: System Administration Guide, Red Hat, Inc, 2005
4. Practical Programming in Tcl and Tk, Fourth Edition – Ken Jones, Brent Welch, Pearson 4th Edition, 2003.
5. Teach Yourself Perl 5 in 21 days– David Till, Sams Publishing; 2nd Edition, 1996

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Elective II

23-344-0311 Reinforcement Learning

Course Outcomes:

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

CO1	Explain the basics of Reinforcement learning	(Cognitive level : Understand)
CO2	Solve problems related to Q learning algorithm	(Cognitive level : Apply)
CO3	Apply SARSA algorithm on any given gaming platform	(Cognitive level : Apply)
CO4	Discuss about the architecture and working of DQN	(Cognitive level : Understand))
CO5	Describe the basis concepts of policy based reinforcement learning	(Cognitive level : Understand)

Mapping of course outcomes with programme outcomes **Low=1, Medium=2, High=3**

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

UNIT I

Reinforcement learning Problem: Elements of Reinforcement Learning, The theoretical foundations of RL: Markov decision processes, The Markov process, Markov reward processes, Adding actions. Exploration and Exploitation dilemma, Epsilon Greedy Algorithm, Model free and Model based RL algorithms, On policy and Off Policy, Value based and Policy Based RL Methods, Dynamic Programming.

UNIT II

Value functions and Bellman Equations, Temporal Difference learning: TD Prediction, Advantages of TD Prediction Methods, Q learning algorithm.

UNIT III

Monte Carlo Methods, Monte Carlo Prediction, Monte Carlo Estimation of Action Values, Monte Carlo Control, SARSA algorithm.

UNIT IV

Function Approximation method, DQN architecture, DQN algorithm, Double DQN.

UNIT V

Policy Based Reinforcement learning, Deep Deterministic Policy Gradient, Action Critic Method, Proximal Policy Optimization, World Model.

TEXTBOOK/REFERENCES:

1. Reinforcement Learning: An Introduction 2ND EDITION, Richard S. Sutton and Andrew G. Barto
2. Deep reinforcement learning Hands-on , Maxim Lapan,PACKET.
3. Reinforcement Learning: Industrial Applications of Intelligent Agents (Grayscale Indian Edition), Phil Winder (Author)

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23-344-0312 - Blockchain Technology

Course Outcomes:

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

CO1	Explain the concept of decentralization, its impact and relationship with blockchain technology	(Cognitive level : Understand)
CO2	Explain the inner workings of blockchain and relevant mechanisms behind Bitcoin and alternative cryptocurrencies	(Cognitive level : (Understand)
CO3	Create and execute smart contracts	(Cognitive level : Create)
CO4	Apply hyperledger Fabric and Ethereum platform to implement the Block chain Applications	(Cognitive level : Apply)
CO5	Examine innovative application models, leveraging the blockchain technology	(Cognitive Level:Analyze)

Mapping of course outcomes with program outcomes - **Low=1, Medium=2, High=3**

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

UNIT 1

Distributed Ledger Technology, Decentralization, Bitcoin Network and Architecture, Block in a Blockchain, Advantages over Traditional Databases, Mining Mechanism, Types of Blockchain: Public, Private, Consortium, Cryptography: Public and private keys, Discrete logarithm problem, Elliptic Curve Cryptography, ECC using Openssl,

Hash Functions, Merkle Tree, Merkle Patricia Trie, Digital Signature, Wallets and Keys, User Addresses and Privacy.

UNIT II

History, Distributed ledger, Creation of Coins, Double spending, Bitcoin protocols, Transaction in Bitcoin Network, Bitcoin payments, Bitcoin investment and buying and selling bitcoins, Bitcoin installation, Setting up a bitcoin node, Setting up the source code, Setting up bitcoin.conf, Starting up a node in testnet, Starting up a node in regtest, Starting up a node in live mainnet, Experimenting with bitcoin-cli, AltCoins, Ethereum, EVM, Accounts, Transactions, Gas, Fees, Smart Contracts, Eth 2.0

UNIT III

Definitions, Types of Mining Algorithms, Proof of Work, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of Elapsed Time, Proof of Burn. Sharding Chains, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.

UNIT IV

Setting up Ethereum Node using Geth Client, Smart Contracts and DApps, Truffle, Ganache CLI, Metamask, Remix, Solidity, Writing and Deploying Smart Contracts in Solidity, Connection to Web3.js Library, Vulnerabilities in Smart Contracts, Attacks, Prevention of Attacks, Decentralized Autonomous Organization (DAO), Building an Initial Coin Offering (ICO), Blockchain application development: Hyperledger Fabric-Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric, Writing smart contract using Ethereum, Overview of Ripple and Corda.

UNIT V

Understanding Blockchain for Enterprises: Permissioned Blockchain: Permissioned model and use cases, Design issues for Permissioned blockchains, Execute contracts, State machine replication, Overview of Consensus models for permissioned blockchain-Distributed consensus in closed environment, Paxos, RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, Lamport-Shostak-Pease BFT Algorithm, Enterprise application of Blockchain: Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Blockchain, Blockchain enabled Trade, Supply Chain Financing, Identity on Blockchain, Voting System, and Healthcare, anomaly detections, serverless blockchain, blockchain on cloud.

TEXT BOOKS/REFERENCES

1. Mastering Bitcoin: Unlocking digital crypto currencies", ORELLY,2015.
2. Joseph J. Bambara and Paul R. Allen, Blockchain – A practical guide to developing business, law, and technology solutions, McGraw Hill, 2018.
3. Melanie Swan, Blockchain – Blueprint for a new economy, OReilly publishers, 2018.
4. Mastering Blockchain, by Lorne Lantz, Daniel Cawrey, Publisher(s): O'Reilly Media, Inc.ISBN: 9781492054702
5. Mastering Blockchain, Imran Bashir, Packt Publishing Ltd, ISBN-10 1787129292, 2017.
6. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.

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23-344-0313 - Computer Vision

Course Outcomes:

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

CO1	Explain digital image formation and representation and apply low level image processing	(Cognitive level: Understand)
CO2	Perform Feature detection	(Cognitive level: Apply)
CO3	Perform Image segmentation, Feature based alignment and image stitching.	(Cognitive level: Apply)
CO4	Employ motion estimation and develop structure from motion.	(Cognitive level: Apply)
CO5	Perform depth estimation, 3-D reconstruction, Image-based renedering, and Case study on recognition systems	(Cognitive level: Apply)

Mapping of course outcomes with programme outcomes - **Low=1, Medium=2, High=3**

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

UNIT I

Digital Image Formation and Representation: Fundamentals of Image Formation, Geometric Primitives and Transformations: Orthogonal, Euclidean, Affine, Projective; Photometric Image Formation, Digital Camera, Low-level Image processing: Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

UNIT II

Feature Detection: Edges - Canny, Laplacian of Gaussian(LoG), Difference of Gaussian(DoG); Lines - Hough Transform, Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

UNIT III

Image Segmentation: Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, Markov Random Field Segmentation, Texture Segmentation; Feature-based Alignment: 2D and 3D Feature-based alignment, Image stitching.

UNIT IV

Motion estimation – Translational alignment, Parametric motion, Spline-based motion, Optical flow, Layered motion. Structure from motion: Geometric intrinsic, Pose estimation, Two-frame structure from motion, Factorization, Bundle adjustment, constrained structure and motion.

UNIT V

Depth estimation: Epipolar Geometry, Sparse Correspondence, Dense Correspondence, Local Methods, Global optimization; 3-D reconstruction, Image-based rendering, Case study on recognition systems.

TEXT BOOK

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003.

REFERENCE BOOKS

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.
3. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.
4. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006

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23-344-0314 Medical Image Analysis

Course Outcomes:

After the completion of the course the student will be able to :

CO 1	Explain principles of medical imaging and medical image analysis softwares.	Cognitive Level: Understand
CO 2	Explain noise reduction in medical images and medical image restoration.	Cognitive Level: Analyze
CO 3	Employ medical image segmentation.	Cognitive Level: Apply
CO 4	Describe feature descriptors and perform feature analysis	Cognitive Level: Analyze
CO 5	Describe different case studies for medical modalities	Cognitive Level: Analyze

Mapping of course outcomes with program outcomes **(Low=1, Medium =2, High=3)**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS02
CO1	3				2	3				1			2	
CO2	3	2	2		2	3				1			2	
CO3	3	2	2		2	3				1			2	
CO4	3	2	2		2	3				1			2	3
CO5	3	2	2		2	3				1			2	3

UNIT I (7 Hours)

Components of Digital Image Processing, Sampling and Quantisation, Principles of Medical imaging, Medical Imaging modalities, Image analysis softwares.

UNIT II (8 Hours)

Types of Noises and Filters used for Noise Reduction, Spatial Domain Filters, Frequency Domain Filters, Image Restoration, Degradation Model, Estimation of Degradation Function, Blur Model, Medical Image Restoration, Blur Identification, Super – Resolution Method.

UNIT III (10 Hours)

Image Segmentation: Segmentation categories, Points Detection, Line Detection, Edge Detection Methods, Thresholding and Edge Thinning, Histogram Based Image Segmentation, Segmentation using Split and Merge Method, Region Growing Method, Watershed Method, K- Means Clustering Method, Self similar Fractal Method, Topological Derivate Based segmentation, Comparison of Segmentation Methods. Systematic Evaluation and Validation on dataset.

UNIT IV (8 Hours)

Selection of Features and feature extraction, Relevant features in medical images, Shape Related Features, Fourier Descriptors, Texture analysis, Detection of Tissues, Analysis of Tissue Structure.

UNIT V (10 Hours)

MR brain image classification, Mammogram image segmentation, Image enhancement in retinal images, Medical image compression, Histopathological blood cell image analysis, Nodule detection in lung images, Cancer detection in skin images. Case studies on some recent advances in analysis and detections on retinal, CT, MRI, ultrasound and histology images.

TEXTBOOKS/REFERENCES

1. Sinha G. R, Patel, B. C.(2014).Medical Image Processing: Concepts and Applications(1sted.) Prentice Hall.
2. Rangayyan R M.(2005).Biomedical Image Analysis(5th ed.).CRC Press.
3. Gonzalez R C, Woods R E.(2018).Digital Image Processing (4th ed.). Pearson.
4. Thomas Martin Deserno (2014). Biomedical Image Processing. Springer.

Web Resources

https://archive.nptel.ac.in/courses/108/105/108105091/

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23-344-0215 Social Network Analysis

Course Outcomes:

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

CO1	Interpret social networks.	Cognitive level: Understand
CO2	Explain different terminologies of graph and representation of graphs.	Cognitive level: Understand
CO3	Calculate centrality, betweenness centrality and directional relations.	Cognitive level: Apply
CO4	Explain structural relations	Cognitive level: Understand
CO5	Analyze social networks using UCINET, PAJEK, ETDRAW, StOCNET, SplusR, NodeXL,SIENA and RSIENA.	Cognitive level: Analyse

Mapping of course outcomes with programme outcomes **Low=1, Medium=2, High=3**

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

Unit I

Introduction to Social Network Analysis, Mathematical representations of Social Networks: Notations for Social Network data – Graph theoretic, sociometric. Graphs – Subgraphs, Dyads, Triads, Nodal degree, Density, Walks, trails and paths, Connected graphs and components, Geodesics, distance and diameter, Connectivity, Isomorphic graphs and subgraphs.

Unit II

Directed graphs – Dyads, Nodal indegree and outdegree, Density, directed walks, paths and semi paths, Reachability and connectivity, Geodesics, distance and diameter. Signed graphs and signed directed graphs Matrices – for graphs, digraphs, valued graphs, two-mode networks, Basic matrix operations, Computing simple network properties.

Unit III

Centrality: Actor centrality, Nondirectional relationships – degree, closeness, betweenness centrality, Directional relations – centrality.

Unit IV

Structural relationships – strong and weak ties, homophily, positive and negative relationships, Link analysis.

Unit V

Network dynamics – cascading behavior, small-world phenomenon, epidemics. Tools for Social Network Analysis - UCINET-PAJEK-ETDRAW-StOCNET- Splus-R-NodeXL-SIENA and RSIENAReal world Social Networks (Facebook-Twitter etc.)

Text Books

1. Social Network Analysis: Methods and Applications, Book by Katherine Faust and Stanley Wasserman Cambridge ; New York : Cambridge University Press, 8th series.
2. Networks, Crowds, and Markets: Reasoning about a Highly Connected World Book by David Easley and Jon Kleinberg
3. Social and Economic Networks Book by Matthew O. Jackson, Illustrated, 21 November 2010

Web Resources

1. NPTEL: https://onlinecourses.nptel.ac.in/noc19_cs66/preview
2. Courseera: https://www.coursera.org/learn/social-network-analysis
3. EDX/UPGRAD: https://www.edx.org/course/social-network-analysis-sna

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23-344-0316 - Computer Forensics

Course Outcomes

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

CO1	Describe different types of threats related to digital information and the relevance of Digital evidence for crime investigation and Explain systematic approach to computer investigations.	(Cognitive level : Understand)
CO2	Apply forensic procedure to collect and recover digital evidence using tools.	(Cognitive level : Apply)
CO3	Judge the validity of digital evidence before presenting using cryptographic hashes.	(Cognitive level : Analyze)
CO4	Apply various tools and commands for capturing digital evidence.	(Cognitive level : Apply)
CO5	Describe steps to follow for network , email and mobile forensics.	(Cognitive level : Understand)

Mapping of course outcomes with programme outcomes - **Low=1, Medium=2, High=3**

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

UNIT I

Introduction to traditional Computer Crime, Problems associated with computer crime, Identity Theft, Identity fraud. Computer Forensics Fundamentals- Type of Computer Forensics Technology. Type of Vendor and Computer Forensics Services,Scientific method in forensic analysis.

UNIT II

Digital Evidence in Criminal Investigations, the digital crime scene, Investigating Cybercrime, Duties Support Functions and Competencies.
Computer investigation and Data Acquisition, Computer Forensics Evidence and CaptureData Recovery-Evidence collection and Data Seizure-Duplication and preservation of Digital Evidence-Computer image verification and Authentication.

UNIT III

Introduction to Incident - Incident Response Methodology - Steps, Activities in Initial Response Phase after detection of an incident, Creating response toolkit

UNIT IV

Initial Response & Volatile Data Collection from Windows system - Initial Response & Volatile Data Collection from Unix system - Forensic Duplication, Forensic Duplicates as Admissible Evidence, Forensic Duplication Tool Requirements, Creating a Forensic Duplicate, Forensic Duplicate of a Hard Drive.

UNIT V

Collecting Network Based Evidence - Investigating Routers - Network Protocols - Email Tracing - Internet Fraud. Hackers Tools. Cellphone and mobile device forensics. Forensics hardwares and softwares, Information Security Investigations, Corporate Cyber Forensics,Investigating large scale Data breach cases, Analyzing Malicious software.

TEXT BOOK

1. John R. Vacca, Computer Forensics: Computer Crime Scene Investigation Laxmi Publications, 2015 reprint. .

REFERENCES

1. Dr.Darren R Hayes, A Practical guide to Computer Forensics investigation, Pearson 2015.
2. Aaron Philipp, David Cowen, Chris Davis , Computer Forensics Secrets & Solutions , McGraw-Hill Osborne Media, 2006.
3. Kenneth C.Brancik “Insider Computer Fraud” Auerbach Publications Taylor & Francis Group–2008.
4. Bill Nelson,Amelia Philips and Christopher Steuart, “Guide to computer forensics and investigations”, Cengage Learning; 4th edition, 2009.
5. Dejey , Murugan ,” Cyber Forensics”, OXFORD,2018.

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23-344-0317 Design Thinking

Course Outcomes:

After the completion of the course the student will be able to:

CO 1	Relate between Design Thinking and Design Feeling	Cognitive Level: Understand
CO 2	Demonstrate Importance of Emotionally Intelligent Design by Analyzing Cases	Cognitive Level: Analyze
CO 3	Use design feeling in practice	Cognitive Level: Apply
CO 4	Experiment to Develop, allocate and respect the right space of Humans and Machines while maintaining the relationship in a Project	Cognitive Level: Apply
CO 5	Build and use Artificial Intelligence applications considering emotions – empathetic technology	Cognitive Level: Apply

Mapping of course outcomes with program outcomes - **Low=1, Medium=2, High=3**

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

UNIT I (9 Hours):

Our emotional relationship with technology – Inventing our best lives, The present : it’s complicated, Design designs us, Why emotionally Intelligent Design.

The history and future of Emotional Design – All the feels, in theory, Emotional design and Technology, Emotion + AI, A checklist for designing with Emotion AI, Human + Machine = Higher Emotional Intelligence.

UNIT II (9 Hours):

Designing, with feeling – Emotionally Intelligent Design Principles, Design Feeling in practice, Find feeling, envision experience, Evolve the relationship, live and reflect, Design Feeling is the new Design Thinking.

UNIT III (9 Hours)

Cultivate Human-Machine Harmony – Understanding the new humans, let machines be machines, Humanize machines, just a little bit, Build relationships, not dependency, Avoiding automating humans, New Human-Machine relationship goals.

UNIT IV (9 Hours):

Crafting Emotional Interventions – Strategies for living digital, Interventions with EQ, Self-Awareness interventions, Self-Management Interventions, Self – Catalyzing Interventions, Self – awareness Interventions, Self – Relationship Interventions, Self – Transcending Interventions, Track progress, Interventions Bolster Emotionally Intelligent Design.

UNIT V (9 Hours):

Forecasting the future with feelings, the trouble with the future, A future fuelled by emotion, Start with future -you,

Create future things, Future thinking as emotional time bending. Towards an emotionally-intelligent future – Emotional Intelligence at scale, A new hope for empathetic technology.

TEXTBOOKS/REFERENCES

1. Pavliscak, Pamela. Emotionally intelligent design: Rethinking how we create products. " O'Reilly Media, Inc.", 2018.
2. Lewrick, Michael, Patrick Link, and Larry Leifer. The design thinking toolbox: A guide to mastering the most popular and valuable innovation methods. John Wiley & Sons, 2020.
3. Brown, Tim. Change by design, revised and updated: how design thinking transforms organizations and inspires innovation. HarperCollins, 2019.
4. Yayici, Emrah. Design thinking methodology book. ArtBizTech, 2016.

5. Tenner, Edward. “The design of everyday things by Donald Norman.” Technology and Culture 56.3 (2015): 785-787.

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Elective III

23-344-0318 - Explainable Artificial Intelligence

Course Outcomes:

After completion of this course, the students will be able to

CO1	Explain the need of Explainable AI in the context of machine learning	(Cognitive level : Understand)
CO2	Analyze Global and local explanations using SHAP and LIME	(Cognitive level : (Analyze)
CO3	Develop interpretable CNN, use unsupervised learning to perform exploratory analysis on a model	(Cognitive level : Analyze)
CO4	Analyze counterfactual, contrastive XAI and interpret methods for multivariate forecasting and sensitivity analysis	(Cognitive level : Analyze)
CO5	Evaluate adversarial (evasion and poisoning) attacks on machine learning models	(Cognitive Level:Analyze)

Mapping of course outcomes with programme outcomes **Low=1, Medium=2, High=3**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2		1		2	2				1			3	2
CO2	2	3	2	2	3					1			3	2
CO3	2	3	2	2	3					1			3	2
CO4	2	3	2	2	3					1			3	2
CO5	2	3	2	2	3	2				1			3	2

UNIT I (7 Hours):

Machine Learning and Explainable AI, Need for XAI, Explainability and interpretability,XAI flow, Making ML models Explainable: Intrinsic Explanations, Post Hoc Explanations,Global or Local Explainability, Properties of Explanations.

UNIT II (8 Hours):

Intrinsic Explainable models: Loss Function, Linear Regression, Logistic Regression, Decision Trees, KNN. Model Agnostic Methods For XAI: Global Explanations, Local Explanations, shap.KernelExplainer, Text Explainer, Gradient Explainer, Local Linear Surrogate Models (LIME): mathematical representation, Bagging classifier, Boosting classifier, Decision Tree, Extra Trees, Creating Lime Explainer, SHAP for Boosted Trees

UNIT III (10 Hours):

Explaining Deep Learning Models: Agnostic Approach-Adversarial features, Augmentations, Occlusions as augmentations, Occlusion as an Agnostic XAI method. Opening Deep Networks: Layer Explanation,CAM and Grad-CAM,Deep Shap/DeepLift, Explainability batch normalizing layer by Layer, Unsupervised methods

UNIT IV (10 Hours):

Counterfactual Explanations Method: Visualizing datapoint using What-If-Tool, Exploring data points, the logic of counterfactual explanations, contrastive explanations method (CEM), CEM applied to example dataset using CNN, Interpretation methods for multivariate forecasting and sensitivity analysis: accessing time series models with traditional interpretation, Generating LSTM attribution with integrated gradients, compute local and global attribution

UNIT V (10 hours):

Understanding the effect of irrelevant features, feature engineering, detecting and mitigating bias, Adversarial attacks, evasion attacks, defending against targeted attacks with preprocessing, Shielding against evasion attacks via adversarial training, evaluating and certifying adversarial robustness.

TEXT BOOKS

1. Explainable AI with Python, Antonio Di Cecco and Leonida Gianfagna, Springer
2. Hands-On Explainable AI (XAI) with Python: Interpret, visualize, explain, and integrate reliable AI for fair, secure, and trustworthy AI apps, Denis Rothman, Packt publisher
3. Interpretable Machine Learning, by Christoph Molnar https://christophm.github.io/interpretable-ml-book/

4. Interpretable Machine Learning with Python: Learn to build interpretable high-performance models with hands-on real-world examples, by Serg Masís , Packt publisher

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23-344-0319 Quantum Computing

Course Outcomes:

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

CO1	Describe the basic concepts of Quantum Computing.	(Cognitive level: Understand)
CO2	Design quantum circuits using qubit gates.	(Cognitive level: Apply)
CO3	Understand basic quantum computing algorithms.	(Cognitive level: Understand)
CO4	Apply quantum cryptographic algorithms.	(Cognitive level: Apply)
CO5	Analyse the characteristics of Quantum Computing Systems.	(Cognitive level: Analyze)

Mapping of course outcomes with programme outcomes - **Low=1, Medium=2, High=3**

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

UNIT I:

Introduction to Quantum Computation:- The Quantum Mechanics of Photon Polarization, Single-Qubit Quantum Systems, Quantum State Spaces, Entangled States, Multiple-Qubit Systems, Measurement of Multiple-Qubit States, EPR Paradox and Bell's Theorem,

Bloch sphere. Quantum mechanics, Probabilities and measurements, entanglement, density operators and correlation, Measurements in bases other than computational basis.

UNIT II:

Quantum correlations: Bell inequalities and entanglement, Schmidt decomposition, super-dense coding, teleportation, PPT criterion. Quantum Circuits: single qubit operations, multiple qubit gates, Universal quantum gates, design of quantum circuits. Unitary Transformations, Unitary Transformations as Quantum Circuits, Reversible Classical Computations to Quantum Computations, Language for Quantum Implementations.

UNIT III:

Quantum Algorithms: Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Computing with Superpositions, Quantum Subroutines, Quantum Fourier Transformations, Shor's Algorithm and Generalizations, Grover's Algorithm and Generalizations, Deutsch's algorithm, Deutsch's-Jozsa algorithm, quantum search.

UNIT IV:

Quantum Information and Cryptography: Limitations of Quantum Computing, Alternatives to the Circuit Model of Quantum Computation, Quantum Protocols, Simulating Quantum Systems, Shannon entropy, noiseless coding, Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem.

UNIT V:

Quantum Subsystems, Properties of Entangled States, Quantum Error Correction, Graph states and codes, CSS Codes, Stabilizer Codes, Flip code, The Shor code, Quantum error correction, Stabilizer codes, Hamming bound Fault Tolerance and Robust Quantum Computing.

TEXT BOOKS/REFERENCES :

1. Michael A. Nielsen, Issac L. Chuang, "Quantum Computation and Quantum Information", Tenth Edition, Cambridge University Press, 2010.
2. N. David Mermin, "Quantum Computer Science: An Introduction", Cambridge University Press, 2007.
3. Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 2013.
4. J. Hidary, Quantum Computing: An Applied Approach, 1 st Edition, Springer Publishing, 2019.

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23-344-0320 Human Computer Interaction

Course Outcomes:

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

CO1	Explain the basic of Human Computer Interaction	(Cognitive level : Understand)
CO2	Describe the design rules used in HCI	(Cognitive level : Understand)
CO3	Compare the design principles of user interfaces	(Cognitive level : Analyse)
CO4	Describe mobile HCI	(Cognitive level : Understand))
CO5	Apply HCI tools	(Cognitive level : Apply)

Mapping of course outcomes with programme outcomes **Low=1, Medium=2, High=3**

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

UNIT I:

Introduction to fundamentals of Human Computer Interaction: The Human: I/O Channels, Memory, Reasoning And Problem Solving; The Computer: Devices, Memory, Processing And Networks; Interaction: Models, Frameworks, Ergonomics, Styles, Elements, Interactivity, Paradigms, User Experience Design (UXD)

UNIT II:

Humans in HCI, Computers in HCI, Designing Human-Computer Interactions, Designing for Diversity The Development Process, Emerging Phenomena in HCI.

Interactive Design: Basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process: Software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules: principles, standards, guidelines, rules. Evaluation Techniques – Universal Design

UNIT III:

HCI Models: Cognitive models: Socio-Organizational issues and stakeholder requirements – Communication and collaboration models-Hypertext, Multimedia and WWW.

Visual Design Principles for Usable Interfaces, Globalization, Localization, and Cross-Cultural User-Interface Design, Speech and Language Interfaces, Applications, and Technologies, Multimedia User Interface Design, Multimodal Interfaces.

UNIT IV:

Mobile HCI: Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools. - Case Studies

UNIT V:

Web Interface Design: Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow - Case Studies.

Fundamentals of HCI Tools like Google Glass, Kinect, Oculus Rift, Myo, Leap Motion, Sense 3D, Guile 3D Studio, Face-Shift and its Implementation. Use of ambient, wearable and vision based sensors and IoT appplications for smart building, smart campus, smart class, smart city, smart home etc.

TEXTBOOK/REFERENCES:

1. Julie A. Jacko, The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications, 3rd Edition, CRC Press, 2012.
2. Samit Bhattacharya, "Human-Computer Interaction: User Centric Computing for Design", McGraw Hill Education (India) Pvt. Ltd, First Edition, 2019.

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23-344-0321 - Natural Language Processing

Course Outcomes:

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

CO1	Describe language models in NLP	Cognitive Level: Understand
CO2	Explain preprocessing steps in NLP and describe grammars and how a language is built based on grammar	Cognitive Level: Understand
CO3	Employ various vectorization techniques and apply them in various datasets	Cognitive Level: Apply
CO4	Explain Neural Language Models and apply supervised ML techniques to various datasets	Cognitive Level: Apply
CO5	Describe various DL techniques that are used with NLP	Cognitive Level: Understand

Mapping of course outcomes with program outcomes - **Low=1, Medium=2, High=3**

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

UNIT I

Regular Expressions, Text Normalization, Edit Distance, Regular Expressions, Words, Corpora, Text Normalization, Minimum Edit Distance, N-gram Language Models, N-Grams, Evaluating Language Models.

UNIT II

Preprocessing: Handling corpus-raw text - Stemming and Lemmatization for raw text, Stop word removal, Feature Engineering: Understanding feature engineering, Basic

feature of NLP - Parsers and parsing, Types of grammar, POS tagging and POS taggers, n-grams, Bag of words, TF-IDF, Encoders, and decoders, Probabilistic models.

UNIT III

Advanced Feature Engineering: Word embedding, Understanding the basics of word2vec, Understanding the components of the word2vec model, Main processing algorithms - CBOW, Skip-gram, Applications of word2vec, and simple examples.

UNIT IV

Neural Networks and Neural Language Models: Training Neural Nets, Neural Language Models

Understanding ML algorithms for NLP: Supervised ML algorithms: Decision tree, Random forest, Naive Bayes, Support vector machines.

UNIT V

Deep Learning Architectures for Sequence Processing: Recurrent Neural Networks, Managing Context in RNNs: LSTMs and GRUs, Self-Attention Networks: Transformers

Case studies: Word sense disambiguation system, Automatic Question Answering system.

TEXTBOOK

1. Jurafsky, Dan. Speech & language processing. Pearson Education India, 2020.
2. Thanaki, Jalaj. Python natural language processing. Packt Publishing Ltd, 2017.

REFERENCE BOOKS

1. Goldberg, Yoav. "Neural network methods for natural language processing." Synthesis lectures on human language technologies 10.1 (2017): 1-309.
2. Manning, Christopher, and Hinrich Schutze. Foundations of statistical natural language processing. MIT Press, 1999.
3. Kulkarni, Akshay, and Adarsha Shivananda. Natural language processing recipes: Unlocking text data with machine learning and deep learning using python. Apress, 2019.

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23-344-0322 - Pattern Recognition

Course Outcomes:

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

CO1	Describe basics of Probability, Random Processes and Linear Algebra, Machine perception and pattern recognition system	(Cognitive level: Understand)
CO2	Perform Bayes Decision Theory and apply Parameter Estimation Methods	(Cognitive level: Understand)
CO3	Apply unsupervised learning and clustering	(Cognitive level: Apply)
CO4	Apply sequential pattern recognition and dimensionality reduction	(Cognitive level: Apply)
CO5	Apply Linear discriminant functions and Non-metric methods for pattern classification	(Cognitive level: Apply)

Mapping of course outcomes with programme outcomes - **Low=1, Medium=2, High=3**

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

UNIT I

Basics of Probability, Random Processes and Linear Algebra: Probability: independence of events, conditional and joint probability, Bayes' theorem; Random Processes: Stationary and nonstationary processes, Expectation, Autocorrelation, Cross-Correlation, spectra; Linear Algebra: Inner product, outer product, inverses, eigenvalues, eigen vectors, singular values, singular vectors.

UNIT II

Machine perception, Pattern recognition systems, Design cycle, Learning and adaptation, Bayes Decision Theory: Minimum-error-rate classification, Classifiers, Discriminant functions, Decision surfaces, Normal density and discriminant functions, discrete features, Parameter Estimation Methods: Maximum-Likelihood estimation: Gaussian case; Maximum a Posteriori estimation; Bayesian estimation: Gaussian case.

UNIT III

Unsupervised learning and clustering: Criterion functions for clustering; Algorithms for clustering: K-Means, Hierarchical and other methods; Cluster validation; Gaussian mixture models; Expectation-Maximization method for parameter estimation; Maximum entropy estimation.

UNIT IV

Sequential Pattern Recognition: Hidden Markov Models (HMMs); Discrete HMMs; Continuous HMM, Nonparametric techniques for density estimation: Parzen-window method; K-Nearest Neighbour method. Dimensionality reduction: Fisher discriminant analysis; Principal component analysis; Factor Analysis.

UNIT V

Linear discriminant functions: Gradient descent procedures; Perceptron; Support vector machines, Non-metric methods for pattern classification: Non-numeric data or nominal data; Decision trees: CART, algorithm independent machine Learning, bias and variance regression and classification classifiers.

TEXT BOOK

1. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001
2. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009
3. C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006

REFERENCE BOOKS

1. Earl Gose , Steve Jost, “Pattern Recognition and Image Analysis”, PEARSON,2015.
2. Robert J.Schalkoff, Pattern Recognition Statistical, Structural and Neural Approaches,John Wiley & Sons Inc., New York, 1992
3. V. S. Devi, M. N. Murty, “Pattern Recognition: An Introduction”, Universities Press,Hyderabad, 2011.

4. Robert J. Schalkoff, “Pattern Recognition : Statistical Structural and Neural Approaches”,John Wiley & Sons Inc., New York, 1992.
5. Tou and Gonzales, “Pattern Recognition Principles”, Wesley Publications Company,London 1974.

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23-344-0323 Data Analytics for Healthcare

Course Outcomes:

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

CO1	Explain the basics concepts of Electronic healthcare data	(Cognitive level : Understand)
CO2	Apply Strategies for optimizing healthcare data quality	(Cognitive level : Apply)
CO3	Apply Phenotyping Algorithms	(Cognitive level : Apply)
CO4	Explain techniques for analysing healthcare data	(Cognitive level : Understand)
CO5	Develop efficient clinical decision support systems.	(Cognitive level : Create)

Mapping of course outcomes with program outcomes - Low=1, Medium=2, High=3

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

UNIT I:

Introduction: Electronic Health care data-Components, Coding Systems, Benefits, Challenges, Sources of data-Surveys, Clinical trials, Medical records, Claims, Other sources, Uses and limitations. Role of analytics in supporting a data-driven learning healthcare system.

UNIT II:

Examine epidemiological concepts in healthcare analytics, application, Health statistics mortality, morbidity, risk adjustment. Methods for selecting, preparing, querying and

transforming healthcare data. Strategies for optimizing data quality; querying tools and methods including data preparation and transformation techniques.

UNIT III:

Quality control in healthcare systems-tools for identifying quality problems, Simulation methods. Analyse and discover patterns, Medical genomics, Phenotyping Algorithms, Biomedical Image Analysis-Mining of Sensor Data in Healthcare.

UNIT IV

Biomedical Signal Analysis-Genomic Data Analysis for Personalized, Review of Clinical Prediction Models-Temporal Data Mining for Healthcare Data, Visual Analytics for Healthcare. Predictive Models for Integrating Clinical and Genomic Data-Information Retrieval for Healthcare-Privacy-Preserving Data Publishing Methods in Healthcare.

UNIT V

Applications: Data Analytics for Pervasive Health-Fraud Detection in Healthcare-Data Analytics for Pharmaceutical Discoveries-Clinical Decision Support Systems-ComputerAssisted Medical Image Analysis Systems- Mobile Imaging and Analytics for Biomedical Data.

TEXT BOOK

1. Chandan K. Reddy and Charu C Aggarwal, “Healthcare data analytics”, CRC press, 2015 2. Trevor L. Strome."Healthcare Analytics for Quality and Performance Improvement", Wiley,2103

REFERENCES

1. Clinical and Translational Science: Principles of Human Research" ,Elseiver,2nd Edition.

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23-344-0324 Ethical Hacking

Course Outcomes:

After the completion of the course the student will be able to:

CO 1	Describe different phases of Ethical Hacking	Cognitive Level: Understand
CO 2	Plan a vulnerability assessment and penetration test for a network	Cognitive Level: Analyze
CO 3	Apply semi-automated exploitation tools for web/database/binary vulnerabilities	Cognitive Level: Apply
CO 4	Report on the strengths and vulnerabilities of the tested network	Cognitive Level: Analyze
CO 5	Develop a understanding of the errors made by users, administrators, or programmers can lead to exploitable insecurities	Cognitive Level: Apply

Mapping of course outcomes with program outcomes- **Low=1, Medium=2, High=3**

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

UNIT I (10 Hours):

Ethical Hacking overview: The Phases of Ethical Hacking, Security audit steps, Gathering Target Information: Reconnaissance, Footprinting, Using Google to Gather Information, DNS Enumeration, Email Tracking, Maltego, Port Scanning, Manual Port

Scanning, Nmap: SYN, Stealth, XMAS, NULL, IDLE, and FIN scans, HTTP Tunneling, IP Spoofing techniques, Social Engineering, Banner Grabbing and OS Fingerprinting Techniques, Finding vulnerabilities: scanning with Nessus, running Nmap scripting, Web application scanning: Nikto, Attacking XAMPP.

UNIT II (10 Hours):

System Hacking: Password Cracking, Escalating Privileges, and Hiding Files, Trojans, Backdoors, Viruses, and Worms: Static Analysis, Static Analysis Challenges, Extending IDA Pro, Binary Analysis, Dynamic analysis using Cuckoo and memory analysis using volatility.

UNIT III (8 Hours):

Gathering Data from Networks: Sniffers, Bypassing the Limitations of Switches, Wireshark Filters, MAC Flooding and DNS Spoofing, Denial of Service, Session Hijacking: SSL attacks, Types of Web Server Vulnerabilities, SQL Injection, XPath Injection, Remote File Inclusion, Cross site scripting attacks, cross site request forgery attack.

UNIT IV (7 Hours):

Wireless Network Hacking: Authentication and Cracking Techniques, Wireless Sniffers to Locate SSIDs, MAC Filters and MAC Spoofing, Rogue Access Points, Wired Equivalent Privacy: weakness, cracking WEP keys with aircracking-ng, Securing Wireless Networks, Types of IDSs and Evasion Techniques, Firewall Types and Honeypot Evasion Techniques.

UNIT V (10 Hours):

Exploitation- techniques, buffer overflows, BASH, Format strings, Shellcode: User Space Shellcode, Shellcode encoding, Self-Corrupting Shellcode, Disassembling Shellcode, Kernel Space Shellcode, writing basic shellcode: port-binding shellcode, reverse connecting shellcode, SEH Overwrite Exploits, Passing Control to SEH, Finding the Attack String in Memory, POP POP RET, SafeSEH.

TEXTBOOKS/REFERENCES

1. Harper, Allen, Ryan Linn, Stephen Sims, Michael Baucom, Daniel Fernandez, Huáscar Tejeda, and Moses Frost. Gray hat hacking: the ethical hacker's handbook. McGraw-Hill Education, 2022.
2. Erickson, Jon. Hacking: the art of exploitation. No starch press, 2008.
3. Weidman, Georgia. Penetration testing: a hands-on introduction to hacking. No starch press, 2014

4. Graves, Kimberly. CEH certified ethical hacker study guide. John Wiley & Sons, 2010
5. Hacking Exposed 7: Network Security Secrets & Solutions byStuart McClure, Joel Scambray, edition 7, McGraw-Hill publishing, 2012
6. Hands on ethical hacking and network defense by Michael T Simpson, Kent Backman, James Corley, Cengage Learning, 2 edition, 2010

Web Resources

1. NPTEL course on Ethical Hacking by Prof.Prof. Indranil Sen Gupta, IIT Kharagpur, https://archive.nptel.ac.in/courses/106/105/106105217/
2. Ethical Hacking Essentials (EHE), offered by EC Council: https://in.coursera.org/learn/ethical-hacking-essentials-ehe
3. Hacking and Patching, by Prof. Edward Chow, University of Colorado Systems, https://in.coursera.org/learn/hacking-patching#syllabus

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23-344-0325 Software Quality Assurance

Course Outcomes:

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

CO1	Describe Software Quality Assurance and related concepts.	(Cognitive level: Understand)
CO2	Design Software Quality Plan	(Cognitive level: Apply)
CO3	Design SQA architecture for a Project	(Cognitive level: Apply)
CO4	Implement Software Test Case design and execution	(Cognitive level: Apply)
CO5	Examine different Quality Management Standards	(Cognitive Level: Analyze)

Mapping of course outcomes with programme outcomes - **Low=1, medium=2, High=3**

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

UNIT I

The Software Quality Challenge – The uniqueness of SQA, Environments for which SQA methods are developed. What is Software Quality? – Software, errors, faults and Failures, classification of causes of Software errors, Definitions of Software Quality and Software Quality Assurance, SQA and Software Engineering.

UNIT II

Software Quality factors – the need for comprehensive software quality requirements, classifications of software requirements into software quality factors. Software quality factors - Product operation, product revision, product transition, alternative models. compliance with quality factors.

Components of the Software Quality Assurance System – Overview – The SQA system – An SQA Architecture, Pre-project components, Software Project Life-Cycle components, Infrastructure components for error prevention and improvement. Management SQA components, SQA Standards, System certifications and assessment components, Organization for SQA – the human components, Considerations guiding construction of an organization's SQA System.

UNIT III

Development and Quality Plans – Development Plan and Quality Plan Objectives, Elements of the development plan, Elements of the Quality Plan, development and quality plans for small projects and internal projects.

Software Testing – Implementation – The testing Process, test case design, automated testing, Alpha and Beta site-testing programmes

Assuring the quality of external participants contributions – Types of external participants, risks and benefits of introducing external participants, assuring quality of external participant's contributions: objectives, SQA tools for assuring quality of external participant's contributions.

UNIT IV

CASE Tools and their effect on Software Quality – What is a CASE tool? The contribution of CASE tool to Software Product Quality, Contribution of CASE tools to Software Maintenance quality, Contribution of CASE tools to improved Project Management.

Procedures and work Instructions – The need for procedures and work instructions, The procedures and procedures manuals, Work instructions and Work instruction manuals, Procedures and Work Instructions: Preparation, implementation and updating.

Corrective and Preventive actions – Introduction: The "3s" development team revisited, corrective and preventive actions – definitions, process, Information collection, Analysis of collected information, Development of solutions and their implementation, follow-up of activities, Organizing for preventive and corrective actions.

UNIT V

Software Quality Metrics – Objectives of quality measurement, classification of Software Quality Metrics, Process and product Metrics, Implementation of Software Quality Metrics, Limitations of Software Metrics.

Quality Management Standards – The scope, ISO 9001 and ISO 900-3, Certification according to ISO 9000-3, Capability Maturity Models – CMM and CMMI assessment methodology, Bootstrap methodology, the SPICE project and ISO/IEC 15504 Software Process Assessment Standard.

SQA Project Process Standards – IEEE Software Engineering Standards – Structure and content of IEEE SE Standards, IEEE/EIA standard 12207 – Software Life Cycle Process, IEEE Standard 1012 – Verification and Validation, IEEE Standard 1028 - Reviews

TEXT BOOKS:

1. Galin, Daniel. Software quality: concepts and practice. John Wiley & Sons, 2018.
2. Basu, Anirban. Software quality assurance, testing and metrics. PHI Learning Pvt. Ltd., 2015.
3. Smith, Howard T. Garst. Software Quality Assurance: A Guide for Developers and Auditors. CRC Press, 2020.
4. Godbole, Nina S. Software quality assurance: Principles and practice. Alpha Science Int'l Ltd., 2004.
5. Goericke, Stephan. The future of software quality assurance. Springer Nature, 2020.

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Elective IV

23-344-0326 Affective Computing

(March 2023)

Course Outcomes:

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

CO1	Explain the various aspects of emotions	(Cognitive level : Understand)
CO2	Discuss the various applications of affective computing	(Cognitive level : Understand)
CO3	Describe in detail the phases in modeling of an affective system.	(Cognitive level : Understand)
CO4	Implement various emotion synthesis strategies	(Cognitive level : Apply))
CO5	Design various affective wearables	(Cognitive level : Apply)

Mapping of course outcomes with programme outcomes **Low=1, Medium=2, High=3**

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

UNIT I:

Emotions Are Physical and Cognitive: Physical vs. Cognitive, Terminology, Physical Aspects of Emotion: Sentic Modulation, Complicating Conditions: Physical Aspects of Emotion, Cognitive Aspects of Emotion: Primary vs. Secondary Emotions, Developing and Learning Emotions, Complicating Conditions: Cognitive Aspects of Emotion, Emotions and Memory.

UNIT II:

Affective Computers: Developing Emotions, Computers that Recognize Emotions, Evaluating Affect Recognition, Computers that Express Emotions, Computers that "Have" Emotions, Components of an Emotion System, Systems that have Emotional Intelligence, Imitating vs. Duplicating. Applications of Affective Computing: Affective Mirror, Text to Speech, Helping Autistic People, Consumer Feedback, Classroom Barometer.

UNIT III:

Modeling an Affective System, A Signal Representation for Emotions and Moods, Physiological Signals, Recognizing and Expressing Affect: Key Issues for Characterizing Affective Patterns, Modeling Affective Patterns. Models for Affective Behavior.

UNIT IV:

Emotion Synthesis: Emotion Synthesis via Cognitive Mechanisms, Emotion Synthesis via Multiple Mechanisms.

UNIT V:

Affective Wearables: Consumer Wearables, Prototype of an Affective Wearable Computer, Technology, Interface, and Human Factors Issues

TEXTBOOK/REFERENCES:

1. Affective Computing (The MIT Press) by Rosalind Picard
2. The Oxford Handbook of Affective Computing

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23-344-0327 Cyber Physical Systems

Course Outcomes:

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

CO1	Explain the core principles behind Cyber Physical Systems.	(Cognitive level : Understand)
CO2	Discuss the components of CPS platform.	(Cognitive level : Understand)
CO3	Examine the stability and performance of CPS systems.	(Cognitive level : Analyze)
CO4	Interpret the challenges involved in the design and validation of CPS.	(Cognitive level :Apply)
CO5	Solve real world problems in the CPS domain.	(Cognitive level :Apply)

Mapping of course outcomes with programme outcomes **Low=1, Medium=2, High=3**

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

UNIT 1

Cyber-Physical Systems (CPS) in the real world, Basic characteristics of the CPSs, Basic principles of design and validation of CPS, Industry 4.0, The Wireless Sensor Networks and the RFID devices as the actors of the CPSs. The Ubiquitous and the Pervasive Computing paradigm introduced by the CPSs. AutoSAR. IOT, IIOT implications.

UNIT II

CPS hardware platforms - Processors, Sensors, Actuators. CPS Network – Wireless Hart, CAN, Automotive Ethernet. CPS software stack – RTOS, scheduling real time control tasks, automated control.

UNIT III

Principles of dynamical system- dynamical systems and stability, controller design techniques, Stability Analysis: CLFs, MLFs, stability under slow switching, performance under packet drop and noise.

UNIT IV

CPS implementation issues- from features to software components, mapping software components to ECUs. CPS performance analysis - effect of scheduling, bus latency, sense and actuation faults on control performance, network congestion, building real-time networks for CPS. CPS case studies: Automotive, Healthcare and Green Building.

UNIT V

Formal methods for safety assurance of CPS: Advanced Automata based modelling and analysis, basic introduction and examples, timed and hybrid Automata, definition of trajectories. Formal analysis: flow pipe construction, reachability analysis. Analysis of CPS software: Weakest preconditions, bounded model checking. CPS software verification: Frama-C, CBMC. Secure task mapping and partitioning, state estimation for attack detection, case study - Vehicle ABS hacking, smart grids attack.

TEXTBOOKS/REFERENCES

1. Introduction to Embedded Systems – A Cyber Physical Systems Approach – E. A. Lee, Sanjit Seshia, MIT Press, Second Edition 2017.

2. Principles of Cyber-Physical Systems – Rajeev Alur, MIT Press, 2015.

3. Logical Foundations of Cyber-Physical Systems – André Platzer, Springer, 1st Edition, 2018

4. High-Performance Embedded Computing: Applications in Cyber-Physical Systems and Mobile Computing – Marilyn Wolf, Morgan Kaufmann; 2nd edition, 2014

5. Verification and control of hybrid systems: a symbolic approach - Paulo Tabuada, Springer-Verlag, 2009

6. Formal Modeling and Verification of Cyber-Physical Systems by Rolf Drechsler, Ulrich Kühne, Springer Nature, 2015

7. Computational Foundations of Cyber Physical Systems" (IIT KGP Course), SoumyajitDey (http://cse.iitkgp.ac.in/~soumya/cps/cps.html)

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23-344-0328 Bioinformatics

Course Outcomes:

After the completion of the course the student will be able to:

CO 1	Describe the basic concepts of molecular Biology, different biological databases & various data retrieval tools	(Cognitive level: Understand)
CO 2	Apply the sequence alignment algorithms for any given sequences.	(Cognitive level: Apply)
CO 3	Apply various algorithms of molecular phylogenetics	(Cognitive level:Apply)
CO 4	Analyze the primary and secondary protein structure prediction methods.	(Cognitive level: Analyze)
CO 5	Develop a solution using machine learning techniques for problems in Bioinformatics.	(Cognitive level: Create)

Mapping of course outcomes with programme outcomes **Low=1, Medium=2, High=3**

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

UNIT 1 [12 hrs.]

Basics of Molecular Biology- Cell as a unit of life-Nucleic Acid, Protein. Central Dogma of Molecular Biology, Genetic Code, Informatics in Biology- Bioinformatics and Computational Biology – Nature & Scope. Biological Databases – Primary DBs - Nucleotide Sequence databases, Protein Sequence databases. Secondary Dbs. Molecular Structure database. Literature database. Data Retrieval Tools – Entrez, SRS. Basic file formats- Ethical issues in Bioinformatics.

UNIT II [10 hrs.]

Sequence Alignment- Basic concepts of sequence similarity, identity and homology. Scoring schemes, Gaps. Pairwise Sequence Alignment and Multiple Sequence Alignment; Global and Local Alignments. PAM and BLOSUM matrices. Database Search: BLAST. Tools: EMBOSS Needle, Clustal Omega.

UNIT III [10 hrs.]

Molecular Phylogenetics –Need & applications, Dendrogram, Cladogram; Rooted/ Unrooted tree; Distance Based tree construction – UPGMA, NJ algorithm. Character Based Methods – Maximum Parsimony. Validating – Jack Knifing, Bootstrapping. Tree calibration, Tool: MEGA

UNIT IV [6 hrs.]

Structural Bioinformatics: Structure Visualization using Pymol. Protein Structure- Primary, Secondary – alpha helics, beta-sheets & turns, Tertiary and Quaternary structures. Protein Structure Prediction. Structure and function.

UNIT V [7 hrs.]

Overview of branches: Nature and Scope of Computational Genomics, Computational Proteomics, Systems Biology & Synthetic Biology, Computer-Aided Drug Design, Next Generation Sequencing. Applications of Machine Learning in Bioinformatics- classification and clustering problems. HMM in bioinformatics.

TEXT BOOKS

1. Lesk, Arthur, Introduction to genomics, Oxford University Press, 2017
2. Zvelebil, Marketa J., and Jeremy O. Baum. Understanding bioinformatics. Garland Science, 2007.
3. Xiong, Jin.Essential bioinformatics. Cambridge University Press, 2006.

Reference Books

1. Bergeron, Bryan P, Bioinformatics Computing, Prentice Hall Professional, 2003
2. Neil James, Pavel A Pevnezer, An Introduction to Bioinformatics Algorithms, MIT Press, 1st ed, 2004
3. Gibas , Cynthia, Developing bioinformatics computer skills, O'reilly 2003

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23-344-0329 Speech Processing

Course Outcomes:

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

CO1	Explain Speech production and characteristics of speech	(Cognitive level: Understand)
CO2	Apply mathematical transforms	(Cognitive level: Apply)
CO3	Explain Cepstrum	(Cognitive level: Understand)
CO4	Examine synthesis and manipulation of Audio Signals	(Cognitive level: Analyze)
CO5	Perform speech parameter estimation techniques	(Cognitive level: Apply)

Mapping of course outcomes with programme outcomes - **Low=1, medium=2, High=3**

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

UNIT I

Introduction, Principal characteristics of Speech, Linguistic Information, Speech and Hearing, Speech Production, Acoustic Characteristics of Speech, Statistical Characteristics of Speech. Fundamental Mathematics for Speech Processing – Preliminaries – number representations, Matrix Arithmetic.

UNIT II

Fundamental Mathematics for Speech Processing – Signals and Linear Systems – Simple Signals, Filtering and convolution. Frequency Analysis – Fourier Transform, Spectra and Correlation, Laplace Transform: poles and zeroes. Discrete-time signals and systems – sampling, frequency transforms of Discrete-time signals, decimation and interpolation. Filters – Bandpass filters, Digital filters, Difference equations and filter structures.

UNIT III

Speech Production Models - Acoustical Theory of Speech Production, Linear Separable Equivalent Circuit Model, Vocal Tract Transmission Model, Vocal Cord Model.

SPEECH ANALYSIS AND ANALYSIS-SYNTHESIS SYSTEMS – Digitization – Sampling, Quantization and coding, A/D and D/A conversion. Spectral Analysis - Spectral structure of speech, Autocorrelation and Fourier transform, Window function, Sound spectrogram.

UNIT IV

Cepstrum - Cepstrum and its application, Homomorphic analysis and LPC cepstrum. Filter Bank and Zero-Crossing Analysis - Digital filter bank, Zero-crossing analysis

Analysis-by-Synthesis Analysis-Synthesis Systems - Analysis-synthesis system structure, Examples of analysis-synthesis systems, Pitch Extraction

UNIT V

LINEAR PREDICTIVE CODING (LPC) ANALYSIS - Principles of LPC Analysis, LPC Analysis Procedure, Maximum Likelihood Spectral Estimation - spectral estimation , likelihood spectral estimation, Source Parameter Estimation from Residual Signals.Applications of Speech Processing.

TEXT BOOKS:

1. Furui, Sadaoki. Digital speech processing: synthesis, and recognition. CRC Press, 2018.
2. O'shaughnessy, Douglas. Speech communication: human and machine. Universities press, 1987.
3. Rabiner, Lawrence, and Ronald Schafer. Theory and applications of digital speech processing. Prentice Hall Press, 2010.
4. Benesty, Jacob, M. Mohan Sondhi, and Yiteng Huang, eds. Springer handbook of speech processing. Vol. 1. Berlin: springer, 2008.
5. Jurafsky, Dan. Speech & language processing. Pearson Education India, 2000.

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23-344-0330 Virtual Reality and Augmented Reality

Course Outcomes:

After the completion of the course the student will be able to:

CO 1	Explain Augmented Reality	Cognitive Level: Understand
CO 2	Apply Computer Graphics and Geometric Modelling Techniques.	Cognitive Level: Apply
CO 3	Implement Virtual Environment.	Cognitive Level: Apply
CO 4	Develop VR Software	Cognitive Level: Apply
CO 5	Develop AR Software	Cognitive Level: Apply

Mapping of course outcomes with program outcomes **Low=1, Medium=2, High=3**

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

UNIT I

Introduction to Augmented, Virtual and Mixed reality, Difference between Augmented Reality and Virtual Reality, AR Technologies, Features of AR, AR devices and

functionalities, Augmented reality methods, visualization techniques for augmented reality, Importance and challenges of AR, Real world uses of AR, AR types, Software tools available for AR, AR powered devices, Compatibility and Performance, AR libraries, Motion tracking and Environmental understanding, Anchors.

UNIT II

The Virtual world space, positioning the virtual observer, human vision, the perspective projection, stereo perspective projection, Color theory, Conversion From 2D to 3D, 3D space curves, 3D boundary representation, Simple 3D modelling, 3D clipping, Illumination models, Reflection models, Shading algorithms, Introduction to Geometrical Transformations, Frames of reference, Modelling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection

UNIT III

Features of VR systems, VR Architecture, VR input hardware: tracking systems, motion capture systems, data gloves, VR output hardware: visual displays. Introduction to Virtual Environment Animation, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in between, free from deformation, particle system; Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft.

UNIT IV

VR software development: Master/slave and Client/server architectures, Cluster rendering, Game Engines and software development kit to develop VR applications for different hardware HTC VIVE, Oculus and Google VR. Interactive Techniques in Virtual Reality: Body Track - Hand Gesture - 3D Manus - Object Grasp. Development Tools and Frameworks in Virtual Reality: Frameworks of Software Development Tools in VR. X3D Standard; Vega - MultiGen – Virtools.

UNIT V

AR software development: AR software, Major Software Components for Augmented Reality Systems, Software used to Create Content for the Augmented Reality Application. Camera parameters and camera calibration, Marker-based augmented reality, AR Toolkit.

TEXTBOOKS/REFERENCES

1. Schmalstieg, D., Höllerer, T., (2016), “Augmented Reality: Principles & Practice,” Pearson, ISBN: 9789332578494
2. Coiffet, P., Burdea, G. C., (2003), “Virtual Reality Technology,” Wiley-IEEE Press, ISBN: 9780471360896
3. Hassanien, A. E., Gupta, D., Khanna, A., Slowik, A., (2022), “Virtual and Augmented Reality for Automobile Industry: Innovation Vision and Applications,” Springer, ISBN: 9783030941017
4. Norman, K., Kirakowski, J., (2018), “ Wiley Handbook of Human Computer Interaction,” Wiley-Blackwell, ISBN: 9781118976135
5. LaViola Jr., J. J., Kruijff, E., McMahan, R. P., Bowman, D. A., Poupyrev, I., (2017), “3D User Interfaces: Theory and Practice,” Pearson, ISBN: 9780134034324
6. Fowler, A., (2019), “Beginning iOS AR Game Development: Developing Augmented Reality Apps with Unity and C#,” Apress, ISBN: 9781484246672

Web Resources

· https://nptel.ac.in/courses/106106138

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23-344-0331 Mobile Application Development

(July 2021)

Course Outcomes:

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

CO1	Explain the fundamentals of Android Programming.	(Cognitive level : Understand)
CO2	Describe Native Capabilities, Messaging, and Location based services.	(Cognitive level : (Understand)
CO3	Create applications that work with databases to store data using Shared preferences and SQLite database.	(Cognitive level : Analyze)
CO4	Apply built in widgets and components in mobile app	(Cognitive level : Apply)
CO5	Develop GUI based applications.	(Cognitive level : Apply)

Mapping of course outcomes with programme outcomes - **Low=1, Medium=2, High=3**

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

UNIT I (13 Hours.):

Introduction to Android Architecture: Introduction, History, Features and Android Architecture. Application Environment and Tools, Android Studio, Android SDK, AVD. Application Components- Activity, Content providers, Broadcast receivers, Services. Intents- Explicit and Implicit Intents, Intent Filter, Manifest File. Debugging android application.

UNIT II (14 Hours.):

User Interface Design: User Interface Design: Views &View Groups, Views : Button, Text Field, Radio Button, Toggle Button, Checkbox, Spinner, Image View, Image switcher, Event Handling, Listeners, Layouts : Linear, Relative, List View, Grid View, Table View, Web View, Adapters. Creating the user interface programmatically, Managing changes to screen orientation, Displaying notifications- Setting up notifications, Notification manager. Designing for Tablets – Working with tablets: Developing for different android platforms, Fragments, combining fragments into a multilane UI, Specialized Fragments

UNIT III (13 Hours.):

Mobile Data Management :Shared Preferences – Saving and Loading User Preferences, Persisting Data to Files, Creating and using Databases, SQLite Databases. Content Providers - Using a Content Provider, Built in Content Provider - Browser, CallLog, Contacts, Media Store and Settings. Creating Your Own Content Providers -Uri, CRUD access

UNIT IV (12 Hours.):

Native Capabilities, Messaging, Location based services Camera, Audio, Sensors and Bluetooth: Android Media API: Playing audio/video, Media recording. Sensors - how sensors work, listening to sensor readings. Bluetooth , Messaging – SMS Messaging, Broadcast Receiver, Sending Email . Maps & Location: Maps : Map - Based Activities, How to load maps, To find map API key, GPS, Working with Location Manager, Working with Google Maps extensions, Location based Services. Location Updates, location-based services (LBS), Location Providers, Selecting a Location Provider, Finding Your Location

UNIT V (11 Hours.):

Threading, Services, Web services Tasks & Processes: Tasks, Switching between Task, Process, Process lifecycle. Threads, Thread Life cycle, Worker Threads, Thread Handlers, Threads & Loopers and IPC.Services: Services and Notifications – bound/unbound services, Starting and stopping services, Android Interface Definition Language, Handler and Messenger, Passing objects over IPC, Scheduling of services. Web Services – Android Server Communication: communication protocols, interacting with server-side applications, developing clients for web services, Exchanging Data over

the Internet data parsing using json and xml parsing. Integrating with 3rd party Apps using Web Services.

TEXTBOOK

1. Beginning Android Programming with Android Studio, 4ed, by J. F. DiMarzio, 2016.
2. Android Application Development Cookbook, by Wei-Meng Lee, John Wiley and Sons, 2013.
3. Professional Android 4 Development by Reto Meier, John Wiley and Sons, 2012.
4. Android in Action, Third Edition, by W. Frank Ableson, RobiSen, Chris King, C. Enrique Ortiz, 2012

Web Resources

1. https://nptel.ac.in/courses/106/106/106106147/
2. https://www.coursera.org/learn/androidapps

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