

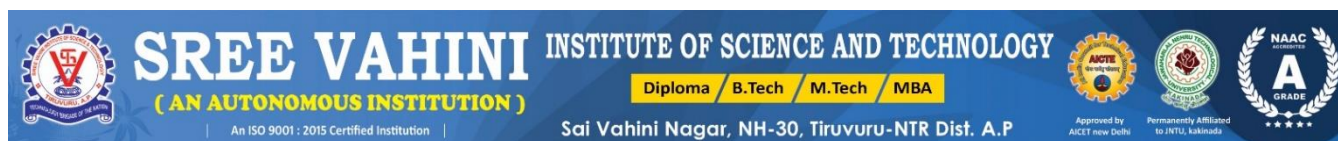
SREE VAHINI



V23 – M.Tech

COURSE STRUCTURE & SYLLABUS

DEPARTMENT OF
COMPUTER SCIENCE AND ENGINEERING



Academic Regulations

(R23) Course Structure & Syllabus

For

Two Year PG Programme

In

M. Tech.

(Computer Science and Engineering)

(Applicable for batches admitted from A.Y. 2023 - 24)

INSTITUTE VISION, MISSION

Institute vision

To be an institute of eminence for quality education and research in engineering, technology and management with ethics and values

Institute Mission

We ae SVIST shall always strive for

- Focusing on outcome-based education with student centric teaching-learning practices.
- Impart cutting edge technologies towards research and innovation.
- Provide an environment to develop intellect, creativity and problem-solving ability through collaboration.
- Involve all stakeholders in holistic development serving the society.

DEPARTMENT VISION, MISSION

Department Vision:

To be a quality CSE education provider and develop a technocrat with social responsibility and leadership qualities.

Department Mission:

- Create a platform for education, research, and development emphasizing coding skills.
- Impart professional, ethical values and societal responsibility to protect the environment.
- Groom industry-ready professionals with skills and abilities.
- Impart high-quality professional training with collaborations towards the overall development of stakeholders.

Programme Education Objectives (PEOs)

After completion of M.Tech (CSE) course students will become

	Programme Educational Objectives
PEO 1	To Empower Critical thinking and Innovative research In coreand Multidisciplinary areas to solve real word problems through life-long learning skills.
PEO 2	Augment Technological competence and self-learning capabilitiesand become adaptable computer science professionals in Academics, Research and Industry.
PEO 3	Exposure to emerging technologies to handle complex challenges adhering to social ,legal and ethical responsibilities

Mapping of Mission Statements to PEOs:

Key components from Department Mission	PEO 1	PEO 2	PEO 3
Quality education	High	Medium	Medium
Research	High	Medium	Low
Teaching-Learning	Medium	Low	High
Sustained Learning	High	High	Medium
Social Responsibility with Ethics	High	Medium	Low

Programme Outcomes (POs)

After completion of M.Tech (CSE) course students will attain the following programme outcomes

Programme Outcomes

PO1	An ability to independently carryout research / investigation & development work to solve practical problems.
PO2	An ability to work and present a substantial technical report /document.
PO3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be a level higher than the requirements in the appropriate bachelor program.
PO4	Explore, select, learn and apply Mathematical foundations, algorithms, databases, networking and computer science principles in modeling and designing computing systems.
PO5	Ability to update skills with enhanced computing technologies for attaining professional excellence and serve in the Academia/Industry.
PO6	Apply state of the art computer science tools and techniques for solving engineering/societal problems by following ethical practices.

ACADEMIC REGULATIONS R23 FOR M. Tech (REGULAR) DEGREE COURSE

Applicable for the students of M. Tech (Regular) Course from the Academic Year 2023-24 onwards. The M. Tech Degree of Jawaharlal Nehru Technological University Kakinada shall be conferred on candidates who are admitted to the program and who fulfill all the requirements for the award of the Degree.

1.0 ELIGIBILITY FOR ADMISSIONS

Admission to the above program shall be made subject to eligibility, qualification and specialization as prescribed by the University from time to time.

Admissions shall be made on the basis of merit/rank obtained by the candidates at the qualifying Entrance Test conducted by the University or on the basis of any other order of merit as approved by the University, subject to reservations as laid down by the Govt. from time to time.

2.0 AWARD OF M. Tech DEGREE

2.1 A student shall be declared eligible for the award of the M. Tech Degree, if he pursues a course of study in not less than two and not more than four academic years.

2.2 The student shall register for all 68 credits and secure all the 68 credits.

2.3 The minimum instruction days in each semester are 90.

3.0 A. PROGRAMMES OF STUDY

The following specializations are offered by various departments at present for the M. Tech Programme of study.

Department	Programme
Civil Engg.	1. M.Tech- Structural Engineering
EEE	1. M.Tech- Advanced Electrical Power System
ME	1. M.Tech- Machine Design 2. M.Tech-Thermal Engineering
ECE	1. M.Tech- Computer and Communication 2. M.Tech- VLSI and Embedded System
CSE	1. M.Tech- Computer Science and Engineering

ATTENDANCE

- 4.0 The faculty handling the course will finalise the attendance as per schedule / before the last instructional day of the course and submit to the Principal through the head of the department.
- 4.1 A student with less than 75% of consolidated attendance (and/or less than 50% in each **and every course**), **will not be permitted to** appear for the end- semester examinations, irrespective of the reason for the shortfall of the attendance. Further, a **student with less than 75% of attendance in Dissertation Phase-2 (IV Semester) will not be permitted to submit his project work.**
- 4.2 The student is however permitted to avail Academic/Medical Leave/ NCC / NSS / Cultural / Sports/ Minor Medical exigencies etc., up to 10% for attending academic related activities like, Industrial Visits, Seminars, Conferences, Competitions etc., with the prior approval of the HoD. After the event, the student should submit the relevant documents for proof to the HoD for approval of the Academic Leave.
- 4.3 **Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%, and minimum of 50% in each and every course including laboratory, Dissertation phase-1, Dissertation Phase-2) for a maximum of ONE time shall be granted by the College Academic Committee. A prescribed fee shall be payable towards condonation of shortage of attendance.**
- 4.4 Shortage of Attendance below 65% in aggregate shall not be condoned and not eligible to write their end semester examination of that class.
- 4.5 A student shall not be promoted to the next semester unless he satisfies the attendance requirement of the present semester, asapplicable. They may seek readmission into that semester when offered next.
- 4.6 If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

5.0 EVALUATION

The performance of the candidate in each semester shall be evaluated subject-wise, with a maximum of 100 marks for theory and 100 marks for practical's, on the basis of Internal Evaluation and End Semester Examination.

- 5.1 **For the theory subjects 60 marks shall be awarded based on the performance in the End Semester Examination and 40marks shall be awarded based on the Internal Evaluation. The weightage of Internal marks for 40 consists of Descriptive – 32 and Assignment – 08 (open book exam). Descriptive exam shall be conducted for a total duration of 120 minutes with 4 questions (without choice) each question for 8 marks. The descriptive examination conducted for 32 marks are to be added to the assignment 8 marks for finalizing internal marks for 40. The internal evaluation shall be made based on the average of the marks secured in the two Mid Term- Examinations conducted-one in the middle of the Semester and the other immediately after the completion of instruction. Semester End Exam Paper containing FIVE mandatory questions (one question from one unit) with internal choice, each carrying 12 marks gives for 60marks.**

- 5.2 For practical subjects, 60 marks shall be awarded based on the performance in the End Semester Examinations and 40 marks shall be awarded as internal marks, based on the day to day work-10 marks, Record-10 marks and the remaining 20 marks to be awarded by conducting an internal laboratory test. The end examination shall be conducted by the examiners, with a breakup marks of Procedure-15, Experimentation-25, Results-10, Viva-voce-10.
- 5.3 For **Mini Project with seminar**, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Project Review Committee consisting of Head of the Department, Supervisor and two other senior faculty members of the department. For Mini Project with seminar, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful. Out of 100 marks, supervisor awards 40% marks and remaining 60% marks are awarded by the project review committee.
- 5.4 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End semester Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together. **For integrated courses, student should secure the minimum academic requirements in both theory and practical together.**
- 5.5 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.4) he has to reappear for the End semester Examination in that subject. A candidate shall be given a chance to re-register for each subject provided the internal marks secured by a candidate are less than 50% and has failed in the end examination. In such a case, the candidate must re-register for the subject(s) and secure the required minimum attendance. The candidate's attendance in the re-registered subject(s) shall be calculated separately to decide upon his eligibility for writing the end examination in those subject(s). In the event of the student taking another chance, his internal marks and end examination marks obtained in the previous attempt stand cancelled. For re-registration the candidates have to apply to the college by paying the requisite fees before the start of the semester in which re-registration is required.
- 5.6 In case the candidate secures less than the required attendance in any re registered subject (s), he shall not be permitted to write the End Examination in that subject. He shall again re-register the subject when next offered.
- 5.7 Laboratory examination for M. Tech. programmes must be conducted with two Examiners, one of them being the Laboratory Class Teacher or teacher from the same **department and the second examiner shall be appointed by the Principal from the panel of examiners submitted by the respective HoD.**
- 5.8 Student is allowed to register for 12 week SWAYAM / NPTEL MOOC courses (recommended by HoD/BoS) and can obtain required credits during II Semester itself. In any case, if a student fails in obtaining credits, he is allowed to repeat the initially opted course / change to another MOOC course or regular course and will be considered as regular candidate only. After successful completion, by end of III/IV Semester, he needs to submit the course certificate (through HoD) to the exam section to perform credit transfer.
In addition to credit courses, for completing the programme and obtaining degree, a student needs to complete audit courses. Audit courses will be conducted, evaluated as normal credit courses, and the assessment will be graded as Pass/Fail.

5.9 Students shall undergo mandatory summer internships (2 credits) for a minimum of eight weeks duration at the end of second semester of the Programme/Summer Break. A student will be required to submit a summer internship report to the concerned department and appear for an oral presentation before the committee. The Committee comprises of Head of the Department and two faculty. The report and the oral presentation shall carry 40% and 60% weightages respectively. For internship, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

6.0 EVALUATION OF PROJECT/DISSERTATION (Phase-I and II):

Every candidate shall be required to submit a thesis or dissertation on a topic approved by the Project Review Committee.

- 6.1 A Project Review Committee (PRC) shall be constituted with Head of the Department and two other senior faculty members in the department.
- 6.2 Registration of Dissertation / Project Work: The work on the project shall be initiated at the beginning of the II year and the duration of the project is two semesters.
- 6.3 A candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work (published base paper(s) / real time project / industry oriented) for approval. The student can initiate the Project work, only after obtaining the approval from the Project Review Committee (PRC).
- 6.4 If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the Project Review Committee (PRC). However, the Project Review Committee (PRC) shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of project proposal. If yes, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.
- 6.5 **A candidate shall present seminar on his project work status in two stages at least with a gap of THREE months between them. If the candidate is absent to any seminar, he should again attend to seminar within two weeks by providing proper evidence to the Project Review Committee for earlier absence to the seminar.**
- 6.6 A candidate is permitted to submit Project Thesis (Dissertation) only after successful completion of theory and practical course **with the approval of PRC** not earlier than 40 weeks from the date of registration of the project work.
- 6.7 Continuous assessment of Dissertation-I and Dissertation-II during the Semester will be monitored by the PRC.
- 6.8 There will be pre-submission seminar at the end of academic term. **After the approval the student has to submit the detail report.**
- 6.9 **The Candidate may be permitted to submit the Project Report If only the work is Published/Accepted to be Published in a National or International Journal / conference of reputed and relevance.**
- 6.10 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College along with plagiarism report (<40%).
- 6.11 The thesis shall be adjudicated by one examiner selected by the Principal, from the panel of 5 examiners, eminent in that field, submitted by the guide concerned and head of the department.
- 6.12 If the report of the examiner is not favorable, the candidate shall revise and resubmit the Thesis, in the time frame as decided by the PRC. If the report of the examiner is unfavorable again, the thesis shall be summarily rejected. The candidate has to re-register for the project

and complete the project within the stipulated time after taking the approval from the Principal.

- 6.13** If the report of the examiner is favorable, Viva-Voce examination shall be conducted by a board consisting of the Supervisor/ Internal examiner, Head of the Department and the examiner who adjudicated the Thesis. The Board shall jointly report the candidate's work for a maximum of 100 Marks. **Out of 100marks, supervisor awards 40 marks and remaining 60 marks are awarded by the board.**
- 6.14** The Head of the Department shall coordinate and make arrangements for the conduct of Viva-Voce examination.
- 6.15** If the report of the Viva-Voce is unsatisfactory (i.e., <50 marks), the candidate shall retake the Viva-Voce examination only after three months. If he fails to get a satisfactory report at the second Viva-Voce examination, the candidate has to re-register for the project and complete the project within the stipulated time after taking the approval from the Institution.

7.0 Cumulative Grade Point Average (CGPA)

Marks Range (Max – 100)	Letter Grade	Level (G)	Grade Point
≥ 90	>90	Outstanding (O)	10
≥80 to <90	90-80	Excellent (S)	9
≥70 to <80	80-70	Very Good (A)	8
≥60 to <70	70-60	Good (B)	7
≥50 to <60	60-50	Fair (C)	6
<50	<50	Fail (F)	0
		Absent	0

Computation of SGPA

The following procedure is to be adopted to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

The **SGPA** is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e. $SGPA (S_i) = \sum (C_i \times G_i) / \sum C_i$

Where C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course.

Computation of CGPA

The **CGPA** is also calculated in the same manner taking into account all the courses undergone by a student over all the semester of a programme, i.e. $CGPA = \sum (C_i \times S_i) / \sum C_i$

Where S_i is the SGPA of the i^{th} semester and C_i is the total number of credits in that semester. The SGPA and CGPA shall be rounded off to TWO decimal points and reported in the transcripts.

8.0 AWARD OF DEGREE AND CLASS

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree he shall be placed in one of the following four classes:

Class Awarded	CGPA to be secured	From the CGPA Secured from 68 Credits.
First Class with Distinction	≥ 7.75 without backlog history	
First Class	≥ 6.75	
Second Class	≥ 5.75 to < 6.75	

The secured grade, grade points, status and credits obtained will be shown separately in the memorandum of marks.

WITHHOLDING OF RESULTS

If the student has not paid the dues, if any, or if any case of indiscipline is pending against him, the result of the student will be withheld. His degree will be withheld in such cases.

9.0 TRANSITORY REGULATIONS

- 9.1 Discontinued or detained candidates are eligible for re- admission into same or equivalent subjects at a time as and when offered.

10. GENERAL

- 10.1 Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.
- 10.2 The academic regulation should be read as a whole for the purpose of any interpretation.
- 10.3 In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.
- 10.4 The College may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the College.

REVISED Bloom's Taxonomy Action Verbs

Definitions	I. Remembering	II. Understanding	III. Applying	IV. Analyzing	V. Evaluating	VI. Creating
Bloom's Definition	Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers.	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas.	Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.	Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.
Verbs	• Choose • Define • Find • How • Label • List • Match • Name • Omit • Recall • Relate • Select • Show • Spell • Tell • What • When • Where • Which • Who • Why	• Classify • Compare • Contrast • Demonstrate • Explain • Extend • Illustrate • Infer • Interpret • Outline • Relate • Rephrase • Show • Summarize • Translate	• Apply • Build • Choose • Construct • Develop • Experiment with • Identify • Interview • Make use of • Model • Organize • Plan • Select • Solve • Utilize	• Analyze • Assume • Categorize • Classify • Compare • Conclusion • Contrast • Discover • Dissect • Distinguish • Divide • Examine • Function • Inference • Inspect • List • Motive • Relationships • Simplify • Survey • Take part in • Test for • Theme	• Agree • Appraise • Assess • Award • Choose • Compare • Conclude • Criteria • Criticize • Decide • Deduct • Defend • Determine • Disprove • Estimate • Evaluate • Explain • Importance • Influence • Interpret • Judge • Justify • Mark • Measure • Opinion • Perceive • Prioritize • Prove • Rate • Recommend • Rule on • Select • Support • Value	• Adapt • Build • Change • Choose • Combine • Compile • Compose • Construct • Create • Delete • Design • Develop • Discuss • Elaborate • Estimate • Formulate • Happen • Imagine • Improve • Invent • Make up • Maximize • Minimize • Modify • Original • Originate • Plan • Predict • Propose • Solution • Solve • Suppose • Test • Theory

Department of Computer Science and Engineering

V23 – M.Tech - Course Structure & Syllabus

M.Tech.(CSE) I SEMESTER						
S.no	Courses	Category	L	T	P	C
1	Program Core-1 1. High Performance Computing (V232115831) 2. Mathematical Foundations of Computer Science (V232115832)	PC	3	0	0	3
2	Program Core-2(Integrated Course-Theory & Laboratory Course) 1. Deep Learning (V232115833) 2. Advanced Data Structures & Algorithms. (V232115834)	PC	3	0	0	3
3	Program Elective-1 1. Computer Vision (V2321158D1) 2. Social Media Analytics (V2321158D2) 3. Elliptic Curve and Quantum Cryptography (V2321158D3) 4. Advanced Databases and Mining (V2321158D4) 5. Digital Image Processing (V2321158D5) 6. Advanced Operating Systems (V2321158D6)	PE	3	0	0	3
4	Program Elective-2 1. Internet of Things (V2321158E1) 2. Block Chain Technologies (V2321158E2) 3. Service Oriented Architecture (V2321158E3) 4. Advanced Software Engineering (V2321158E4) 5. Advanced Compiler Design (V2321158E5) 6. Advanced Computer Networks (V2321158E6)	PE	3	0	0	3
5	Research Methodology and IPR	CC	2	0	0	2
6	Laboratory-1 Software Lab-1 (V232115861)	LB	0	0	3	2
7	Core II Advanced Data Structures & Algorithms (V232115862)	LB	0	0	3	2
8	Audit Course-1 1. English for Research Paper Writing 2. Disaster Management 3. Sanskrit for Technical Knowledge 4. Value Education (V321258C1)	AC	2	0	0	0

Department of Computer Science and Engineering

V23 – MTech - Course Structure & Syllabus

M.Tech.(CSE) II SEMESTER						
S.No	Courses	Category	L	T	P	C
1	Program Core-3 (Integrated Course-Theory & Laboratory Course) 1. DevOps (V232125831) 2. MEAN Stack Technologies (V232125832)	PC	3	0	0	3
2	Program Core-4 1. Reinforcement Learning (V232125833) 2. Machine Learning (V232125834)	PC	3	0	0	3
3	Program Elective-3 1. Natural Language Processing (V2321258F1) 2. Cyber Security (V2321258F2) 3. Agile technologies (V2321258F3) 4. Big Data Analytics (V2321258F4) 5. Full Stack Technologies (V2321258F5) 6. Soft Computing (V2321258F6)	PC	3	0	0	3
4	Program Elective-4 1. Robotic Process Automation (V2321258G1) 2. Medical Image Data Analysis (V2321258G2) 3. Design of Secure Protocols (V2321258G3) 4. Cloud Computing (V2321258G4) 5. Information Security (V2321258G5) 6. Software Reliability (V2321258G6)	PE	3	0	0	3
5	Laboratory-1 1. DevOps (V232125861) 2. MEAN Stack Technologies (V232125862)	LB	0	0	3	2
6	Laboratory-2 SoftwareLab-2 (V232125863) (Experiments covering Program Core4)	LB	0	0	3	2
7	Mini Project with Seminar (V23212CC91)	MP	2	0	0	2
8	Audit Course-1 Constitution of India (V2321158C4)	AC	2	0	0	0

Department of Computer Science and Engineering

V23 – MTech - Course Structure & Syllabus

S.No	Courses	Category	L	T	P	C
1	Program Elective-5 1. Biometric Security (V2322158H1) 2. Mining Massive Data Sets (V2322158H2) 3. Generative AI (V2322158H3) 4. Software Defined Networks (V2322158H4) 5. Game Theory (V2322158H5) 6. Randomized and Approximation Algorithms (V2322158H6) / MOOCs-1 (12 week NPTEL / SWAYAM course)	PE	3	0	0	3
2	Open Elective 1. MOOCs-2(12 week NPTEL/SWAYAM course) 2. A Course offered by other departments (V232215851)	OE	3	0	0	3
4	Dissertation-I/ Industrial Project	PJ	0	0	20	10

Department of Computer Science and Engineering

V23 – MTech - Course Structure & Syllabus

M. Tech. (CSE) IV SEMESTER							
S.No	Course Code	Courses	Category	L	T	P	C
1	V23222CCA1	Dissertation-II	PJ	0	0	32	16
Total Credits							16

I Year - I Semester	High Performance Computing (V232115831)	L	T	P	C
		3	0	0	3

Course Objectives:

The main objectives of the course is to study parallel computing hardware and programming models, performance analysis and modeling of parallel programs

Course Outcomes:

On completion of the course, student will be able to–

- Describe different parallel architectures, inter-connect networks, programming models
- Develop an efficient parallel algorithm to solve given problem
- Analyze and measure performance of modern parallel computing systems
- Build the logic to parallelize the programming task

Unit I Introduction:

Motivating Parallelism, Scope of Parallel Computing, Parallel Programming Platforms: Implicit Parallelism, Trends in Microprocessor and Architectures, Limitations of Memory, System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Scalable design principles, Architectures: N-wide superscalar architectures, Multi-core architecture.

Unit II Parallel Programming :

Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models, The Age of Parallel Processing, the Rise of GPU Computing, A Brief History of GPUs, Early GPU.

Unit III Basic Communication:

Operations- One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All- to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations. Programming shared address space platforms: threads-basics, synchronization, OpenMP programming

Unit IV

Analytical Models: Sources of overhead in Parallel Programs, Performance Metrics for Parallel Systems, and The effect of Granularity on Performance, Scalability of Parallel Systems, Minimum execution time and minimum cost, optimal execution time. Dense Matrix Algorithms: MatrixVector Multiplication, Matrix-Matrix Multiplication.

Unit V :

Parallel Algorithms- Sorting and Graph : Issues in Sorting on Parallel Computers, Bubble Sort and its Variants, Parallelizing Quick sort, All-Pairs Shortest Paths, Algorithm for sparse graph, Parallel Depth-First Search, Parallel BestFirst Search.

CUDA Architecture : CUDA Architecture, Using the CUDA Architecture, Applications of CUDA Introduction to CUDA C-Write and launch CUDA C kernels,

Manage GPU memory, Manage communication and synchronization, Parallel programming in CUDA- C.

Text Books:

1. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, "Introduction to Parallel Computing", 2nd edition, Addison-Wesley, 2003, ISBN: 0-201-64865-2
2. Jason sanders, Edward Kandrot, "CUDA by Example", Addison-Wesley, ISBN-13: 978-0-13-138768-3

Reference Books :

1. Kai Hwang, "Scalable Parallel Computing", McGraw Hill 1998, ISBN:0070317984
2. Shane Cook, "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs", Morgan Kaufmann Publishers Inc. San Francisco, CA, USA 2013 ISBN: 9780124159884
3. David Culler Jaswinder Pal Singh, "Parallel Computer Architecture: A Hardware/Software Approach", Morgan Kaufmann,1999, ISBN 978-1- 55860-343-1
4. Rod Stephens, "Essential Algorithms", Wiley, ISBN: 978-1-118-61210-1

I Year - I Semester	Mathematical Foundations of Computer Science (V232115832)	L	T	P	C
		3	0	0	3

Course Objectives: This course is aimed at enabling the students to

- To understand the mathematical fundamentals that is prerequisites for variety of courses like Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems bioinformatics, Machine learning.
- To develop the understanding of the mathematical and logical basis to many modern techniques in computer science technology like machine learning, programming language design, and concurrency.

Course Outcomes:

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

CO	Course Outcomes	Knowledge Level (K)#
CO1	To apply the basic rules and theorems of probability theory such as Baye's Theorem, to determine probabilities that help to solve engineering problems and to determine the expectation and variance of a random variable from its distribution.	K3
CO2	Able to perform and analyze of sampling, means, proportions, variances and estimates the maximum likelihood based on population parameters.	K4
CO3	To learn how to formulate and test hypotheses about sample means, variances and proportions and to draw conclusions based on the results of statistical tests.	K6
CO4	Design various ciphers using number theory.	K6
CO5	Apply graph theory for real time problems like network routing problem.	K3

UNIT I: Basic Probability and Random Variables: Random Experiments, Sample Spaces Events, the Concept of Probability the Axioms of Probability, Some Important Theorems on Probability Assignment of Probabilities, Conditional Probability Theorems on Conditional Probability, Independent Events, Bayes Theorem or Rule. Random Variables, Discrete Probability Distributions, Distribution Functions for Random Variables, Distribution Functions for Discrete Random Variables, Continuous Random Variables

UNIT II: Sampling and Estimation Theory: Population and Sample, Statistical Inference Sampling With and Without Replacement Random Samples, Random Numbers Population Parameters Sample Statistics Sampling Distributions, Frequency Distributions, Relative Frequency Distributions, Computation of Mean, Variance, and Moments for Grouped Data. Unbiased Estimates and Efficient Estimates Point Estimates and Interval Estimates. Reliability Confidence Interval Estimates of Population Parameters, Maximum Likelihood Estimates

UNIT III: Tests of Hypothesis and Significance: Statistical Decisions Statistical Hypotheses. Null Hypotheses Tests of Hypotheses and Significance Type I and Type II Errors Level of Significance Tests Involving the Normal Distribution One-Tailed and Two-Tailed Tests P Value Special Tests of Significance for Large Samples Special Tests of Significance for Small Samples Relationship between Estimation Theory and Hypothesis Testing Operating Characteristic Curves. Power of a Test Quality Control Charts Fitting Theoretical Distributions to Sample Frequency Distributions, The Chi-Square Test for Goodness of Fit Contingency Tables Yates' Correction for Continuity Coefficient of Contingency.

UNIT IV: Algebraic Structures and Number Theory: Algebraic Systems, Examples, General Properties, Semi Groups and Monoids, Homomorphism of Semi Groups and Monoids, Group, Subgroup, Abelian Group, Homomorphism, Isomorphism. Properties of Integers, Division Theorem, The Greatest Common Divisor, Euclidean Algorithm, Least Common Multiple, Testing for Prime Numbers, The Fundamental Theorem of Arithmetic, Modular Arithmetic (Fermat's Theorem and Euler's Theorem)

UNIT V: Graph Theory: Basic Concepts of Graphs, Sub graphs, Matrix Representation of Graphs: Adjacency Matrices, Incidence Matrices, Isomorphic Graphs, Paths and Circuits, Eulerian and Hamiltonian Graphs, Multigraphs, Planar Graphs, Euler's Formula, Graph Colouring and Covering, Chromatic Number, Spanning Trees, Algorithms for Spanning Trees (Problems Only and Theorems without Proofs).

Text Books:

1. Foundation Mathematics for Computer Science, 1st edition, John Vince, Springer, 2015
2. Probability & Statistics, 3rd Edition, Murray R. Spiegel, John J. Schiller and R. Alu Srinivasan, Schaum's Outline Series, Tata McGraw-Hill Publishers, 2018
3. Probability and Statistics with Reliability, 2nd edition, K. Trivedi, Wiley, 2011
4. Discrete Mathematics and its Applications with Combinatorics and Graph Theory, 7th Edition, H. Rosen, Tata McGraw Hill, 2003

Reference Books:

1. Probability and Computing: Randomized Algorithms and Probabilistic Analysis, 1st edition, M. Mitzenmacher and E. Upfal, 2005
2. Applied Combinatorics, 6th edition, Alan Tucker, Wiley, 2012

I Year - I Semester	Deep Learning (V232115833)	L	T	P	C
		3	0	3	4.5

Course Objectives:

The objective of this course is to cover the fundamentals of neural networks as well as some advanced topics such as recurrent neural networks, longshort term memory cells and convolutional neural networks.

Course Outcomes

After completion of course, students would be able to:

- Explore feed forward networks and Deep Neural networks
- Mathematically understand the deep learning approaches and paradigms
- Apply the deep learning techniques for various applications

UNIT I:

Basics- Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability, Convergence theorem for Perceptron Learning Algorithm.

UNIT II:

Feedforward Networks- Multilayer Perceptron, Gradient Descent, Back propagation, Empirical Risk Minimization, regularization, auto encoders.

Deep Neural Networks: Difficulty of training deep neural networks, Greedy layer wise training.

UNIT III:

Better Training of Neural Networks- Newer optimization methods for neural networks (Adagrad, adadelata, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).

UNIT IV:

Recurrent Neural Networks- Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs.

Convolutional Neural Networks: LeNet, AlexNet. Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.

UNIT V:

Recent trends- Variational Autoencoders

Applications: Vision, NLP, Speech

Text Books:

1. Deep Learning, Ian Good fellow and YoshuaBengio and Aaron Courville, MIT Press, 2016.

Reference Books:

1. Neural Networks: A Systematic Introduction, Raúl Rojas, 1996
2. Pattern Recognition and Machine Learning, Christopher Bishop, 2007
3. Deep Learning with Python, François Chollet, Manning Publications, 2017

Software Packages required:

- Keras
- Tensorflow
- PyTorch

List of Experiments:

1. Implement multilayer perceptron algorithm for MNIST Hand written Digit Classification.
2. Design a neural network for classifying movie reviews (Binary Classification) using IMDB dataset.
3. Design a neural Network for classifying news wires (Multi class classification) using Reuters dataset.
4. Design a neural network for predicting house prices using Boston Housing Price dataset.
5. Build a Convolution Neural Network for MNIST Hand written Digit Classification.
6. Build a Convolution Neural Network for simple image (dogs and Cats) Classification
7. Use a pre-trained convolution neural network (VGG16) for image classification.
8. Implement one hot encoding of words or characters.
9. Implement word embeddings for IMDB dataset.
10. Implement a Recurrent Neural Network for IMDB movie review classification problem.

Text Books:

1. Reza Zadeh and Bharath Ramsundar, "Tensorflow for Deep Learning", O'Reilly publishers, 2018

References:

1. <https://github.com/fchollet/deep-learning-with-python-notebooks>

I Year - I Semester	Advanced Data Structures & Algorithms. (V232115834)	L	T	P	C
		3	0	3	4.5

Course Objectives: From the course the student will learn

- Single Linked, Double Linked Lists, Stacks, Queues, Searching and Sorting techniques, Trees, Binary trees, representation, traversal, Graphs- storage, traversal.
- Hash table representation, Hash functions, Priority queues, Priority queues using heaps, Search trees.
- AVL trees, operations of AVL trees, Red- Black trees, Splay trees, comparison of search trees.

Course Outcomes:

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

CO	Course Outcomes	Knowledge Level (K)#
CO1	Ability to write and analyze algorithms for algorithm correctness and efficiency. Demonstrate various searching, sorting techniques and be able to apply and solve problems of real life	K4
CO2	Master a variety of advanced abstract data type (ADT) and data structures like linked list, stacks and queues and their Implementation	K3
CO3	Design and implement variety of data structures including binary trees, binary search tree and AVL Tree	K5
CO4	Design and implement variety of data structures including heaps, and search trees. Ability to compare various search trees and find solutions for IT related problems and demonstrate hash techniques.	K4
CO5	Design and implement graphs.	K5

UNIT I: Introduction, Classification of Data Structure, concept of Data Types, Algorithm, importance of Algorithm Analysis, Complexity of an algorithm, Asymptotic Analysis and Notations. (Ref-1)

Searching-Linear and Binary, Search Methods, **Sorting**-Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort. (Text-1)

UNIT II:

Singly Linked Lists, Doubly Linked Lists, Circular Lists-Algorithms.

Stacks and Queues: Algorithm Implementation using Linked Lists and its applications (Text-1)

UNIT III:

Trees- Binary trees, Properties, Representation and Traversals (DFT, BFT), Expression Trees (Infix, prefix, postfix).

Search Trees- Binary Search Trees, Definition, ADT, Implementation, **Operations-** Searching, Insertion, Deletion.

Search Trees- AVL Trees, Definition, Height of AVL Tree, Operations-, Insertion, Deletion and Searching (Text-1)

UNIT IV:

Hashing: Hash Functions, Collision Resolution-Separate Chaining, **Open Addressing-** Linear Probing, Quadratic Probing, Double Hashing.

Priority queues- Definition, Insertion, Deletion.

Introduction to Red-Black and Splay Trees, B-Trees, Comparison of Search Trees. (Text-1)

UNIT V:

Graphs- Basic Concepts, Storage structures, Traversal Algorithms, shortest path algorithms: Minimum Spanning Trees, Prim's Algorithm. Kruskal's Algorithm, Dijkstra's algorithm, Warshall's Algorithm, Applications of Graphs (Text-2)

List of Experiments:

Experiment 1:

Write a java program to perform various operations on single linked list

Experiment 2:

Write a java program for the following

- Reverse a linked list
- Sort the data in a linked list
- Remove duplicates
- Merge two linked lists

Experiment 3:

Write a java program to perform various operations on doubly linked list.

Experiment 4:

Write a java program to perform various operations on circular linked list.

Experiment 5:

Write a java program for performing various operations on stack using linkedlist.

Experiment 6:

Write a java program for performing various operations on queue using linkedlist.

Experiment 7:

Write a java program for the following using stack

- Infix to postfix conversion.

- b) Expression evaluation.
- c) Obtain the binary number for a given decimal number.

Experiment 8:

Write a java program to implement various operations on Binary Search Tree Using Recursive and Non-Recursive methods.

Experiment 9:

Write a java program to implement the following for a graph.

- a) BFS
- b) DFS

Experiment 10:

Write a java program to implement Merge & Heap Sort of given elements.

Experiment 11:

Write a java program to implement Quick Sort of given elements.

Experiment 12:

Write a java program to implement various operations on AVL trees.

Experiment 13:

Write a java program to perform the following operations:

- a) Insertion into a B-tree
- b) Searching in a B-tree

Experiment 14:

Write a java program to implementation of recursive and non-recursive functions to Binary tree Traversals

Experiment 15:

Write a java program to implement all the functions of Dictionary (ADT) using Hashing.

Text Books:

1. Data Structures and Algorithm Analysis, 3/e, Mark Allen Weiss, Pearson
2. Data Structures Using C, 2/e, Reema Thareja, Oxford

Reference Books:

1. A simplified Approach to Data Structures, Vishal Goyal, Lalit Goyal, Pawan kumar, SPD.
2. Data Structures: A Pseudo Code Approach, 2/e, Richard F.Gilberg, Behrouz A. Forouzon and Cengage, 2005

Year - I Semester	Computer Vision (V2321158D1)	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand the Fundamental Concepts related to sources, shadows and shading
- To understand the Geometry of Multiple Views

Course Outcomes:

- Implement fundamental image processing techniques required for computer vision
- Implement boundary tracking techniques
- Apply chain codes and other region descriptors, Hough Transform for line, circle, and ellipse detections.
- Apply 3D vision techniques and Implement motion related techniques.
- Develop applications using computer vision techniques.

UNIT –I:

CAMERAS: Pinhole Cameras Radiometry – Measuring Light: Light in Space, Light Surfaces, Important Special Cases Sources, Shadows, And Shading: Qualitative Radiometry, Sources and Their Effects, Local Shading Models, Application: Photometric Stereo, Interreflections: Global Shading Models Color: The Physics of Color, Human Color Perception, Representing Color, A Model for Image Color, Surface Color from Image Color.

UNIT-II:

Linear Filters: Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates, Edge Detection: Noise, Estimating Derivatives, Detecting Edges Texture: Representing Texture, Analysis (and Synthesis) Using Oriented Pyramids, Application: Synthesis by Sampling Local Models, Shape from Texture.

UNIT-III:

The Geometry of Multiple Views: Two Views Stereopsis: Reconstruction, Human Stereopsis, Binocular Fusion, Using More Cameras Segmentation by Clustering: What Is Segmentation? Human Vision: Grouping and Gestalt, Applications: Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels, Segmentation by Graph-Theoretic Clustering,

UNIT-IV:

Segmentation by Fitting a Model: The Hough Transform, Fitting Lines, Fitting Curves, Fitting as a Probabilistic Inference Problem, Robustness Segmentation and Fitting Using Probabilistic Methods: Missing Data Problems, Fitting, and Segmentation, The EM Algorithm in Practice, Tracking With Linear Dynamic Models: Tracking as an Abstract Inference Problem, Linear Dynamic Models,

Kalman Filtering, Data Association, Applications and Examples

UNIT- V:

Geometric Camera Models: Elements of Analytical Euclidean Geometry, Camera Parameters and the Perspective Projection, Affine Cameras and Affine Projection Equations Geometric Camera Calibration: Least-Squares Parameter Estimation, A Linear Approach to Camera Calibration, Taking Radial Distortion into Account, Analytical Photogrammetry, Case study: Mobile Robot Localization Model- Based Vision: Initial Assumptions, Obtaining Hypotheses by Pose Consistency, Obtaining Hypotheses by pose Clustering, Obtaining Hypotheses Using Invariants, Verification, Case study: Registration In Medical Imaging Systems, Curved Surfaces and Alignment.

Text Books:

1. David A. Forsyth and Jean Ponce: Computer Vision – A Modern Approach, PHI Learning (Indian Edition), 2009.

Reference Books:

1. E. R. Davies: Computer and Machine Vision – Theory, Algorithms and Practicalities, Elsevier (Academic Press), 4th edition, 2013.
2. R. C. Gonzalez and R. E. Woods “Digital Image Processing” Addison Wesley 2008.
3. Richard Szeliski “Computer Vision: Algorithms and Applications” Springer-Verlag London Limited 2011.

I Year - I Semester	Social Media Analytics (V2321158D2)	L	T	P	C
		3	0	0	3

Course Objectives:

Knowledge on social media and its analytics Course

Course Outcomes:

1. Understanding characteristics and types of social media
2. Knowledge on layers of social media analytics
3. Apply text analysis tools on social media data
4. Understand the significance of action analytics
5. Detect viral topics on social media(YouTube)

Unit I:

Introduction To Social Media World Wide Web, Web 1.0, Web 2.0, Web 3.0, Social Media, Core Characteristics Of Social Media, Types Of Social Media, Social Networking Sites, Using Facebook For Business Purposes, Content Communities

Unit- II:

Social Media Analytics Overview Purpose Of Social Media Analytics, Social Media Vs. Traditional Business Analytics, Seven Layers Of Social Media Analytics, Types Of Social Media Analytics, Social Media Analytics Cycle, Challenges To Social Media Analytics, Social Media Analytics Tools. Case Study: The Underground Campaign That Scored Big

Unit III:

Social Media Text Analytics Types Of Social Media Text, Purpose Of Text Analytics, Steps In Text Analytics, Social Media Text Analysis Tools. Case Study: Tapping Into Online Customer Opinions

Unit IV:

Social Media Actions Analytics Introduction To Actions Analytics, Common Social Media Actions, Actions Analytics Tools. Case Study: Cover-More Group

Unit V:

Social Media Hyperlink Analytics Types Of Hyperlinks, Hyperlink Analytics, Types Of Hyperlink Analytics, Hyperlink Analytics Tools. Case Study: Hyperlinks And Viral YouTube Videos

Text Books:

1. Seven Layers Of Social Media Analytics Mining Business Insights From Social Media Text, Actions, Networks, Hyperlinks, Apps, Search Engine, And Location Data By Gohar F. Khan Isbn: 1507823207, Isbn-13:9781507823200

Reference Books:

1. Social Media Analytics: Techniques And Insights For Extracting Business Value Out Of Social Media By Matthew Ganis, Avinash Kohirkar, Pearson Education.
2. Social Media Analytics: Effective Tools for Building, Interpreting, and Using Metrics, Marshall Sponder, MGH.
3. Big Data And Analytics, Seema Acharya, Subhasinin Chellappan, Wiley Publications.
4. Big Data, Black Book tm , Dreamtech Press, 2015 Edition.

I Year - I Semester	Elliptic Curve and Quantum Cryptography (V2321158D3)	L	T	P	C
		3	0	0	3

Course Objectives:

Objective of the course is to build quantum-preparedness for the post quantum era.

Course Outcomes:

1. Basic understanding about Quantum Information and Computation.
2. Understand attack Strategies on QKD Protocols.
3. Analyze and understand statistical analysis of QKD Networks in Real-Life Environment.
4. Apply Quantum-cryptographic networks.

UNIT I:

Elliptic curves Introduction, Efficient computation, Isogenies and endomorphisms, Elliptic curves over finite fields, The discrete logarithm problem, Integer factorization and primality proving, Endomorphism rings, Elliptic curves over the complex numbers

UNIT II:

Quantum Information Theory, Unconditional Secure Authentication, Entropy, Quantum Key Distribution, Quantum Channel, Public Channel, QKD Gain, Finite Resources Adaptive Cascade Introduction, Error Correction and the Cascade Protocol

UNIT III:

Adaptive Initial Block-Size Selection, Fixed Initial Block-Size, Dynamic Initial Block-Size

Attack Strategies on QKD Protocols: Introduction, Attack Strategies in an Ideal Environment, Individual Attacks in an Realistic Environment QKD Systems: Introduction, QKD Systems

UNIT IV:

Statistical Analysis of QKD Networks in Real-Life Environment: Statistical Methods, Statistical Analysis QKD Networks Based on Q3P: QKD Networks, PPP, Q3P, Routing, Transport

UNIT V:

Quantum-Cryptographic Networks from a Prototype to the Citizen: The SECOQC Project, How to Bring QKD into the “Real” Life The Ring of Trust Model: Introduction, Model of the Point of Trust, Communication in the Point of Trust Model, Exemplified Communications, A Medical Information System Based on the Ring of Trust

Text Book:

1. Kollmitzer C., Pivk M. (Eds.), Applied Quantum Cryptography, Lect. Notes Phys. 797 (Springer, Berlin Heidelberg 2010).
2. Washington, Lawrence C. Elliptic Curves: Number Theory and Cryptography. Second edition. Chapman & Hall / CRC, 2008. ISBN: 9781420071467.

Reference Books:

1. Gerald B. Gilbert, Michael Hamrick, and Yaakov S. Weinstein, Quantum Cryptography, World Scientific Publishing.
2. Gilles Van Assche, Quantum Cryptography and Secret-Key Distillation, Cambridge University Press

I Year - I Semester	Advanced Databases and Mining (V2321158D4)	L	T	P	C
		3	0	0	3

Course Objectives:

- This subject provides an introduction to multidisciplinary field of data mining, the general data features, techniques for data preprocessing, general implementation of data warehouses and OLAP, the relationship between data warehousing and other generalization methods
- The concepts of data clustering includes a different methods of clustering such as k-means, k-medoids, db scan algorithm, role of data mining in web mining.

Course Outcomes:

CO	Description	Knowledge Level (K)#
CO1	Apply various normal forms for designing a database schema.	K3
CO2	Examine appropriate techniques for controlling the consequences of concurrent data access and to restrict unauthorized access, and also able to perform Query Optimization.	K2
CO3	Perform OLAP operations and apply data preprocessing strategies.	K3
CO4	Analyze data visualizations, and observe the patterns that can be discovered by association rule mining.	K4
CO5	Analyze and apply the appropriate classification/clustering techniques for solving real world problems.	K4

UNIT I:

An Overview of NoSQL: Review of the Relational Model, ACID Properties, Distributed Databases: Sharding and Replication, Consistency, The CAP Theorem, NoSQL Data Models. Four Types of NoSQL Database, Value of Relational Databases, Persistent Data, Concurrency, Integration, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Key Points.

UNIT II:

MongoDB: The Document Data Model, Documents and Collections, MongoDB Use Cases, Embedded Data Models, Normalized Data, Replication via Replica Sets, MongoDB Design, MongoDB and the CAP Theorem, The MongoDB Data Manipulation Language, Transactions, Atomicity, and Documents, Durability and Journaling, Batch Processing and Aggregation, Indexing, Auto-Sharding, Shard Keys, and Horizontal Scalability, Writing to Shards, MongoDB as a File System

UNIT III:

Cassandra: The Column-Family Data Model, Databases and Tables, Columns, Types, and Keys, The Data Manipulation Language, Cassandra's Architecture, Key Spaces,

Replication, and Column-Families, The CAP Theorem, Consistent Hashing, Managing Cluster Nodes

UNIT IV:

Data preprocessing: cleaning, transformation, reduction, filters and discretization (demonstration with weka). **Data mining algorithms:** association rules, mining weather data, generating item sets and rules efficiently, correlation analysis. visualization techniques (demonstration with weka)

UNIT V:

Classification & Clustering: ZeroR, OneR, Naïve Bayesian and Decision trees classification and evaluation (bootstrapping and k-fold cross validation) techniques. k-means, DBSCAN and Hierarchical clustering methods (demonstration with weka).

Text Books:

1. Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Wiley Publications, 1st Edition, 2019
2. Data Mining: Concepts and Techniques, J. Han and M. Kamber, Morgan Kaufmann C.J. Date, Database Systems, Pearson, 3rd edition

Reference Books:

1. MongoDB: The Definitive Guide, 3rd Edition, by Shannon Bradshaw, Eoin Brazil, Kristina Chodorow, 2019, O'Reilly Media, Inc.,
2. Cassandra: The Definitive Guide, 3rd Edition, by Jeff Carpenter, Eben Hewitt, 2020, O'Reilly Media, Inc.

Weblinks :

https://www.saedsayad.com/data_mining_map.htm

I Year - I Semester	Digital Image Processing (V2321158D5)	L	T	P	C
		3	0	0	3

Course Objectives:

1. Provide a theoretical and mathematical foundation of fundamental Digital Image Processing concepts.
2. The topics include image acquisition, sampling and quantization, preprocessing, enhancement, restoration, segmentation, and compression.

Course Outcomes:

1. Demonstrate the knowledge of the basic concepts of two-dimensional signal acquisition, sampling, and quantization.
2. Demonstrate the knowledge of filtering techniques.
3. Demonstrate the knowledge of 2D transformation techniques.
4. Demonstrate the knowledge of image enhancement, segmentation, restoration and compression techniques.

UNIT – I:

Digital Image Fundamentals: Digital Image through Scanner, Digital Camera. Concept of Gray Levels. Gray Level to Binary Image Conversion. Sampling and Quantization. Relationship between Pixels. Imaging Geometry. 2D Transformations-DFT, DCT, KLT and SVD.

UNIT – II:

Image Enhancement in Spatial Domain Point Processing, Histogram Processing, Spatial Filtering, Enhancement in Frequency Domain, Image Smoothing, Image Sharpening.

UNIT – III:

Image Restoration Degradation Model, Algebraic Approach to Restoration, Inverse Filtering, Least Mean Square Filters, Constrained Least Squares Restoration, Interactive Restoration.

UNIT – IV:

Image Segmentation Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region Oriented Segmentation.

UNIT – V:

Image Compression Redundancies and their Removal Methods, Fidelity Criteria, Image Compression Models, Source Encoder and Decoder, Error Free Compression, Lossy Compression.

Text Book:

1. Digital Image Processing: R.C. Gonzalez & R. E. Woods, Addison Wesley/ Pearson Education, 2nd Ed, 2004.

Reference Books:

1. Fundamentals of Digital Image Processing: A. K. Jain, PHI.
2. Digital Image Processing using MATLAB: Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins: Pearson Education India, 2004.
3. Digital Image Processing: William K. Pratt, John Wiley, 3rd Edition, 2004

I Year - I Semester	Advanced Operating Systems (V2321158D6)	L	T	P	C
		3	0	0	3

Course Objectives: This course is aimed at enabling the students to provide comprehensive and up-to-date coverage of the major developments in distributed Operating System, Multi-processor Operating System and to cover important theoretical foundations including Process Synchronization, Concurrency, Event ordering, Mutual Exclusion, Deadlock.

Course Outcomes:

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

CO	Course Outcomes	Knowledge Level (K)#
CO1	Illustrate on the fundamental concepts of operating systems, its architecture and process management.	K2
CO2	Analyses on memory management concepts including page replacement algorithms.	K4
CO3	Elaborate on Process synchronisation mechanisms and deadlocks in operating systems.	K6
CO4	Make use of Distributed systems for implementing synchronisation.	K3
CO5	Apply protection and security in operating systems.	K3

UNIT-I:

Overview of Operating systems: Introduction, Operating system services, System calls, Types of operating systems. **Process Management:** Process Concepts, Process states, process control block, process scheduling, Operations on processes, Scheduling Algorithms.

UNIT-II:

Memory management concepts: Swapping, Contiguous memory allocation, Paging, Segmentation, Virtual memory, Demand Paging, Page-replacement Algorithms, Thrashing.

UNIT-III

Process Synchronization: Critical section problem, Semaphores, Readers- Writers problem. **Deadlocks:** System model, Deadlocks Characterization, Methods for handling deadlocks, Deadlock prevention, Avoidance, Detection and Recovery from Deadlocks.

UNIT-IV

Operating System Support in Distributed Systems : Introduction , Operating System layer, Role of protection processes and address space. **Distributed Systems and Synchronization:** Clock Synchronization, logical clocks, mutual exclusion, Data-Centric Consistency Models, Client-Centric Consistency Models, Consistency Protocols, Ricart-Agarwala Algorithm, Maekawa Algorithm.

UNIT- V

File systems and protection: The concept of file, Access methods, Directory structure, File system structure, File system implementation, File sharing, Protection, Directory implementation, Allocation methods, Free space management. Case studies of Android, and iOS.

Text Books:

1. Operating System Concepts, 8th edition, Silberschatz and Galvin, John Wiley, 2009.
2. Distributed Systems, 2nd edition, Andrew S. Tanenbaum, Maarten Vantenn, 2007.

Reference Books:

1. Advanced Concepts in Operating Systems, Indian edition, Singhal, Mand Shivaratri, N.. Tata McGraw Hill, 2001.
2. Distributed computing: Principles, Algorithms, and systems, 1st edition, Kshemkalyani, A and Singhal M Cambridge university press, 2008.

I Year - I Semester	Internet of Things (V2321158E1)	L	T	P	C
		3	0	0	3

Course Objectives:

- To Understand Smart Objects and IoT Architectures.
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications.

Course Outcomes:

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

CO	Course Outcomes	Knowledge Level (K)#
CO1	Summarize on the term 'internet of things' in different contexts.	K2
CO2	Analyze various protocols for IoT.	K4
CO3	Design a PoC of an IoT system using Raspberry Pi/Arduino	K6
CO4	Apply data analytics and use cloud offerings related to IoT.	K3
CO5	Analyze applications of IoT in real time scenario	K4

UNIT I: FUNDAMENTALS OF IoT: Evolution of Internet of Things, Enabling Technologies, IoT Architectures, oneM2M, IoT World Forum (IoTWF) and Alternative IoT models, Simplified IoT Architecture and Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.

UNIT II: IoT PROTOCOLS: IT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks, Application Transport Methods: Supervisory Control and Data Acquisition, Application Layer Protocols: CoAP and MQTT.

UNIT III: DESIGN AND DEVELOPMENT: Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks, Arduino, Board details, IDE programming, Raspberry Pi, Interfaces and Raspberry Pi with Python Programming.

UNIT IV: DATA ANALYTICS AND SUPPORTING SERVICES: Structured Vs Unstructured Data and Data in Motion Vs Data in Rest, Role of Machine Learning – No SQL Databases, Hadoop Ecosystem, Apache Kafka, Apache Spark, Edge Streaming Analytics and Network Analytics, Xively Cloud for IoT, Python Web Application Framework, Django, AWS for IoT, System Management with NETCONF-YANG.

UNIT V: CASE STUDIES/INDUSTRIAL APPLICATIONS: Cisco IoT system, IBM Watson IoT platform, Manufacturing, Converged Plant wide Ethernet Model (CPwE), Power Utility Industry, Grid Blocks Reference Model, Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control.

Text Books:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, First Edition-2017

Reference Books:

1. Internet of Things – A hands-on approach, ArshdeepBahga, Vijay Madiseti, Universities Press, First Edition-2015
2. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2nd Edition-2012 (for Unit 2).
3. “From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence”, Jan Ho“ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 1st edition 2014.
4. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer, 2011.
5. Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, Michael Margolis, Arduino Cookbook and O’Reilly Media, 2011.

I Year - I Semester	Block Chain Technologies (V2321158E2)	L	T	P	C
		3	0	0	3

Course Objectives:

1. To learn the fundamentals of Block Chain and various types of block chain and consensus mechanism.
2. To understand public block chain system, Private block chain system and consortium block chain.
3. Able to know the security issues of blockchain technology.

Course Outcomes:

1. Able to work in the field of block chain technologies.

UNIT – I:

Fundamentals of Blockchain: Introduction, Origin of Blockchain, Blockchain Solution, Components of Blockchain, Block in a Blockchain, The Technology and the Future.

Blockchain Types and Consensus Mechanism: Introduction, Decentralization and Distribution, Types of Blockchain, Consensus Protocol.

Cryptocurrency: Bitcoin, Altcoin and Token: Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics, Types of Cryptocurrencies, Cryptocurrency Usage.

UNIT – II:

Public Blockchain System: Introduction, Public Blockchain, Popular Public Blockchains, The Bitcoin Blockchain, Ethereum Blockchain.

Smart Contracts: Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart Contracts, Types of Oracles, Smart Contracts in Ethereum, Smart Contracts in Industry.

UNIT – III:

Private Blockchain System: Introduction, Key Characteristics of Private Blockchain, Private Blockchain, Private Blockchain Examples, Private Blockchain and Open Source, E-commerce Site Example, Various Commands (Instructions) in E-commerce Blockchain, Smart Contract in Private Environment, State Machine, Different Algorithms of Permissioned Blockchain, Byzantine Fault, Multichain.

Consortium Blockchain: Introduction, Key Characteristics of Consortium Blockchain, Need of Consortium Blockchain, Hyperledger Platform, Overview of Ripple, Overview of Corda.

Initial Coin Offering: Introduction, Blockchain Fundraising Methods, Launching an ICO, Investing in an ICO, Pros and Cons of Initial Coin Offering, Successful Initial Coin Offerings, Evolution of ICO, ICO Platforms.

UNIT – IV:

Security in Blockchain: Introduction, Security Aspects in Bitcoin, Security and Privacy Challenges of Blockchain in General, Performance and Scalability, Identity Management and Authentication, Regulatory Compliance and Assurance, Safeguarding Blockchain Smart Contract (DApp), Security Aspects in Hyperledger Fabric.

Applications of Blockchain: Introduction, Blockchain in Banking and Finance, Blockchain in Education, Blockchain in Energy, Blockchain in Healthcare, Blockchain in Real-estate, Blockchain in Supply Chain, The Blockchain and IoT. Limitations and Challenges of Blockchain.

UNIT – V:

Blockchain Case Studies:

Case Study 1 – Retail,

Case Study 2 – Banking and Financial Services, Case

Study 3 – Healthcare,

Case Study 4 – Energy and Utilities.

Blockchain Platform using Python: Introduction, Learn How to Use Python Online Editor, Basic Programming Using Python, Python Packages for Blockchain.

Blockchain platform using Hyperledger Fabric: Introduction, Components of Hyperledger Fabric Network, Chain codes from Developer.ibm.com, Blockchain Application Using Fabric Java SDK.

Text book:

1. “Block chain Technology”, Chandramouli Subramanian, Asha A.George, Abhilasj K A and Meena Karthikeyan , Universities Press.

Reference Books:

1. Blockchain Blue print for Economy, Melanie Swan, SPD Oreilly.
2. Blockchain for Business, Jai Singh Arun, Jerry Cuomo, Nitin Gaur, Pearson Addition Wesley

I Year - I Semester	Service Oriented Architectures (V2321158E3)	L	T	P	C
		3	0	0	3

Course Objectives:

- To learn fundamentals of XML.
- To provide an overview of Service Oriented Architecture and Web services and their importance.
- To learn web services standards and technologies.
- To learn service-oriented analysis and design for developing SOA based applications.

Course Outcomes:

Upon successful completion of the course, students should be able to:

1. Able to build applications based on XML.
2. Know the service orientation concepts, benefits of SOA.
3. Develop web services and WS standards.
4. Use web services extensions to develop solutions.
5. Apply service modeling, service oriented analysis and design for application development

UNIT-I:

INTRODUCTION TO XML: XML document structure, Well-formed and valid documents, DTD, XML Schema, Parsing XML using DOM, SAX, XPath, XML Transformation and XSL, X Query.

UNIT-II:

SERVICE ORIENTED ARCHITECTURE (SOA) Basics: Characteristics of SOA, Benefits of SOA, and Comparing SOA with Client-Server and Distributed architectures, Principles of Service Orientation, Service layers.

UNIT-III:

WEB SERVICES (WS) and STANDARDS: Web Services Platform, Service descriptions, WSDL, Messaging with SOAP, Service discovery, UDDI, Service- Level Interaction Patterns, Orchestration and Choreography.

UNIT-IV:

Web Services Extensions : WS Addressing, WS Reliable Messaging, WS Policy, WS Coordination, WS Transactions, WS Security, Examples.

UNIT-V:

Service Oriented Analysis and Design: SOA delivery strategies, Service oriented analysis, Service Modelling, Service oriented design, Standards and composition guidelines, Service design, Business process design, Case Study.

Text Books:

1. Thomas Erl, “Service Oriented Architecture: Concepts, Technology and Design”, Pearson Education, 2005.
2. Sandeep Chatterjee and James Webber, “Developing Enterprise Web Services: An Architect's Guide”, Prentice Hall, 2004.
3. James McGovern, Sameer Tyagi, Michael E Stevens and Sunil Mathew, “Java Web Services Architecture”, Elsevier, 2003.

Reference Books:

1. Ron Schmelzer et al. \ XML and Web Services., Pearson Education, 2002.
2. Frank P.Coyle, \XML, Web Services and the Data Revolution., Pearson Education, 2002
3. Thomas Erl, “Service Oriented Architecture: Concepts, Technology, and Design”, Pearson Education, 2005.

I Year - I Semester	Advanced Software Engineering (V2321158E4)	L	T	P	C
		3	0	0	3

Course Objectives: This course is designed to provide an in depth understanding of phases of Software Development, common process models including Waterfall, the Unified Process, hands-on experience with elements of the agile process, a variety of Software Engineering practices such as requirements analysis and specification, code analysis, code debugging, testing, and Software Design techniques

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

CO	Course Outcomes	Knowledge Level (K)#
CO1	Demonstrate software process, various models and Agile methodologies	K2
CO2	Analyze and Specify software requirements through a SRS documents	K3, K4
CO3	Design and Plan software solutions to problems	K6
CO4	Analyze the importance of Quality assurance and design, implement, and execute test cases at the Unit level	K4, K6
CO5	Design, implement, and execute test cases at Integration level and analyze the role of various metrics.	K6

UNIT I:

Software and Software Engineering: Nature of software, Software Process, Software Engineering Practice.

Process Models: Generic process model, defining a framework activity, identifying task set, process assessment and improvement, perspective process models

Agility and process: Agility, Agile process, Scrum, other Agile frameworks, recommended process model

UNIT II:

Human aspects of Software Engineering: characteristics and psychology of Software Engineer, software team, team structure

Principles that guide practice: core principles, principles that guide each framework activity

Understanding Requirements: Requirements engineering, establishing groundwork, requirements gathering, developing use cases, building analysis model, negotiating requirements, requirements monitoring, validating requirements

Requirements modeling: requirements analysis, class-based modeling, functional modeling, behavioural modeling

UNIT III:

Design: Design process, design concepts, design model

Architectural design: software architecture, architectural styles, architectural design, assessing alternative architectural designs

User experience design: elements, golden rules, User interface analysis and design, user experience analysis, user interface design, design evaluation, usability and accessibility
Design for mobility: mobile development life cycle, mobile architecture, web design pyramid, , mobility and design quality, best practices.

UNIT IV:

Quality: software quality, quality dilemma, achieving software quality

Reviews: review metrics, Informal reviews, Formal technical reviews

Software Quality Assurance: elements, SQA process, Product characteristics, SQA tasks, goals and metrics, statistical software quality assurance, software reliability, ISO 9000 quality standards, SQA plan

Software testing: strategic approach to software testing, planning and recordkeeping, test case design, white box testing, black box testing, object oriented testing

UNIT V:

Software testing- integration level: Software testing fundamentals, integration testing, regression testing, integration testing in OO context, validation testing

Software testing- testing for mobility: mobile testing guidelines, testing strategies, User experience testing issues, web application testing, Web testing strategies, security testing, performance testing

Software metrics and analytics: software measurement, software analytics, product metrics, metrics for testing, metrics for maintenance, process and project metrics, software measurement, metrics for software quality

Text Books:

1. “Software Engineering, A practitioner’s Approach”, Roger S. Pressman, Bruce R. Maxim, 9th Edition, Tata McGraw-Hill.
2. “Software Engineering”, Ian Sommerville, 9th edition, Pearson education

Reference Books:

1. Software Engineering : A Primer, Waman S Jawadekar, Tata McGraw-Hill, 2008
2. Software Engineering, Principles and Practices, Deepak Jain, Oxford University Press.

I Year - I Semester	Advanced Compiler Design (V2321158E5)	L	T	P	C
		3	0	0	3

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

CO	Course Outcomes	Knowledge Level (K)#
CO1	Demonstrate phases in the design of compiler	K2
CO2	Organize Syntax Analysis, Top Down and LL(1) grammars	K3
CO3	Design Bottom Up Parsing and Construction of LR parsers	K6
CO4	Analyze synthesized, inherited attributes and syntax directed translation schemes	K4
CO5	Determine algorithms to generate code for a target machine	K5

SYLLABUS:

UNIT-1: Lexical Analysis: Language Processors, Structure of a Compiler, Lexical Analysis, The Role of the Lexical Analyzer, Bootstrapping, Input Buffering, Specification of Tokens, Recognition of Tokens, Lexical Analyzer Generator-LEX, Finite Automata, Regular Expressions and Finite Automata, Design of a Lexical Analyzer Generator.

UNIT-2: Syntax Analysis: The Role of the Parser, Context-Free Grammars, Derivations, Parse Trees, Ambiguity, Left Recursion, Left Factoring, **Top Down Parsing:** Pre Processing Steps of Top Down Parsing, Backtracking, Recursive Descent Parsing, LL (1) Grammars, Non-recursive Predictive Parsing, Error Recovery in Predictive Parsing.

UNIT-3: Bottom Up Parsing: Introduction, Difference between LR and LL Parsers, Types of LR Parsers, Shift Reduce Parsing, SLR Parsers, Construction of SLR Parsing Tables, More Powerful LR Parses, Construction of CLR (1) and LALR Parsing Tables, Dangling Else Ambiguity, Error Recovery in LR Parsing, Handling Ambiguity Grammar with LR Parsers.

UNIT-4: Syntax Directed Translation: Syntax-Directed Definitions, Evaluation Orders for SDD's, Applications of Syntax Directed Translation, Syntax-Directed Translation Schemes, Implementing L-Attributed SDD's. **Intermediate Code Generation:** Variants of Syntax Trees, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking, Control Flow, Backpatching, Intermediate Code for Procedures.

UNIT-5: Run Time Environments: Storage Organization, Run Time Storage Allocation, Activation Records, Procedure Calls, Displays, **Code Optimization:** The Principle Sources of Optimization, Basic Blocks, Optimization of Basic Blocks, Structure Preserving Transformations, Flow Graphs, Loop Optimization, Data-Flow Analysis, Peephole Optimization, **Code Generation:** Issues in the Design of a Code Generator, Object Code Forms, Code Generation Algorithm, Register Allocation and Assignment.

Text Books:

- Compilers: Principles, Techniques and Tools, Second Edition, Alfred V.Aho, Monica S. Lam, Ravi Sethi, Jeffry D. Ullman, Pearson Publishers, 2007.

Reference Books:

1. Compiler Construction, Principles and Practice, Kenneth C Loudon, Cengage Learning, 2006
2. Modern compiler implementation in C, Andrew W Appel, Revised edition, Cambridge University Press.
3. Optimizing Compilers for Modern Architectures, Randy Allen, Ken Kennedy, Morgan Kaufmann, 2001.
4. Levine, J.R., T. Mason and D. Brown, Lex and Yacc, edition, O'Reilly & Associates, 1990

I Year - I Semester	Advanced Computer Networks (V2321158E6)	L	T	P	C
		3	0	0	3

Course Objectives: This course is aimed at enabling the students to

- The course is aimed at providing basic understanding of Computer networks starting with OSI Reference Model, Protocols at different layers with special emphasis on IP, TCP & UDP and Routing algorithms.
- Some of the major topics which are included in this course are CSMA/CD, TCP/IP implementation, LANs/WANs, internetworking technologies, Routing and Addressing.
- Provide the mathematical background of routing protocols.
- Aim of this course is to develop some familiarity with current research problems and research methods in advance computer networks.

Course Outcomes:

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

CO	Course Outcomes	Knowledge Level (K)#
CO1	Illustrate reference models with layers, protocols and interfaces.	K2
CO2	Describe the routing algorithms, Sub netting and Addressing of IP V4and IPV6.	K4
CO3	Describe and Analysis of basic protocols of computer networks, and how they can be used to assist in network design and implementation.	K3
CO4	Describe the concepts Wireless LANS, WIMAX, IEEE 802.11, Cellular telephony and Satellite networks	K6
CO5	Describe the emerging trends in networks-MANETS and WSN	K2

Unit-I: Network layer: Network Layer design issues: store-and forward packet switching, services provided transport layers, implementation connection less services, implementation connection oriented services, comparison of virtual – circuit and datagram subnets, Routing Algorithms-shortest path routing, flooding, distance vector routing, link state routing, Hierarchical routing,

congestion control algorithms : Approaches to congestion control, Traffic aware routing, Admission control, Traffic throttling, choke Packets, Load shedding, Random early detection, Quality of Service, Application requirements, Traffic shaping, Leaky and Token buckets

Unit-II: Internetworking and IP protocols: How networks differ, How net works can be connected, internetworking, tunneling, The network layer in the internet,IPV4 Protocol, IP addresses, Subnets, CIDR, classful and Special addressing, network address translation (NAT),IPV6 Address structure address space, IPV6 Advantages, packet format, extension Headers, Transition from IPV4 to IPV6 , Internet Control Protocols-IMCP, ARP, DHCP

Unit-III: Transport Layer Protocols: Introduction, Services, Port numbers, User Datagram Protocol: User datagram, UDP services, UDP Applications, Transmission control Protocol: TCP services, TCP features, Segment, A TCP connection, State transition diagram, Windows in TCP, Flow control and error control, TCP Congestion control, TCP Timers, **SCTP:** SCTP services SCTP features, packet format, An SCTP association, flow control, error control.

Unit- IV: Wireless LANS: Introduction, Architectural comparison, Access control, The IEEE 802.11 Project: Architecture, MAC sub layer, Addressing Mechanism, Physical Layer, Bluetooth: Architecture, Bluetooth Layers

Other Wireless Networks: WIMAX: Services, IEEE project 802.16, Layers in project 802.16, Cellular Telephony: Operations, First Generation (1G), Second Generation (2G), Third Generation (3G), Fourth Generation (4G), Satellite Networks: Operation, GEO Satellites, MEO satellites, LEO satellites.

Unit-V: Emerging trends in Computer networks:

Mobile computing: Motivation for mobile computing, Protocol stack issues in mobile computing environment, mobility issues in mobile computing, security issues in mobile networks, MOBILE Ad Hoc Networks: Applications of Ad Hoc Networks, Challenges and Issues in MANETS, MAC Layer Issues Routing Protocols in MANET, Transport Layer Issues, Ad hoc Network Security

Wireless Sensor Networks: WSN functioning, Operating system support in sensor devices, WSN characteristics, sensor network operation, Sensor Architecture: Cluster management, Wireless Mesh Networks: WMN design , Issues in WMNs, Computational Grids, Grid Features, Issues in Grid construction design, Grid design features, P2P Networks: Characteristics of P2P Networks, Classification of P2P systems, Gnutella, BitTorrent, Session Initiation Protocol(SIP) , Characteristics and addressing, Components of SIP, SIP establishment, SIP security.

Text Books:

1. Data communications and networking 4th edition Behrouz A Fourzan, TMH-2007
2. Computer networks 4th edition Andrew S Tanenbaum, Pearson, 2012
3. Computer networks, Mayank Dave, CENGAGE, First edition. 2012

Reference Books:

1. Computer networks, A system Approach, 5th ed, Larry L Peterson and Bruce S Davie, Elsevier-2012

I Year - I Semester	Research Methodology and IPR	L	T	P	C
		2	0	0	2

Course Objectives:

- ☐ Student able analyze the Effective literature studies approaches, analysis, Plagiarism, Research ethics.
- ☐ Student should able understand problem, Scope and objectives of research problem.
- ☐ To learn and understand Traditional knowledge Case Studies, IPR and IITs

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

Course Outcomes		Knowledge Level (K)#
CO1	Demonstrate the research and its types, Reviewing literature. Identifying and defining research problem.	K2
CO2	Explaining research design methods, sampling techniques	K5
CO3	Designing and development of measuring instruments, data collection and analysis methods	K6
CO4	Show the IPR protection provides an incentive to inventors for further research work and Investment in R & D, which leads to creation of new and better products, and in turn brings about, Economic growth and social benefits.	K1
CO5	Identify Research proposal, research report and evaluating research	K3

UNIT-I: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT-II: Effective literature studies approaches, analysis, Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT-III: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT

UNIT-IV: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications

UNIT-V: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text Book:

1. Research methodology: an introduction for science & engineering students, 1st Edition, [Stuart Melville](#), [Wayne Goddard](#), 1996

Reference Books:

1. Research Methodology: A Step by Step Guide for beginners, 2nd Edition, Ranjit Kumar, 2011
2. Resisting Intellectual Property, 1st Edition, Halbert, Taylor & Francis Ltd., 2007

I Year - I Semester	Software Lab-1 (V232115861)	L	T	P	C
		0	0	3	1.5

List of Experiments:

1. Get familiar with OpenMP environment
2. Executing simple programs with OpenMp (vector addition, dot product)
3. Design and implement parallel Breadth First Search and Depth First search based on existing algorithms using OpenMP. Use a Tree or an undirected graph for BFS and DFS.
4. Write a program to implement parallel Bubble sort and Merge sort using OpenMP. Use existing algorithms and measure the performance of sequential and parallel algorithms.
5. Implement Min, Max, Sum and Average operations using Parallel Reduction
6. Write a CUDA Program for
 - Addition of two large vectors
 - Matrix multiplication using CUDA C
7. Mini Project: Evaluate performance enhancement of parallel Quicksort Algorithm using MPI

I Year - I Semester	English for Research Paper Writing	L	T	P	C
		2	0	0	0

Course Objectives:

- ☐ Understand that how to improve your writing skills and level of Readability
- ☐ Learn about what to write in each section
- ☐ Understand the skills needed when writing a Title

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

Course Outcomes		Knowledge Level (K)#
CO1	How to improve your writing skills and level of readability	K1
CO2	Explain about what to write in each section	K3
CO3	Classify the skills needed when writing a Title	K2

UNIT-I: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT-II: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts Introduction

UNIT-III: Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT-IV: Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature

UNIT-V: Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT-VI: Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Text Books:

- Writing for Science, 0th Edition, Yale University Press, Goldbort R 2006
- How to Write and Publish a Scientific Paper, 7th Edition, Cambridge University Press, Day R 2006
- Handbook of Writing for the Mathematical Sciences, 2nd Edition, SIAM, Highman's book, Highman N 1998

I Year - I Semester	Disaster Management	L	T	P	C
		2	0	0	0

Course Objectives:

- ☐ Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- ☐ Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- ☐ Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- ☐ critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

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

Course Outcomes		Knowledge Level (K)#
CO1	Demonstrate the critical understanding of key concepts in disaster risk reduction and humanitarian response.	K2
CO2	Evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.	K5
CO3	Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.	K6
CO4	Analyze the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in	K4
CO5	Describe disaster risk reduction and humanitarian response. Outline the disaster risk reduction and humanitarian response policy and practice from multiple perspectives.	K2,K3

UNIT-I: Introduction- Disaster- Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT-II: Repercussions of Disasters And Hazards- Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters- Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT-III: Disaster Prone Areas In India- Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches, Areas Prone to Cyclonic and Coastal Hazards With Special Reference to Tsunami, Post-Disaster Diseases and Epidemics

UNIT–IV: Disaster Preparedness And Management- Preparedness: Monitoring of Phenomena Triggering A Disaster or Hazard;
Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT–V: Risk Assessment- Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment, Strategies for Survival.

Disaster Mitigation- Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation, Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation In India.

Text Books:

1. Disaster Management in India: Perspectives, issues and strategies, R.Nishith, Singh AK, New Royal book Company
2. Disaster Mitigation Experiences and Reflections, Sahni, New Title Edition, Pardeep Et. Al. (Eds.), Prentice Hall Of India, New Delhi
3. Disaster Administration and Management Text and Case Studies, 1st Edition, Deep & Deep Publication Pvt. Ltd., Goel S. L., New Delhi

I Year - I Semester	Sanskrit for Technical Knowledge	L	T	P	C
		2	0	0	0

Course Objectives:

- ☐ To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- ☐ Learning of Sanskrit to improve brain functioning
- ☐ Learning of Sanskrit to develop the logic in mathematics, science & other subjects
- ☐ enhancing the memory power
- ☐ The engineering scholars equipped with Sanskrit will be able to explore the
- ☐ Huge knowledge from ancient literature

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

Course Outcomes		Knowledge Level (K)#
CO1	Demonstrate basic Sanskrit language	K2
CO2	Illustrate Ancient Sanskrit literature about science & technology	K2
CO3	Build a logical language will help to develop logic in students	K6

UNIT-I: Alphabets in Sanskrit, Past/Present/Future Tense.

UNIT-II: Simple Sentences forming in Sanskrit.

UNIT-III: Order of Sanskrit sentences, Introduction of roots in Sanskrit language.

UNIT-IV: Technical information about Sanskrit Literature.

UNIT-V: Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics.

Text Books:

1. Abhyaspustakam – Dr.Vishwas, 1st Edition, Samskrita-Bharti Publication, New Delhi
2. Teach Yourself Sanskrit, Prathama Deeksha, Vempati Kutumbashastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. India's Glorious Scientific Tradition, 1st Edition, Suresh Soni, Ocean books (P) Ltd., New Delhi

I Year - I Semester	Value Education (V2321258C1)	L	T	P	C
		2	0	0	0

Course Objectives:

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

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

Course Outcomes		Knowledge Level (K)#
CO1	Infer the knowledge of self-development	K2
CO2	Describe the importance of Human values	K2
CO3	Developing the overall personality	K6

UNIT-I: Values and self-development- Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation, Standards and principles, Value judgments

UNIT-II: Importance of cultivation of values- Sense of duty, Devotion, Self- reliance, Confidence, Concentration. Truthfulness, Cleanliness, Honesty, Humanity, Power of faith, National Unity, Patriotism. Love for nature, Discipline.

UNIT-III: Personality and Behaviour Development-Soul and Scientific attitude, Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking.

UNIT – IV: Free from anger, Dignity of labour- Universal brotherhood and religious tolerance, True friendship, Happiness Vs suffering, love for truth, Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature.

UNIT – V: Character and Competence- Holy books vs Blind faith, Self- management and Good health, Science of reincarnation, Equality, Nonviolence, Humility, Role of Women, All religions and same message, Mind your Mind, Self- control, Honesty, Studying effectively.

Text Books:

1. Values and Ethics for organizations Theory and practice, Latest Edition, Chakroborty, S.K., Oxford University Press, New Delhi

I Year - II Semester	DevOps (V232125831)	L	T	P	C
		3	0	0	3

Course Objectives: The main objectives of this course are to:

1. Describe the agile relationship between development and IT operations.
2. Understand the skill sets and high-functioning teams involved in DevOps and related methods to reach a continuous delivery capability.
3. Implement automated system update and DevOps lifecycle.

Course Outcomes: On successful completion of this course, students will be able to:

1. Identify the DevOps Concepts and Tools for effective project management.
2. Utilize GIT to keep track of different versions of the source code.
3. Build and Automate Test using Jenkins.
4. Implement containerization with Docker.
5. Use ANSIBLE, Kubernetes for automation and deployment.

UNIT-I

Introduction to DevOps: Introduction to SDLC, Agile Model. Introduction to DevOps. DevOps Features, DevOps Architecture, DevOps Lifecycle, Understanding Workflow and principles, Introduction to DevOps tools, Build Automation, Delivery Automation, Understanding Code Quality, and Automation of CI / CD. Release management, Scrum, Kanban, delivery pipeline, bottlenecks, examples

UNIT-II

Source Code Management (GIT): The need for source code control, The history of source code management, Roles and code, source code management system and migrations. What is Version Control and GIT, GIT Installation, GIT features, GIT workflow, working with remote repository, GIT commands, GIT branching, GIT staging and collaboration. **UNIT TESTING - CODE COVERAGE:** Junit, NUnit & Code Coverage with Sonar Qube, SonarQube - Code Quality Analysis.

UNIT-III

Build Automation - Continuous Integration (CI): Build Automation, What is CI Why CI is Required, CI tools, Introduction to Jenkins (With Architecture), Jenkins workflow, Jenkins master slave architecture, Jenkins Pipelines, PIPELINE BASICS - Jenkins Master, Node, Agent, and Executor Freestyle Projects & Pipelines, Jenkins for Continuous Integration, Create and Manage Builds, User Management in Jenkins Schedule Builds, Launch Builds on Slave Nodes.

UNIT-IV

Continuous Delivery: Importance of Continuous Delivery, CONTINUOUS DEPLOYMENT CD Flow, Containerization with Docker: Introduction to Docker, Docker installation, Docker commands, Images & Containers, DockerFile, Running containers, Working with containers and publish to Docker Hub.

Testing Tools: Introduction to Selenium and its features, JavaScript testing.

UNIT-V

Configuration Management - ANSIBLE: Introduction to Ansible, Ansible tasks Roles, Jinja2 templating, Vaults, Deployments using Ansible.

CONTAINERIZATION USING KUBERNETES(OPENSHIFT): Introduction to Kubernetes Namespace & Resources, CI/CD - On OCP, BC, DC & ConfigMaps, Deploying Apps on Openshift Container Pods. Introduction to Puppet master and Chef.

List of Experiments:

1. Write code for a simple user registration form for an event.
2. Explore Git and GitHub commands.
3. Practice Source code management on GitHub. Experiment with the source code written in exercise 1.
4. Jenkins installation and setup, explore the environment.
5. Demonstrate continuous integration and development using Jenkins.
6. Explore Docker commands for content management.
7. Develop a simple containerized application using Docker.
8. Integrate Kubernetes and Docker
9. Automate the process of running containerized application developed in exercise 7 using Kubernetes.
10. Install and Explore Selenium for automated testing.
11. Write a simple program in JavaScript and perform testing using Selenium.
12. Develop test cases for the above containerized application using selenium.

Text Books

1. Joyner, Joseph., Devops for Beginners: Devops Software Development Method Guide for Software Developers and It Professionals, 1st Edition Mihails Konoplows, 2015.
2. Alisson Machado de Menezes., Hands-on DevOps with Linux, 1st Edition, BPB Publications, India, 2021.

Reference Books

1. Len Bass, Ingo Weber, Liming Zhu. DevOps: A Software Architect's Perspective. Addison Wesley; ISBN-10
2. Gene Kim Je Humble, Patrick Debois, John Willis. The DevOps Handbook, 1st Edition, IT Revolution Press, 2016.
3. Verona, Joakim Practical DevOps, 1st Edition, Packt Publishing, 2016.
4. Joakim Verona. Practical Devops, Second Edition. Ingram short title; 2nd edition (2018). ISBN10: 1788392574
5. Deepak Gaikwad, Viral Thakkar. DevOps Tools from Practitioner's Viewpoint. Wiley publications. ISBN: 9788126579952

I Year - II Semester	MEAN Stack Technologies (V232125832)	L	T	P	C
		3	0	0	3

Course Objectives:

From the course the student will learn

- ☐ Translate user requirements into the overall architecture and implementation of new systems and Manage Project and coordinate with the Client.
- ☐ Writing optimized front end code HTML and JavaScript.
- ☐ Monitor the performance of web applications & infrastructure and Troubleshooting web application with a fast and accurate a resolution
- ☐ Design and implementation of Robust and Scalable Front End Applications.

Course Outcomes:

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

CO	Description	Knowledge Level (K)#
CO1	Identify the Basic Concepts of Web & Markup Languages.	K3
CO2	Develop web Applications using Scripting Languages & Frameworks.	K3
CO3	Make use of Express JS and Node JS frameworks	K3
CO4	Illustrate the uses of web services concepts like restful, react js.	K2
CO5	Adapt to Deployment Techniques & Working with cloud platform.	K6

UNIT I: Introduction to Web: Internet and World Wide Web, Domain name service, Protocols: HTTP, FTP, SMTP. **Html5** concepts, **CSS3**, Anatomy of a web page. **XML:** Document type Definition, XML schemas, Document object model, XSLT, DOM and SAX Approaches.

UNIT II: JavaScript: The Basic of JavaScript: Objects, Primitives Operations and Expressions, Control Statements, Arrays, Functions, Constructors, Pattern Matching using Regular Expressions. **Angular Java Script** Angular JS

Expressions: ARRAY, Objects, \$eval, Strings, Angular JS Form Validation & Form Submission, Single Page Application development using Angular JS

UNIT III: Node.js: Introduction, Advantages, Node.js Process Model, Node JS Modules. **Express.js:** Introduction to Express Framework, Introduction to Nodejs , What is Nodejs, Getting Started with Express, Your first Express App, Express Routing, Implementing MVC in Express, Middleware, Using Template Engines, Error Handling , API Handling , Debugging, Developing Template Engines, Using Process Managers, Security & Deployment.

UNIT IV: RESTful Web Services: Using the Uniform Interface, Designing URIs, Web Linking, Conditional Requests. **React Js:** Welcome to React, Obstacles and Roadblocks, React's Future, Keeping Up with the Changes, Working with the Files, Pure React, Page Setup, The Virtual DOM, React Elements, ReactDOM, Children, Constructing Elements with Data, React Components, DOM Rendering, Factories

UNIT V: Mongo DB: Introduction, Architecture, Features, Examples, Database Creation & Collection in Mongo DB. Deploying Applications: Web hosting & Domains, Deployment Using Cloud Platforms.

List of Experiments:

Experiment-1:

Develop static pages (using only HTML) of an online Book store. The pages should resemble: www.amazon.com. The website should consist of the following pages. Home page

- ☐ Registration and user Login
- ☐ User profile page
- ☐ Books catalog
- ☐ Shopping cart
- ☐ Payment by credit card Order Conformation

Experiment-2:

Write an HTML page including any required JavaScript that takes a number from text field in the range of 0 to 999 and shows it in words. It should not accept four and above digits, alphabets and special characters.

Experiment-3:

Develop and demonstrate JavaScript with POP-UP boxes and functions for the following problems:

- a) Input: Click on Display Date button using on click () function Output: Display date in the textbox
- b) Input: A number n obtained using prompt Output: Factorial of n number using alert
- c) Input: A number n obtained using prompt Output: A multiplication table of numbers from 1 to 10 of n using alert
- d) Input: A number n obtained using prompt and add another number using confirm Output: Sum of the entire n numbers using alert

Experiment-4:

Create a simple visual bean with a area filled with a color. The shape of the area depends on the property shape. If it is set to true then the shape of the area is Square and it is Circle, if it is false. The color of the area should be changed dynamically for every mouse click.

Experiment-5:

Create an XML document that contains 10 users information. Write a Java Program, which takes User Id as input and returns the user details by taking the user information from XML document using DOM parser or SAX parser.

Experiment-6:

Develop and demonstrate PHP Script for the following problems:

- Write a PHP Script to find out the Sum of the Individual Digits.
- Write a PHP Script to check whether the given number is Palindrome or not

Experiment-7:

Implement the following in CSS

- Implementation of 'get' and 'post' methods.
- Implementation in colors, boarder padding.
- Implementation button frames tables, navigation bars.

Experiment-8:

Implement the web applications with Database using

- PHP,
- Servlets and
- JSP.

Experiment-9:

Write a program to design a simple calculator using

- JavaScript
- PHP
- Servlet and
- JSP.

Experiment-10:

Create registration and login forms with validations using Jscript query.

Experiment-11:

Jscript to retrieve student information from student database using database connectivity.

Experiment-12:

Implement the following in React JS

- Using React Js creating constructs data elements.
- Using React Js implementations DoM.

Experiment-13:

Implement the following in Angular JS

- Angular Js data binding.
- Angular JS directives and Events.
- Using angular Js fetching data from MySQL.

Experiment-14:

Develop and demonstrate Invoking data using Jscript from Mongo DB.

Experiment-15:

Create an Online fee payment form using JScript and MangoDB.

Text Books:

1. Programming the World Wide Web, Robert W Sebesta, 7ed, Pearson-2013
2. Web Technologies, Uttam K Roy, Oxford-2010
3. Pro Mean Stack Development, ELadElrom, Apress 1st edition-2016
4. Restful Web Services Cookbook, SubbuAllamraju, O'Reilly-2010
5. JavaScript & jQuery the missing manual, David sawyer mcfarland, O'Reilly 3rd Edition-2015
6. Web Hosting for Dummies, Peter Pollock, John Wiley Brand-2013

Reference Books:

1. Ruby on Rails up and Running, Lightning fast Web development, Bruce Tate, Curt Hibbs, Oreilly, 1st edition-2006
2. Programming Perl, 4ed, Tom Christiansen, Jonathan Orwant, Oreilly, 2012
3. Web Technologies, HTML < JavaScript, PHP, Java, JSP, XML and AJAX, Black book, Dream Tech 1st edition-2013
4. An Introduction to Web Design, Programming, Paul S Wang, Sanda S Katila, Cengage Learning, 1st edition-2003
5. Express.JS Guide, The Comprehensive Book on Express.js, Azat Mardan, Lean Publishing-2014

I Year - II Semester	Reinforcement Learning (V232125833)	L	T	P	C
		3	0	0	3

Course Objective:

To provide the fundamentals of Reinforcement learning.

Course Outcomes:

- Enumerate the elements of Reinforcement Learning
- Solve the n-armed Bandit problem
- Compare different Finite Markov Decision Process
- Discuss about Monte Carlo Methods in solving real world problems
- List the Applications and Case Studies of Reinforcement Learning

UNIT-I

The Reinforcement Learning Problem: Reinforcement Learning, Examples, Elements of Reinforcement Learning, Limitations and Scope, An Extended Example: Tic-Tac-Toe, Summary, History of Reinforcement Learning.

UNIT-II

Multi-arm Bandits: An n-Armed Bandit Problem, Action-Value Methods, Incremental Implementation, Tracking a Nonstationary Problem, Optimistic Initial Values, Upper-Confidence-Bound Action Selection, Gradient Bandits, Associative Search (Contextual Bandits)

UNIT-III

Finite Markov Decision Processes: The Agent-Environment Interface, Goals and Rewards, Returns, Unified Notation for Episodic and Continuing Tasks, The Markov Property, Markov Decision Processes, Value Functions, Optimal Value Functions, Optimality and Approximation.

UNIT-IV

Monte Carlo Methods: Monte Carlo Prediction, Monte Carlo Estimation of Action Values, Monte Carlo Control, Monte Carlo Control without Exploring Starts, Off-policy Prediction via Importance Sampling, Incremental Implementation, Off-Policy Monte Carlo Control, Importance Sampling on Truncated Returns

UNIT-V

Applications and Case Studies: TD-Gammon, Samuel's Checkers Player, The Acrobot, Elevator Dispatching, Dynamic Channel Allocation, Job-Shop Scheduling.

Text Books:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning-An Introduction", 2nd Edition, The MIT Press, 2018
2. Marco Wiering, Martijn van Otterlo Reinforcement Learning: State-of-the-Art (Adaptation, Learning, and Optimization (12)) 2012th Edition

Reference Books:

1. Vincent François-Lavet , Peter Henderson , Riashat Islam, An Introduction to Deep Reinforcement Learning (Foundations and Trends(r)in Machine Learning) , 2019

I Year - II Semester	Machine Learning (V232125834)	L	T	P	C
		3	0	0	3

Course Objectives:

Machine Learning course will

- Develop an appreciation for what is involved in learning from data.
- Demonstrate a wide variety of learning algorithms.
- Demonstrate how to apply a variety of learning algorithms to data.
- Demonstrate how to perform evaluation of learning algorithms and model selection.

Course Outcomes:

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

- Domain Knowledge for Productive use of Machine Learning and Diversity of Data.
- Demonstrate on Supervised and Computational Learning
- Analyze on Statistics in learning techniques and Logistic Regression
- Illustrate on Support Vector Machines and Perceptron Algorithm
- Design a Multilayer Perceptron Networks and classification of decision tree

UNIT-I:

Introduction-Towards Intelligent Machines, Well posed Problems, Example of Applications in diverse fields, Data Representation, Domain Knowledge for Productive use of Machine Learning, Diversity of Data: Structured / Unstructured, Forms of Learning, Machine Learning and Data Mining, Basic Linear Algebra in Machine Learning Techniques.

UNIT-II:

Supervised Learning- Rationale and Basics: Learning from Observations, Bias and Why Learning Works: Computational Learning Theory, Occam's Razor Principle and Overfitting Avoidance Heuristic Search in inductive Learning, Estimating Generalization Errors, Metrics for assessing regression, Metrics for assessing classification.

UNIT-III:

Statistical Learning- Machine Learning and Inferential Statistical Analysis, Descriptive Statistics in learning techniques, Bayesian Reasoning: A probabilistic approach to inference, K-Nearest Neighbor Classifier. Discriminant functions and regression functions, Linear Regression with Least Square Error Criterion, Logistic Regression for Classification Tasks, Fisher's Linear Discriminant and Thresholding for Classification, Minimum Description Length Principle.

UNIT-IV:

Support Vector Machines (SVM)-Introduction, Linear Discriminant Functions for Binary Classification, Perceptron Algorithm, Large Margin Classifier for linearly separable data, Linear Soft Margin Classifier for Overlapping Classes, Kernel Induced Feature Spaces, Nonlinear Classifier, Regression by Support vector Machines. **Learning with Neural Networks:** Towards Cognitive Machine, Neuron Models, Network Architectures, Perceptrons, Linear neuron and the Widrow-Hoff Learning Rule, The error correction delta rule.

UNIT -V:

Multilayer Perceptron Networks and error back propagation algorithm, Radial Basis Functions Networks. **Decision Tree Learning:** Introduction, Example of classification decision tree, measures of impurity for evaluating splits in decision trees, ID3, C4.5, and CART decision trees, pruning the tree, strengths and weakness of decision tree approach.

Text Books:

1. Applied Machine Learning, M.Gopal, McGraw Hill Education, 2019
2. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012

Reference Books:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
2. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

I Year - II Semester	Natural Language Processing (V2321258F1)	L	T	P	C
		3	0	0	3

Course Objectives:

This course introduces the fundamental concepts and techniques of natural language processing (NLP).

- Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
- The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.
- Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.

Course Outcomes:

After completion of this course

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

UNIT I:

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

UNIT II:

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

UNIT III:

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

UNIT IV:

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

UNIT V:

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

Text Books:

1. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, 2nd Edition, Daniel Jurafsky, James H. Martin -Pearson Publication, 2014.
2. Natural Language Processing with Python, First Edition, Steven Bird, Ewan Klein and Edward Loper, O'Reilly Media, 2009.

Reference Books:

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

I Year - II Semester	Cyber Security (V2321258F2)	L	T	P	C
		3	0	0	3

Course Objectives:

- Cyber security course is to create a strong foundation and detailed technical knowledge in security, privacy, and cryptography applied to computer systems networks and web applications.

Course Outcomes:

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

CO	Description	Knowledge Level (K)#
CO1	Understand key terms and concepts in security, intellectual property and cyber crimes, trademarks and domain theft.	K4
CO2	Determine computer technologies, digital evidence collection, and evidentiary reporting in forensic acquisition	K3
CO3	Secure both clean and corrupted systems, protecting personal data, securing simple computer networks, and safe Internet usage.	K4
CO4	Incorporate approaches for incident analysis and response	K6

UNIT– I: Introduction to Cyber security- Cyber security objectives, Cyber security roles, Differences between Information Security & Cyber security.

Cyber security Principles-Confidentiality, integrity & availability Authentication & non repudiation.

UNIT–II: Information Security (IS) within Lifecycle Management-Lifecycle management landscape, Security architecture processes, Security architecture tools, Intermediate lifecycle management concepts. **Risks & Vulnerabilities-** Basics of risk management, Operational threat environments, Classes of attacks.

UNIT–III: Incident Response- Incident categories, Incident response Incident recovery. **Operational security protection:** Digital and data assets, ports and protocols, Protection technologies, Identity and access Management, configuration management.

UNIT – IV: Threat Detection and Evaluation (DE): Monitoring- Vulnerability Management, Security Logs and Alerts, Monitoring Tools and Appliances. **Analysis-** Network traffic Analysis, packet capture and analysis

UNIT – V: Introduction to backdoor System and security-Introduction to metasploit, Backdoor, demilitarized zone(DMZ), Digital Signature, Brief study on Hardening of operating system.

Text Books:

1. Security Analyst Student Hand Book , NASSCOM: Dec 2015
2. Information Security Management Principles Updated Edition by David Alexander, Amanda Finch, David Sutton ,Published by BCS, June 2013

Reference Books:

1. CSX- cyber security fundamentals 2nd edition, Published by ISACA, Cyber security, Network Security, Data Governance Security

I Year - II Semester	Agile Technologies (V2321258F3)	L	T	P	C
		3	0	0	3

Course Objectives:

The main objectives of this course are to introduce the important concepts of Agile software development Process, emphasize the role of stand-up meetings in software collaboration, impart the knowledge on values and principles in understanding agility

Course Outcomes: At the end of the course the student should be able to:

CO1: Explain fundamentals of Agile methodology. –L2

CO2: Apply agile principles on real time projects.- L3

CO3: Apply Scrum principles, organize sprints and user stories.. –L3

CO4: Apply practices of XP and Incremental design. –L3

CO5: Describe principles of Kanban, Coaching and make use of an area chart to visualize work in progress. –L2

UNIT I :

Learning Agile: Getting Agile into your brain, Understanding Agile values, No Silver Bullet, Agile to the Rescue, adding Agile makes a difference. A fractured perspective, How a fractured perspective causes project problems. The Agile Manifesto, Purpose behind Each Practice. Individuals and Interactions Over Processes and Tools, Working Software over Comprehensive Documentation, Customer Collaboration over Contract Negotiation, Responding to Change over Following a Plan, Principles over Practices. Understanding the Elephant, Methodologies Help You Get It All in Place at Once, Where to Start with a New Methodology.

UNIT II :

The Agile Principles: The 12 Principles of Agile Software, The Customer Is Always Right, “Do As I Say, Not As I Said”. Delivering the Project, Better Project Delivery for the Ebook Reader Project. Communicating and Working Together, Better Communication for the Ebook Reader Project. Project Execution—Moving the Project Along, A Better Working Environment for the Ebook Reader Project Team. Constantly Improving the Project and the Team. The Agile Project: Bringing All the Principles Together

UNIT III :

SCRUM and Self-Organizing Teams: The Rules of Scrum, Act I: I Can Haz Scrum?, Everyone on a Scrum Team owns the Project, The Scrum Master Guides the Team’s Decisions, The Product Owner Helps the Team Understand the Value of the Software, Everyone Owns the Project, Scrum Has Its Own Set of Values, Status Updates Are for Social Networks!, The Whole Team Uses the Daily Scrum, Feedback and the Visibility-Inspection-Adaptation Cycle, The Last Responsible Moment, How to Hold an Effective Daily Scrum. Sprinting into a Wall, Sprints, Planning, and Retrospectives, Iterative or Incremental?, The Product Owner Makes or Breaks the Sprint, Visibility and Value, How to Plan and Run an Effective Scrum Sprint

Scrum Planning And Collective Commitment: Not Quite Expecting the Unexpected, User Stories, Velocity, and Generally Accepted Scrum Practices, Make Your Software Useful, User Stories Help Build Features Your Users Will Use, Conditions of

Satisfaction, Story Points and Velocity, Burndown Charts, Planning and Running a Sprint Using Stories, Points, Tasks, and a Task Board. Victory Lap, Scrum Values Revisited, Practices Do Work Without the Values (Just Don't Call It Scrum), Is Your Company's Culture Compatible with Scrum Values.

UNIT IV :

XP And Embracing Change: Going into Overtime, The Primary Practices of XP, Programming Practices, Integration Practices, Planning Practices, Team Practices, Why Teams Resist Changes, and How the Practices Help. The Game Plan Changed, but We're Still Losing, The XP Values Help the Team Change Their Mindset, XP Helps Developers Learn to Work with Users, Practices Only "Stick" When the Team Truly Believes in Them, An Effective Mindset Starts with the XP Values, The XP Values, Paved with Good Intentions. The Momentum Shifts, Understanding the XP Principles Helps You Embrace Change, The Principles of XP, XP Principles Help You Understand Planning, XP Principles Help You Understand Practices—and Vice Versa, Feedback Loops.

XP, Simplicity, and Incremental Design: Code and Design, Code Smells and Antipatterns (or, How to Tell If You're Being Too Clever), XP Teams Look for Code Smells and Fix Them, Hooks, Edge Cases, and Code That Does Too Much. Make Code and Design Decisions at the Last Responsible Moment, Fix Technical Debt by Refactoring Mercilessly, Use Continuous Integration to Find Design Problems, Avoid Monolithic Design, Incremental Design and the Holistic XP Practices. Teams Work Best When They Feel Like They Have Time to Think, Team Members Trust Each Other and Make Decisions Together. The XP Design, Planning, Team, and Holistic Practices Form an Ecosystem Incremental Design Versus Designing for Reuse, When Units Interact in a Simple Way, the System Can Grow Incrementally, Great Design Emerges from Simple Interactions, Final Score.

UNIT V:

Lean, Eliminating Waste, and Seeing the whole: Lean Thinking, Commitment, Options Thinking, and Set-Based Development, Creating Heroes and Magical Thinking. Eliminate Waste, Use a Value Stream Map to Help See Waste Clearly, Gain a Deeper Understanding of the Product, See the Whole, Find the Root Cause of Problems That You Discover. Deliver As Fast As Possible, Use an Area Chart to Visualize Work in Progress, Control Bottlenecks by Limiting Work in Progress.

Kanban, Flow, and Constantly Improving: The Principles of Kanban, Find a Starting Point and Evolve Experimentally from There. Stories Go into the System; Code Comes Out, Improving Your Process with Kanban, Visualize the Workflow, Limit Work in Progress. Measure and Manage Flow, Managing Flow with WIP Limits Naturally Creates Slack. Make Process Policies Explicit So Everyone Is on the Same Page. Emergent Behavior with Kanban.

The Agile Coach: Coaches Understand Why People Don't Always Want to Change. The Principles of Coaching.

Text Books :

1. Andrew Stellman, Jill Alison Hart, Learning Agile, O'Reilly, 2015.

Reference Books:

1. Andrew stellman, Jennifer Green, Head first Agile, O'Reilly, 2017.
2. Rubin K , Essential Scrum : A practical guide to the most popular Agile process, Addison-Wesley, 2013

I Year - II Semester	Big Data Analytics (V2321258F4)	L	T	P	C
		3	0	0	3

Course Objectives:

This course is aimed at enabling the students to

- Provide an overview of an exciting growing field of big data analytics.
- Introduce the tools required to manage and analyze big data like Hadoop, NoSQL, Map Reduce, HIVE, Cassandra, Spark.
- Teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
- Optimize business decisions and create competitive advantage with Big Data analytics

Course Outcomes:

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

1. Illustrate big data and its use cases from selected business domains.
2. Interpret the applicability of NoSQL databases using Cassandra
3. Analyze the big data using Hadoop, Map Reduce, Hive and Apache Spark
4. Implement real time processing with Spark Streaming for data intensive applications.

UNIT I: What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.

UNIT II: Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schema less databases, materialized views, distribution models, sharding, master-slave replication, peer- peer replication, sharding and replication, consistency, relaxing consistency, version stamps, Working with Cassandra ,Table creation, loading and reading data.

UNIT III: Data formats, analyzing data with Hadoop, scaling out, Architecture of Hadoop distributed file system (HDFS), fault tolerance, with data replication, High availability, Data locality , Map Reduce Architecture, Process flow, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization. Introduction to Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, Logical joins, Window functions, Optimization, Table partitioning, Bucketing, Indexing, Join strategies.

UNIT IV: Apache spark- Advantages over Hadoop, lazy evaluation, In memory processing, DAG, Spark context, Spark Session, RDD, Transformations- Narrow and Wide, Actions, Data frames ,RDD to Data frames, Catalyst optimizer, Data Frame Transformations, Working with Dates and Timestamps, Working with Nulls in Data, Working with Complex Types, Working with JSON, Grouping, Window Functions, Joins, Data Sources, Broadcast Variables, Accumulators, Deploying Spark- On-Premises

Cluster Deployments, Cluster Managers- Standalone Mode, Spark on YARN , Spark Logs, The Spark UI- Spark UI History Server, Debugging and Spark First Aid

UNIT V: Spark-Performance Tuning, Stream Processing Fundamentals, Event- Time and State full Processing - Event Time, State full Processing, Windows on Event Time- Tumbling Windows, Handling Late Data with Watermarks, Dropping Duplicates in a Stream, Structured Streaming Basics - Core Concepts, Structured Streaming in Action, Transformations on Streams, Input and Output.

Text Books:

1. Big Data, Big Analytics: Emerging, Michael Minnelli, Michelle Chambers, and Ambiga Dhiraj, 1st edition ,2013
2. SPARK: The Definitive Guide, Bill Chambers & Matei Zaharia, O'Reilley, 2018- first Edition.
3. Business Intelligence and Analytic Trends for Today's Businesses", Wiley, First edition-2013.
4. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World Polyglot Persistence", Addison-Wesley Professional, 2012
5. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012

Reference Books:

1. "Hadoop Operations", O'Reilley, Eric Sammer, First Edition -2012.
2. "Programming Hive", O'Reilley, E. Capriolo, D. Wampler, and J. Rutherglen, 2012.
3. "Cassandra: The Definitive Guide", O'Reilley, Eben Hewitt, 2010
4. NPTEL MOOC - Big Data Computing -
<https://archive.nptel.ac.in/courses/106/104/106104189/>
5. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01330150430522572825271_shared/overview
6. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01350157647851520010610/overview

I Year - II Semester	Full Stack Technologies (V2321258F5)	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the concepts and technologies involved in full stack development.
- Learn to design and implement both front-end and back-end components of a web application.
- Gain proficiency in using popular full stack frameworks and tools.
- Develop skills in deploying and maintaining full stack applications.
- Explore best practices and emerging trends in full stack development.

Course Outcomes:

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

- Design and implement the front-end of a web application using modern frameworks.
- Develop and integrate back-end services to support web application functionality.
- Utilize databases and data storage solutions for full stack applications.
- Implement security measures for full stack applications.
- Deploy and manage full stack applications in a production environment.

Unit I: Introduction to Full Stack Development

Definition and Components of Full Stack, Front-End vs Back-End Development, Role of Full Stack Developer, Tools and Technologies Overview

Unit II: Front-End Development

HTML5, CSS3, and JavaScript, Responsive Web Design and CSS Frameworks (e.g., Bootstrap), Front-End Frameworks (e.g., React, Angular, Vue.js), State Management in Front-End Applications

Unit III: Back-End Development

Server-Side Programming Languages (e.g., Node.js, Python, Ruby), Web Frameworks (e.g., Express.js, Django, Ruby on Rails), API Development and Integration, Authentication and Authorization

Unit IV: Databases and Data Storage

Relational Databases (e.g., MySQL, PostgreSQL), NoSQL Databases (e.g., MongoDB), Object-Relational Mapping (ORM), Data Caching and Storage Solutions

Unit V: Deployment and Best Practices

Version Control (e.g., Git), Containerization and Orchestration (e.g., Docker, Kubernetes), Continuous Integration and Continuous Deployment (CI/CD), Performance Optimization and Security Best Practices

Text Books:

1. "Full Stack Development with JHipster" by Deepu K Sasidharan and Sendil Kumar N
2. "MEAN Web Development" by Amos Q. Haviv

Reference Books:

1. "Pro MERN Stack" by Vasani Subramanian
2. Documentation and resources from popular full stack frameworks (React, Angular, Express.js, Django, etc.)

I Year - II Semester	Soft Computing (V2321258F6)	L	T	P	C
		3	0	0	3

Course Objectives:

To introduce the concepts in Soft Computing such as Artificial Neural Networks, Fuzzy logic-based systems, genetic algorithm-based systems and their hybrids.

Course Outcomes:

The Students will be able to

- Learn soft computing techniques and their applications.
- Analyze various neural network architectures.
- Define the fuzzy systems.
- Understand the genetic algorithm concepts and their applications.
- Identify and select a suitable Soft Computing technology to solve the problem; construct a solution and implement a Soft Computing solution

UNIT I:

Introduction to Soft Computing, Artificial neural networks, biological neurons, Basic models of artificial neural networks, Connections, Learning, Activation Functions, McCulloch and Pitts Neuron, Hebb network.

UNIT II:

Perceptron networks, Learning rule, Training and testing algorithm, Adaptive Linear Neuron, Back propagation Network, Architecture, Training algorithm

UNIT III:

Fuzzy logic, fuzzy sets, properties, operations on fuzzy sets, fuzzy relations, operations on fuzzy relations, Fuzzy membership functions, fuzzification, Methods of membership, value assignments, intuition, inference, rank ordering, Lambda – cuts for fuzzy sets, Defuzzification methods

UNIT IV:

Truth values and Tables in Fuzzy Logic, Fuzzy propositions, Formation of fuzzy rules, Decomposition of rules, Aggregation of rules, Fuzzy Inference Systems, Mamdani and Sugeno types, Neuro-fuzzy hybrid systems, characteristics , classification

UNIT V:

Introduction to genetic algorithm, operators in genetic algorithm, coding, selection, cross over, mutation, Stopping condition for genetic algorithm flow, Genetic-neuro hybrid systems, GeneticFuzzy rule based system

Text Books:

1. S. N. Sivanandam and S. N. Deepa, Principles of soft computing – John Wiley & Sons, 2007.
2. Timothy J. Ross, Fuzzy Logic with engineering applications , John Wiley & Sons, 2016.

Reference Books:

1. N. K. Sinha and M. M. Gupta, Soft Computing & Intelligent Systems: Theory & Applications-Academic Press /Elsevier. 2009.
2. Simon Haykin, Neural Network- A Comprehensive Foundation- Prentice Hall International, Inc. 1998
3. R. Eberhart and Y. Shi, Computational Intelligence: Concepts to Implementation, Morgan Kaufman/Elsevier, 2007.
3. Driankov D., Hellendoorn H. and Reinfrank M., An Introduction to Fuzzy Control Narosa Pub., 2001.
4. Bart Kosko, Neural Network and Fuzzy Systems- Prentice Hall, Inc., Englewood Cliffs, 1992
5. Goldberg D.E., Genetic Algorithms in Search, Optimization, and Machine Learning Addison Wesley, 1989

I Year - II Semester	Robotic Process Automation (V2321258G1)	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the fundamentals of Robotic Process Automation (RPA).
- Learn to identify and analyze processes suitable for automation.
- Gain hands-on experience in developing RPA solutions.
- Explore best practices for implementing and managing RPA projects.
- Evaluate the impact of RPA on business processes and workforce.

Course Outcomes:

- Upon completion of the course, students should be able to:
- Define the principles and concepts of Robotic Process Automation.
- Identify and analyze business processes suitable for RPA.
- Develop RPA solutions using industry-standard tools.
- Implement best practices for successful RPA deployment.
- Analyze the impact of RPA on business efficiency and workforce.

Unit I: Introduction to Robotic Process Automation, Definition and Principles of RPA, Benefits and Challenges, Use Cases and Applications of RPA, RPA Tools and Platforms Overview

Unit II: Identifying and Analyzing Processes for RPA, Process Discovery and Analysis, Criteria for RPA Suitability, Process Mapping and Documentation, Stakeholder Engagement in RPA

Unit III: RPA Development and Implementation RPA Tools Hands-on: UiPath, Automation Anywhere, Blue Prism, Building RPA Bots: Design, Development, and Testing, Process Automation Lifecycle, Error Handling and Exception Management in RPA

Unit IV: Best Practices in RPA Design Patterns for RPA, Security and Compliance in RPA, Change Management in RPA Projects, Monitoring and Reporting in RPA

Unit V: Impact of RPA on Business and Workforce, Business Process Reengineering with RPA, RPA and Workforce Collaboration, Ethics and Social Implications of RPA, Future Trends in RPA

Textbooks:

1. "Mastering UiPath: Robotic Process Automation" by Alok Mani Tripathi
2. "Robotic Process Automation Handbook" by Tom Taulli

I Year - II Semester	Medical Image Data Analysis (V2321258G2)	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the fundamentals of medical image data and its characteristics.
- Learn various techniques for preprocessing and enhancing medical images.
- Develop skills in using machine learning and deep learning for medical image analysis.
- Explore applications of medical image data analysis in diagnosis and research.
- Understand the challenges and ethical considerations in medical image analysis.

Course Outcomes:

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

- Explain the unique characteristics of medical image data.
- Apply preprocessing and enhancement techniques to improve the quality of medical images.
- Implement machine learning and deep learning models for medical image analysis.
- Evaluate the performance of image analysis models in medical applications.
- Demonstrate awareness of ethical considerations in handling medical image data.

Unit I: Introduction to Medical Image Data

Characteristics of Medical Image Data, Modalities in Medical Imaging (X-ray, CT, MRI, PET, etc.), Challenges in Medical Image Analysis, Overview of Image Data Acquisition in Healthcare

Unit II: Preprocessing and Enhancement in Medical Imaging

Image Denoising and Filtering Techniques, Contrast Enhancement Methods, Registration and Fusion of Medical Images, Artifact Correction in Medical Images

Unit III: Machine Learning in Medical Image Analysis

Overview of Machine Learning in Healthcare, Feature Extraction from Medical Images, Classification and Regression Models for Medical Image Analysis, Evaluation Metrics in Medical Image Classification

Unit IV: Deep Learning for Medical Image Analysis

Convolutional Neural Networks (CNNs) for Image Analysis, Transfer Learning in Medical Imaging, Generative Adversarial Networks (GANs) for Medical Image Synthesis, Explainability and Interpretability in Deep Learning Models

Unit V: Applications and Challenges

Disease Diagnosis and Prediction from Medical Images, Computer-Aided Diagnosis (CAD), Image Segmentation in Medical Imaging, Challenges and Ethical Considerations in Medical Image Analysis

Text Books:

1. "Medical Image Analysis " by Alejandro Frangi, Jerry Prince, Milan Sonka
2. "Deep Learning for Medical Image Analysis" by S. Kevin Zhou

Reference Books:

1. "Handbook of Medical Image Processing and Analysis" by Isaac N.Bankman

I Year - II Semester	Design of Secure Protocols (V2321258G3)	L	T	P	C
		3	0	0	3

Course Objectives:

Understand the principles of secure communication and cryptographic protocols.

- ☐ Learn the design principles for secure communication protocols.
- ☐ Explore various cryptographic techniques used in secure protocols.
- ☐ Develop skills in the analysis and verification of secure protocols.
- ☐ Investigate emerging trends and challenges in secure protocol design.

Course Outcomes:

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

- ☐ Explain the principles of secure communication and the role of protocols.
- ☐ Design secure communication protocols for various applications.
- ☐ Implement and analyze cryptographic techniques in protocol design.
- ☐ Evaluate the security properties of existing protocols.
- ☐ Propose solutions to emerging challenges in secure protocol design.

Unit I: Introduction to Secure Protocols

Basics of Cryptography and Network Security, Principles of Secure Communication, Security Threats and Attacks in Communication, Overview of Cryptographic Protocols

Unit II: Design Principles for Secure Protocols

Security Services: Authentication, Confidentiality, Integrity, Key Management in Protocols, Trust Models and Trust Establishment, Usability and Human Factors in Protocol Design

Unit III: Cryptographic Techniques in Secure Protocols

Symmetric and Asymmetric Key Cryptography, Hash Functions and Digital Signatures, Public Key Infrastructure (PKI), Secure Multi-party Computation (SMPC) in Protocols

Unit IV: Analysis and Verification of Secure Protocols

Formal Methods for Protocol Analysis, Model Checking and Theorem Proving, Common Vulnerabilities and Attack Mitigation, Protocol Testing and Validation

Unit V: Emerging Trends and Challenges

Post-Quantum Cryptography in Protocols, Secure Protocols for Internet of Things (IoT), Blockchain and Distributed Ledger Technologies, Privacy- Preserving Protocols

Text Books:

1. "Cryptography and Network Security: Principles and Practice" by William Stallings
2. "Security Engineering: A Guide to Building Dependable Distributed Systems" by Ross Anderson

Reference Books:

1. "Protocols for Secure Electronic Commerce" by Mostefa Golea

I Year - II Semester	Cloud Computing (V2321258G4)	L	T	P	C
		3	0	0	3

Course Objectives:

- ☐ To implement Virtualization
- ☐ To implement Task Scheduling algorithms.
- ☐ Apply Map-Reduce concept to applications.
- ☐ To build Private Cloud.
- ☐ Broadly educate to know the impact of engineering on legal and societal issues involved.

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

Course Outcomes		Knowledge Level (K)#
CO1	Interpret the key dimensions of the challenge of Cloud Computing	K2
CO2	Examine the economics, financial, and technological implications for selecting cloud computing for own organization.	K4
CO3	Assessing the financial, technological, and organizational capacity of employer's for actively initiating and installing cloud-based applications	K5
CO4	Evaluate own organizations' needs for capacity building and training in cloud computing-related IT areas.	K5
CO5	To Illustrate Virtualization for Data-Center Automation.	K2

UNIT I: Introduction: Network centric computing, Network centric content, peer-to-peer systems, cloud computing delivery models and services, Ethical issues, Vulnerabilities, Major challenges for cloud computing. **Parallel and Distributed Systems:** Introduction, architecture, distributed systems, communication protocols, logical clocks, message delivery rules, concurrency, model concurrency with Petri Nets.

UNIT II: Cloud Infrastructure: At Amazon, The Google Perspective, Microsoft Windows Azure, Open Source Software Platforms, Cloud storage diversity, Inter cloud, energy use and ecological impact, responsibility sharing, user experience, Software licensing, **Cloud Computing** : Applications and Paradigms: Challenges for cloud, existing cloud applications and new opportunities, architectural styles, workflows, The Zookeeper, The Map Reduce Program model, HPC on cloud, biological research.

UNIT III: Cloud Resource virtualization: Virtualization, layering and virtualization, virtual machine monitors, virtual machines, virtualization- full and para, performance and security isolation, hardware support for virtualization, Case Study: Xen, vBlades, **Cloud Resource Management and Scheduling:** Policies and Mechanisms, Applications of control theory to task scheduling, Stability of a two-level resource allocation architecture, feedback control based on dynamic thresholds, coordination, resource bundling, scheduling algorithms, fair queuing, start time fair queuing, cloud scheduling subject to deadlines, Scheduling Map Reduce applications, Resource

management and dynamic application scaling.

UNIT IV: Storage Systems: Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system. Apache Hadoop, Big Table, Megastore (text book 1), Amazon Simple Storage Service(S3) (Text book 2), **Cloud Security:** Cloud security risks, security – a top concern for cloud users, privacy and privacy impact assessment, trust, OS security, Virtual machine security, Security risks.

UNIT V: Cloud Application Development: Amazon Web Services : EC2 – instances, connecting clients, security rules, launching, usage of S3 in Java, Installing Simple Notification Service on Ubuntu 10.04, Installing Hadoop on Eclipse, Cloud based simulation of a Distributed trust algorithm, Cloud service for adaptive data streaming (Text Book 1), **Google:** Google App Engine, Google Web Toolkit (Text Book 2), **Microsoft:** Azure Services Platform, Windows live, Exchange Online, Share Point Services, Microsoft Dynamics CRM (Text Book 2).

Text Books:

1. Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier 2nd edition-2017
2. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH-2013

Reference book:

1. Mastering Cloud Computing, Foundations and Application Programming, RajKumar Buyya, Christen vecctiola, S Tammaraiselvi, TMH 1st edition-2013

I Year - II Semester	Information Security (V2321258G5)	L	T	P	C
		3	0	0	3

Course Objectives: To make the student learn different encryption techniques along with hash functions, MAC, digital signatures and their use in various protocols for network security and system security.

Course Outcomes:

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

CO 1. Identify the basic concepts of cryptography.

CO 2. Classify the symmetric encryption techniques.

CO 3. Apply various public key cryptography techniques, implement Hashing and Digital Signature.

CO 4. Design authentication applications and analyze network security protocols

CO 5. Apply security mechanisms to detect and prevent various attacks.

UNIT I:

Introduction: Security Attacks, Security Services, Security Mechanisms, and a Model for Network Security. Non-Cryptographic Protocol Vulnerabilities - DoS, DDoS, Session Hijacking and Spoofing, Software Vulnerabilities - Phishing, Buffer Overflow, Format String Attacks, SQL Injection. Basics of Cryptography – Steganography, Symmetric Cipher Model, Substitution Techniques, Transportation Techniques, Other Cipher Properties - Confusion, Diffusion, Block and Stream Ciphers.

UNIT II:

Secret Key Cryptography: S-DES, Data Encryption Standard (DES), Strength of DES, Block Cipher Design Principles and Modes of Operations, Triple DES, AES.

Number Theory: Divisibility and the Division Algorithm, Prime and Relatively Prime Numbers, Modular Arithmetic, Fermat's and Euler's Theorems, the Chinese Remainder Theorem, Discrete Logarithms.

UNIT III:

Public Key Cryptography: Principles of Public Key Cryptosystems, RSA Algorithm, Diffie-Hellman Key Exchange, Introduction to Elliptic Curve Cryptography.

Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Secure Hash Algorithm, Message Authentication Codes – Message Authentication Requirements and Functions, HMAC, Digital signatures, Digital Signature Standards.

Authentication Applications: Kerberos, Key Management and Distribution, X.509 Directory Authentication service, Public Key Infrastructure, Electronic Mail Security: Pretty Good Privacy.

UNIT IV:

IP Security: Overview, Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange.

Web Security: Web Security Considerations, Secure Sockets Layer and Transport Layer Security, Electronic Payment.

UNIT V:

System Security: Malicious Software –Types, Viruses, Virus Counter measures, Worms.
Firewalls: Characteristics, Types of Firewalls, Placement of Firewalls, Firewall Configuration, Trusted Systems.

Text Books:

1. William Stallings, Cryptography and Network Security, 4th Edition, Pearson Education.
2. Atul Kahate, Cryptography and Network Security, 2nd Edition, McGraw Hill.

Reference Books:

1. Mark Stamp, Information Security - Principles and Practice, Wiley India.
2. Forouzan Mukhopadhyay, Cryptography and Network Security, 2nd Edition, McGraw Hill.
3. C K Shyamala, N Harini, Dr T R Padmanabhan, Cryptography and Network Security: 1st Edition, Wiley India.

I Year - II Semester	Software Reliability (V2321258G6)	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the concepts and metrics related to software reliability.
- Learn techniques for measuring, predicting, and improving software reliability.
- Explore various models used in the analysis of software reliability.
- Develop skills in designing reliable software systems.
- Investigate practical applications and challenges in software reliability.

Course Outcomes:

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

- Explain the concepts and importance of software reliability.
- Apply statistical techniques for reliability measurement and prediction.
- Implement software reliability models and analyze their outputs.
- Design and implement strategies for improving software reliability.
- Evaluate the impact of software reliability on overall system performance.

Unit I: Introduction to Software Reliability

Definition and Importance of Software Reliability, Factors Influencing Software Reliability, Software Failure and Fault Analysis, Role of Reliability in Software Engineering

Unit II: Software Reliability Metrics and Measurement

Reliability Metrics: MTTF, MTTR, Availability, Software Reliability Growth Models, Fault Detection and Correction, Reliability Measurement Techniques

Unit III: Software Reliability Models

Exponential Model, Weibull Model, Log-Logistic Model, Non-Homogeneous Poisson Process (NHPP) Model

Unit IV: Techniques for Improving Software Reliability

Fault Tolerance and Redundancy, Error Detection and Recovery, Code Reviews and Inspections, Testing Strategies for Reliability

Unit V: Practical Applications and Emerging Trends

Reliability in Cloud Computing, Reliability in Distributed Systems, Reliability in Safety-Critical Systems, Machine Learning for Predicting Software Reliability

Text Books:

1. "Software Reliability Engineering" by John D. Musa, Anthony Iannino, and K. Nagel
2. "Quantitative Software Engineering" by Lawrence Bernstein

Reference Books:

1. "Software Engineering: A Practitioner's Approach" by Roger S. Pressman

I Year - II Semester	Software Lab-2 (V232125863)	L	T	P	C
		0	0	3	2

Course Outcomes: On completion of this course, the student will be able to

- Implement machine learning algorithms to real world problems
- Choose appropriate machine learning algorithm for a problem
- Interpret the results of two different machine learning algorithms

List of Experiments:

1. Implement **Principal Component Analysis (PCA)** and **Singular Value Decomposition (SVD)** using NumPy.
2. Implement and demonstrate the **FIND-S algorithm** for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
3. For a given set of training data examples stored in a .CSV file, implement and demonstrate the **Candidate-Elimination algorithm** to output a description of the set of all hypotheses consistent with the training examples.
4. Write a program to demonstrate the working of the decision tree based **ID3 algorithm**. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
5. Build an Artificial Neural Network by implementing the **Back propagation algorithm** and test the same using appropriate data sets.
6. Write a program to implement the **naïve Bayesian classifier** for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
7. Assuming a set of documents that need to be classified, use the **naïve Bayesian Classifier** model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
8. Write a program to construct a **Bayesian network** considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.
9. Apply **EM algorithm** to cluster a set of data stored in a .CSV file. Use the same data set for clustering using **k-Means algorithm**. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.
10. Write a program to implement **k-Nearest Neighbour algorithm** to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
11. Implement the non-parametric **Locally Weighted Regression algorithm** in order to fit data points. Select appropriate data set for your experiment and draw graphs.
12. Create the following **plots** using Matplotlib, Pandas Visualization, Seaborn on iris dataset, wine reviews datasets.
 - a) Scatter Plot
 - b) Line chart
 - c) Histogram

I Year - II Semester	Constitution of India (V2321158C4)	L	T	P	C
		2	0	0	0

Course Objectives:

- ☐ Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- ☐ To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- ☐ To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

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

	Course Outcomes	Knowledge Level (K)#
CO1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.	K6
CO2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.	K6
CO3	Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.	K6
CO4	Discuss the passage of the Hindu Code Bill of 1956.	K6
CO5	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.	K6

UNIT-I: History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working)

Philosophy of the Indian Constitution- Preamble, Salient, Features

UNIT-II: Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT-III: Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, **Executive-** President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

UNIT–IV: Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: ZilaPachayat, Elected officials and their roles, CEO ZilaPachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT–V: Election Commission: Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

Text Books:

1. The Constitution of India, 1st Edition, (Bare Act), Government Publication, 1950
2. Framing of Indian Constitution, 1st Edition, Dr. S. N. Busi, Dr. B. R. Ambedkar 2015

Reference Books:

1. Indian Constitution Law, 7th Edition, M. P. Jain, Lexis Nexis, 2014

I Year - II Semester	Pedagogy Studies	L	T	P	C
		2	0	0	0

Course Objectives:

Students will be able to:

- ☐ Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- ☐ Identify critical evidence gaps to guide the development.

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

	Course Outcomes	Knowledge Level (K)#
CO1	What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?	K1
CO2	What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?	K1
CO3	How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?	K1

UNIT-I: Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and Searching.

UNIT-II: Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.

UNIT-III: Evidence on the effectiveness of pedagogical practices: Methodology for the in depth stage: quality assessment of included studies, How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy, Theory of change, Strength and nature of the body of evidence for effective pedagogical practices, Pedagogic theory and pedagogical approaches, Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT-IV: Professional development: Alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes

UNIT-V: Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

Text Books:

1. Classroom interaction in Kenyan primary schools, Ackers J, HardmanF, Compare, 31 (2): 245-261, 2001
2. Curricular reform in schools: The importance of evaluation, Agrawal M, Journal of Curriculum Studies, 36 (3): 361-379, 2004

Reference Books:

1. Teacher training in Ghana: does it count? Multi-site teacher education research project (MUSTER) country report 1, Akyeampong K, London: DFID, 2003

I Year - II Semester	Stress Management by Yoga	L	T	P	C
		2	0	0	0

Course Objectives:

- To achieve overall health of body and mind
- To overcome stress

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

	Course Outcomes	Knowledge Level (K)#
CO1	Develop healthy mind in a healthy body thus improving social health also	K2
CO2	Improve efficiency	K6

UNIT – I: Definitions of Eight parts of yoga. (Ashtanga).

UNIT – II: Yam and Niyam. Do's and Don'ts in life.

UNIT – III: Ahinsa, satya, astheya, bramhacharya and aparigraha Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

UNIT – IV: Asan and Pranayam, Various yoga poses and their benefits for mind & body.

UNIT – V: Regularization of breathing techniques and its effects-Types of pranayam.

Text Books:

1. Yogic Asanas for Group Training-Part-I : Janardan Swami Yogabhyasi Mandal, Nagpur
2. Rajayoga or conquering the Internal Nature, Swami Vivekananda, Advaita Ashrama Publication Department, Kolkata

I Year - II Semester	Personality Development through Life Enlightenment Skills	L	T	P	C
		2	0	0	0

Course Objectives:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

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

	Course Outcomes	Knowledge Level (K)#
CO1	Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life	K2
CO2	The person who has studied Geeta will lead the nation and mankind to peace and prosperity	K3
CO3	Study of Neetishatakam will help in developing versatile personality of students.	K5

UNIT-I: Neetisatakam-Holistic development of personality, Verses- 19,20,21,22 (wisdom), Verses- 29, 31, 32 (pride & heroism), Verses- 26,28,63,65 (virtue), Verses- 52, 53, 59 (don'ts), Verses- 71,73,75,78 (do's)

UNIT-II: Approach to day to day work and duties. Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47, 48

UNIT-III: Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5, 13, 17, 23,35, Chapter 18- Verses 45, 46, 48

UNIT-IV: Statements of basic knowledge. Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16, 17, 18

UNIT-V: Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36, 37, 42, Chapter 4-Verses 18, 38, 39 Chapter18 – Verses 37, 38, 63

Text Books:

- Srimad Bhagavad Gita, Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
- Bhartrihari's Three Satakam (Niti-sringar-vairagya), P.Gopinath

Reference Books:

- Rashtriya Sanskrit Sansthanam, New Delhi.

II Year - I Semester	Biometric Security (V2322158H1)	L	T	P	C
		3	0	0	3

Course Objectives:

- Describe the principles of the three core biometric modalities (face, fingerprint and iris), and know how to deploy them in authentication scenarios
- Organize and conduct biometric data collections, and apply biometric databases in system evaluation
- Calculate distributions of within- and between-class matching scores, and calculate various error estimates based on these distributions
- Identify the privacy and security concerns surrounding biometric systems, and know how to address them in such a way that balances both
- Recognize differences between algorithm design and systems engineering biometrics
- Deploy statistical methods in biometric system evaluation
- Itemize the most up-to-date examples of real biometric applications in human authentication.

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

	Course Outcomes	Knowledge Level (K)#
CO1	Demonstrate knowledge of the basic physical and biological science and engineering principles underlying biometric systems	K2
CO2	Analyze biometric systems at the component level and be able to analyze and design basic biometric system applications	K4
CO3	Illustrate to work effectively in teams and express their work and ideas orally and in writing	K2
CO4	Identify the sociological and acceptance issues associated with the design and implementation of biometric systems	K3
CO5	Elaborate various Biometric security issues in real world applications	K6

UNIT-I: Biometrics- Introduction, benefits of biometrics over traditional authentication systems, benefits of biometrics in identification systems, selecting a biometric for a system, Applications, Key biometric terms and processes, biometric matching methods, Accuracy in biometric systems

UNIT-II: Physiological Biometric Technologies- Fingerprints, Technical description, characteristics, Competing technologies, strengths, weaknesses, deployment, Facial scan, Technical description, characteristics, weaknesses, deployment, Iris scan, Technical description, characteristics, strength, weaknesses, deployment

UNIT-III: Physiological Biometric Technologies- Hand Biometric: Palm Print, Vein Pattern, Signature and Hand Writing Technology-Technical description, characteristics, strengths, weaknesses and deployment.

UNIT–IV: Behavioural Biometric Technologies- Voice Recognition and Key stroke dynamics: Introduction, working, strengths and weaknesses, Voice Recognition Applications, Understanding Voice Recognition, Choice of Features, Speaker modeling, Pattern Matching, Key Stroke Dynamics, Active and Passive Biometrics.

UNIT – V: Multi biometrics and multi factor biometrics- two-factor authentication with passwords, tickets and tokens, executive decision, implementation plan, Securing Biometric Template- Cancelable Biometrics, Authentication, Security Analysis.

Text Books:

1. A Privacy Enhancing Biometric, Chuck Wilson, Vein pattern recognition, CRC press, 1st Edition, 2010
2. Biometrics: Identity Verification in a Network, 1st Edition, Samir Nanavathi, Michel Thieme, and Raj Nanavathi, Wiley Eastern, 2002
3. Implementing Biometric Security, 1st Edition, John Chirillo and Scott Blaul, Wiley Eastern Publication, 2005

II Year - I Semester	Mining Massive Data Sets (V2322158H2)	L	T	P	C
		3	0	0	3

Course Outcomes:

Upon Successful completion of course, the student will be able to

1. Recollecting fundamentals of data mining- L2
2. Apply the concept of Map reduce and data streams for storing and processing of massive data sets - L3
3. Analyze the issues underlying the effective applications of massive datasets - L4
4. Evaluate different clustering algorithms and analyze various decomposition techniques - L4

Unit I:

Data Mining: Introduction, Statistical Modeling, Machine Learning, Computational Approaches to Modeling, Feature Extraction, Statistical Limits on Data Mining, Hash Functions, Indexes, Natural Logarithms, Power Laws. (CO 1)

Unit II:

Map Reduce and the New Software Stack: Distributed File Systems, Map Reduce, Algorithms Using MapReduce, Extensions to MapReduce, Complexity Theory for MapReduce (CO 2)

Unit III:

Mining Data Streams: The Stream Data Model, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Counting Ones in a Window, Decaying Windows. (CO 1, CO 2)

Unit IV:

Frequent Item sets: The Market-Basket Model, Market Baskets and the A-Priori Algorithm, Handling Larger Datasets in Main Memory, Limited-Pass Algorithms, Counting Frequent Items in a Stream. (CO 1, CO 3)

Unit V:

Clustering: Introduction to Clustering Techniques, Hierarchical Clustering, K- means Algorithms, The CURE Algorithm, Clustering in Non-Euclidean Spaces, and Clustering for Streams and Parallelism.

Dimensionality Reduction: Eigen values and Eigenvectors of Symmetric Matrices, Principal-Component Analysis, Singular-Value Decomposition, CUR Decomposition (CO 1, CO 4).

Text Books:

1. Mining of Massive Datasets - Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman

II Year - I Semester	Generative AI (V2322158H3)	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the principles and concepts underlying Generative AI.
- Explore various types of generative models and their applications.
- Develop practical skills in implementing and training generative models.
- Evaluate the performance and limitations of different generative AI techniques.
- Analyze ethical considerations and emerging trends in Generative AI.

Course Outcomes:

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

- Explain the fundamental concepts of Generative AI and its applications.
- Implement and train different types of generative models, including GANs and sequence generation models.
- Critically assess the strengths and weaknesses of generative models in various domains.
- Apply generative AI techniques to real-world problems and datasets.
- Demonstrate awareness of ethical considerations in Generative AI and propose responsible solutions.

Unit I:

Introduction to Generative AI: “Drawing” Data from Models Applications of AI , The rules of probability, Why use generative models, Style transfer and image transformation

Unit-II:

Building Blocks of Deep Neural Networks Perceptrons — a brain in a function, Multi-layer perceptrons and backpropagation, Varieties of networks: Convolution and recursive, Networks for seeing: Convolutional architectures, Networks for sequence data RNNs and LSTMs

Unit-III:

Image Generation with GANs, The taxonomy of generative models Generative adversarial networks, Vanilla GAN, Improved GANs, Progeressive GAN

Unit-IV:

Deepfakes with GANs, Deepfakes overview, Modes of operation, Key feature set, High-level workflow, Replacement using autoencoders, Re-enactment using pix2pix

Unit-V:

Composing Music with Generative Models Getting started with music generation, Music generation using LSTMs, Music generation using GANs, MuseGAN — polyphonic music generation, Emerging applications in generative AI

Text books:

1. Generative AI with Python and TensorFlow 2, Joseph Babcock, Raghav Bali
2. Hands-On Generative Adversarial Networks with Keras, Rafael Valle, Packt Publishing

II Year - I Semester	Software Defined Networks (V2322158H3)	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the principles and concepts of Software Defined Networking.
- Learn about the architecture and components of SDN.
- Explore SDN programming and network virtualization.
- Gain hands-on experience in deploying SDN solutions.
- Analyze the impact of SDN on network management and security.

Course Outcomes:

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

- Explain the principles and advantages of Software Defined Networking.
- Describe the architecture and components of an SDN.
- Develop and implement SDN applications using programming languages.
- Evaluate the performance and scalability of SDN solutions.
- Assess the impact of SDN on network management and security.

Unit I: Introduction to SDN

Evolution of Networking Paradigms, Challenges in Traditional Network Architectures, Principles of Software Defined Networking, SDN Use Cases and Applications

Unit II: SDN Architecture and Components

SDN Controller: Functions and Types, Southbound APIs (e.g., OpenFlow), Northbound APIs for SDN Applications, Data Plane and Control Plane Separation

Unit III: SDN Programming

Programming SDN Applications, SDN Language and Tools (e.g., P4, ONOS), Network Function Virtualization (NFV), SDN Orchestration and Automation

Unit IV: Deployment of SDN Solutions

SDN in Data Centers, SDN in Wide Area Networks (WAN), SDN in Internet Service Providers (ISPs), Case Studies of SDN Deployments

Unit V: SDN Management and Security

Network Management in SDN, Security Challenges in SDN, SDN Security Mechanisms, Future Trends in SDN

Text Books:

1. "Software-Defined Networking: Anatomy of OpenFlow" by Doug Marschke and Pete Moyer
2. "SDN: Software Defined Networks" by Thomas D. Nadeau and Ken Gray

Reference Books:

1. "Software Defined Networks: A Comprehensive Approach" by Paul Goransson and Chuck Black

II Year - I Semester	Game Theory (V2322158H5)	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the fundamental concepts and principles of game theory.
- Analyze strategic interactions in various domains using game theory.
- Apply game theory to model decision-making in economics, computerscience, and other fields.
- Explore different solution concepts and equilibrium concepts in games.
- Develop critical thinking skills in analyzing and solving real-world problems using game theory.

Course Outcomes:

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

- Define and explain the basic concepts of game theory.
- Model and analyze strategic interactions in different scenarios.
- Apply game theory to real-world problems in economics, computer science, and other domains.
- Evaluate and compare different solution concepts and equilibrium concepts.
- Develop skills in strategic thinking and decision-making.

Unit I: Introduction to Game Theory

Definition and Scope of Game Theory, Elements of a Game: Players, Strategies, Payoffs, Classification of Games: Cooperative vs. Non-cooperative, Historical Overview of Game Theory

Unit II: Basic Concepts and Definitions

Normal Form and Extensive Form Games, Dominant Strategies and Nash Equilibrium, Mixed Strategies and Bayesian Games, Subgame Perfect Equilibrium

Unit III: Applications of Game Theory

Game Theory in Economics: Oligopoly, Auctions, Bargaining, Game Theory in Computer Science: Network Protocols, Security, Game Theory in Political Science and Biology, Case Studies in Real-World Applications

Unit IV: Solution Concepts in Game Theory

Pareto Efficiency and Social Welfare, Nash Bargaining Solution, Core and Shapley Value in Cooperative Games, Stability Concepts: Stochastic Stability, Evolutionary Stability

Unit V: Advanced Topics and Emerging Trends

Repeated Games and Folk Theorems, Evolutionary Game Theory, Behavioral Game Theory, Applications in Machine Learning and Artificial Intelligence

Text Books:

1. "Game Theory: An Introduction" by Steven Tadelis
2. "Strategy: An Introduction to Game Theory" by Joel Watson

Reference Books:

1. "Game Theory for Applied Economists" by Robert Gibbons
2. "A Course in Game Theory" by Martin J. Osborne and Ariel Rubinstein

II Year - I Semester	Randomized and Approximation Algorithms (V2322158H6)	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the fundamentals of randomized algorithms.
- Explore techniques for designing and analyzing approximation algorithms.
- Apply randomized and approximation algorithms to solve real-world problems.
- Analyze the trade-offs between deterministic and randomized approaches.
- Develop critical thinking skills in algorithmic design and analysis.

Course Outcomes:

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

- Explain the principles and concepts of randomized algorithms.
- Design and analyze randomized algorithms for various problems.
- Design and analyze approximation algorithms for optimization problems.
- Evaluate the performance and guarantees of approximation algorithms.
- Apply randomized and approximation algorithms to solve optimization problems.

Unit I: Introduction to Randomized Algorithms

Basics of Probability and Randomized Algorithms, Monte Carlo, Las Vegas, and Deterministic Algorithms, Randomized Complexity Classes, Analysis of Randomized Algorithms

Unit II: Randomized Data Structures and Techniques

Randomized Search Trees, Hashing and Universal Hash Functions, Randomized Sorting Algorithms, Markov Chains and Random Walks

Unit III: Approximation Algorithms: Basics

Introduction to Approximation Algorithms, Greedy Algorithms and Local Search, PTAS (Polynomial Time Approximation Schemes), FPTAS (Fully Polynomial Time Approximation Schemes)

Unit IV: Advanced Topics in Approximation Algorithms

NP-Hardness and Inapproximability, Approximation Algorithms for Specific Problems (e.g., Vertex Cover, Traveling Salesman Problem), Randomized Rounding and Primal-Dual Techniques, Online and Streaming Approximation Algorithms

Unit V: Applications and Case Studies

Approximation Algorithms in Network Design, Approximation Algorithms in Scheduling Problems, Randomized and Approximation Algorithms in Machine Learning, Case Studies and Real-World Applications

Text Books:

1. "Randomized Algorithms" by Rajeev Motwani and Prabhakar Raghavan
2. "Approximation Algorithms" by Vijay V. Vazirani

Reference Books:

1. "Randomized Algorithms and Probabilistic Analysis" by Christos H. Papadimitriou and Kenneth Steiglitz
2. "The Design of Approximation Algorithms" by David P. Williamson and David B. Shmoys

Open Electives offered by the Department of CSE

II Year - I Semester	Python Programming (V232215852)	L	T	P	C
		3	0	0	3

Course Objectives:

From the course the student will learn

- ☐ To acquire programming skills in core Python.
- ☐ To acquire Object Oriented Skills in Python.
- ☐ To develop the skill of designing Graphical user Interfaces in Python.
- ☐ To develop the ability to write database applications in Python.

Course Outcomes:

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

CO	Description	Knowledge Level (K)#
CO1	Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.	K2
CO2	Express proficiency in the handling of strings and functions.	K2
CO3	Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets.	K3
CO4	Identify the commonly used operations involving file systems and regular expressions.	K2
CO5	Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python, NumPy, Pandas	K3

UNIT I :Parts of Python Programming Language, Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, The type() Function and Is Operator, Dynamic and Strongly Typed Language, **Control Flow Statements**, The if Decision Control Flow Statement, The if...else Decision Control Flow Statement, The if...elif...else Decision Control Statement, Nested if Statement, The while Loop, The for Loop, The continue and break Statements, Catching Exceptions Using try and except Statement, **Functions**, Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments.

UNIT II: Strings, Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings, Lists, Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, The del Statement.

UNIT III: Dictionaries, Creating Dictionary, Accessing and Modifying key: value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, The del Statement, Tuples and Sets, Creating Tuples, Basic Tuple Operations, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Tuple Methods, Using zip() Function, Sets, Set Methods, Traversing of Sets, Frozen set.

UNIT IV: Files, Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, The Pickle Module, Reading and Writing CSV Files, Python os and os. path Modules, Regular Expression Operations, Using Special Characters, Regular Expression Methods, Named Groups in Python Regular Expressions, Regular Expression with glob Module.

UNIT V: Object-Oriented Programming, Classes and Objects, Creating Classes in Python, Creating Objects in Python, The Constructor Method, Classes with Multiple Objects, Class Attributes versus Data Attributes, Encapsulation, Inheritance, The Polymorphism. Numpy with Python, Pandas

Text Books:

- 1) “Introduction to Python Programming”, 1st Edition, Gowrishankar S, Veena A, CRC Press/Taylor & Francis, ISBN-13: 978-0815394372, 2018
- 2) Introduction to Programming Using Python by Y Daniel Liang, Pearson Publishers 1st edition-2012

Reference Books:

- 1) “Python Data Science Handbook: Essential Tools for Working with Data”, 1st Edition, Jake VanderPlas, O’Reilly Media, 2016
- 2) “Core Python Applications Programming”, 3rd Edition, Wesley J Chun Pearson Education India, 2015

II Year - I Semester	Management Information System (V232215853)	L	T	P	C
		3	0	0	3

UNIT-I:

Management Information Systems: A Framework: Importance of MIS, MIS: A Definition nature and Scope of MIS, **Structure and Classification of MIS:** Structure of MIS, MIS Classification

Information and System Concepts: Information: A Definition, Types of Information, Dimensions of Information, System: A Definition, Kinds of Systems, System Related Concepts, Elements of a System, Human as an Information Processing System **Information Systems for Competitive Advantage:** Introduction, Changing concepts of Information System, Competitive Advantage, Information systems Strategies for Dealing with competitive Force, Porter's Value Chain Model, Strategic Information Systems (SIS)

UNIT-II:

BUSINESS APPLICATIONS OF IS

e – Commerce: Introduction, e – Commerce **ERP Systems:** Introduction, Enterprise Information Systems

Decision – Support Systems: Decision – Making: A Concept, Simon's Model of Decision – Making Types of Decisions, Methods for Choosing Among Alternatives, Decision – Making and MIS, Decision Support Systems – Why?, Decision Support Systems: A framework, Characteristics and Capabilities of DSS

Business Intelligence and knowledge Management System: Business Intelligence, Knowledge Management System

UNIT-III:

Information System Planning: Information System Planning: WHY? Planning Terminology Information System Planning, The Nolan Stage Model, The Four – Stage Model of IS planning Selecting A Methodology, Information Resources Management (IRM), Organization Structure and Location of MIS

System Acquisition: Acquisition of Information Systems, Acquisition of Hardware and Software

UNIT- IV:

System Implementation: IMPLEMENTATION PROCESS, Organisational Change

Evaluation & Maintenance of IS: Evaluation of MIS, System Maintenance

IS Security and Control: IS Security Threats, Protecting Information System, IS Security Technology The Disaster Recovery Plan

UNIT-V:

System Development Approaches: System Development Stages, System Development Approaches

System Analysis and Design: SYSTEM ANALYSIS - Introduction, Requirement determination, Strategies for Requirement Determination, Structured Analysis Tools

SYSTEMS DESIGN: Design Objectives, Conceptual Design, Design Methods, Detailed System Design

TEXTBOOKS:

1. Management Information System, Managerial Perspectives, D P Goyal, 3 ed, McMillan Publications

II Year - I Semester	Principles of Cyber Security (V232215854)	L	T	P	C
		3	0	0	3

Course Objectives:

- Cyber security course is to create a strong foundation and detailed technical knowledge in security, privacy, and cryptography applied to computer systems networks and web applications.

Course Outcomes:

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

CO	Description	Knowledge Level (K)#
CO1	Understand key terms and concepts in security, intellectual property and cyber crimes, trademarks and domain theft.	K4
CO2	Determine computer technologies, digital evidence collection, and evidentiary reporting in forensic acquisition	K3
CO3	Secure both clean and corrupted systems, protecting personal data, securing simple computer networks, and safe Internet usage.	K4
CO4	Incorporate approaches for incident analysis and response	K6

UNIT– I: Introduction to Cyber security- Cyber security objectives, Cyber security roles, Differences between Information Security & Cyber security.

Cyber security Principles-Confidentiality, integrity & availability Authentication & non repudiation.

UNIT–II: Information Security (IS) within Lifecycle Management-Lifecycle management landscape, Security architecture processes, Security architecture tools, Intermediate lifecycle management concepts. **Risks & Vulnerabilities-** Basics of risk management, Operational threat environments, Classes of attacks.

UNIT–III: Incident Response- Incident categories, Incident response Incident recovery.

Operational security protection: Digital and data assets, ports and protocols, Protection technologies, Identity and access Management, configuration management.

UNIT – IV: Threat Detection and Evaluation (DE): Monitoring- Vulnerability Management, Security Logs and Alerts, Monitoring Tools and Appliances. **Analysis-** Network traffic Analysis, packet capture and analysis

UNIT – V: Introduction to backdoor System and security-Introduction to metasploit, Backdoor, demilitarized zone(DMZ), Digital Signature, Brief study on Hardening of operating system.

Text Books:

3. Security Analyst Student Hand Book , NASSCOM: Dec 2015
4. Information Security Management Principles Updated Edition by David Alexander, Amanda Finch, David Sutton ,Published by BCS, June 2013

Reference Books:

2. CSX- cyber security fundamentals 2nd edition, Published by ISACA, Cyber security, Network Security, Data Governance Security

II Year - I Semester	Internet of Things (V232215855)	L	T	P	C
		3	0	0	3

Course Objectives:

- To Understand Smart Objects and IoT Architectures.
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications.

Course Outcomes:

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

CO	Course Outcomes	Knowledge Level (K)#
CO1	Summarize on the term 'internet of things' in different contexts.	K2
CO2	Analyze various protocols for IoT.	K4
CO3	Design a PoC of an IoT system using Raspberry Pi/Arduino	K6
CO4	Apply data analytics and use cloud offerings related to IoT.	K3
CO5	Analyze applications of IoT in real time scenario	K4

UNIT I: FUNDAMENTALS OF IoT: Evolution of Internet of Things, Enabling Technologies, IoT Architectures, oneM2M, IoT World Forum (IoTWF) and Alternative IoT models, Simplified IoT Architecture and Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.

UNIT II: IoT PROTOCOLS: IT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks, Application Transport Methods: Supervisory Control and Data Acquisition, Application Layer Protocols: CoAP and MQTT.

UNIT III: DESIGN AND DEVELOPMENT: Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks, Arduino, Board details, IDE programming, Raspberry Pi, Interfaces and Raspberry Pi with Python Programming.

UNIT IV: DATA ANALYTICS AND SUPPORTING SERVICES:

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest, Role of Machine Learning – No SQL Databases, Hadoop Ecosystem, Apache Kafka, Apache Spark, Edge Streaming Analytics and Network Analytics, Xively Cloud for IoT, Python Web Application Framework, Django, AWS for IoT, System Management with NETCONF-YANG.

UNIT V: CASE STUDIES/INDUSTRIAL APPLICATIONS: Cisco IoT system, IBM

Watson IoT platform, Manufacturing, Converged Plant wide Ethernet Model (CPwE), Power Utility Industry, Grid Blocks Reference Model, Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control.

Text Books:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, First Edition-2017

Reference Books:

1. Internet of Things – A hands-on approach, ArshdeepBahga, Vijay Madiseti, Universities Press, First Edition-2015
2. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2nd Edition-2012 (for Unit 2).
3. “From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence”, Jan Ho“ ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 1st edition 2014.
4. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer, 2011.
5. Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, Michael Margolis, Arduino Cookbook and O’Reilly Media, 2011.

II Year - I Semester	Artificial Intelligence and Machine Learning (V232215856)	L	T	P	C
		3	0	0	3

Course Objectives:

The learning objectives of this course are:

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
- To design and analyze various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Understanding fuzzy logic, ANN and Understanding GA & EP

Course Outcomes:

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

CO	Description	Knowledge Level (K)#
CO1	Learn the concepts of biological foundations of artificial neural networks	K2
CO2	Identifications of fuzzy and neural network	K3
CO3	Extract features that can be used for a particular machine learning approach in various IOT applications	K4
CO4	To compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.	K3
CO5	To mathematically analyze various machine learning approaches and paradigms.	K2

Unit 1: Biological foundations to intelligent System, Artificial Neural Networks, Single layer and Multilayer Feed Forward NN ,LMS and Back Propagation Algorithm, Feedback networks and Radial Basis Function Networks.

Unit-2: Fuzzy Logic, Knowledge Representation and Inference Mechanism, Defuzzification Methods, Fuzzy Neural Networks, some algorithms to learn the parameters of the network like GA. System Identification using Fuzzy and Neural Network.

Unit-3: Supervised Learning (Regression/Classification):

Basic methods: Distance-based methods, Nearest-Neighbors', Decision Trees, Naive Bayes, Linear models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi-class/Structured Outputs, Ranking.

Unit-4: Unsupervised Learning: Clustering: K-means/Kernel K-means, Dimensionality Reduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion, Generative Models (mixture models and latent factor models).

Unit-5: Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging and Random).

Text Books:

1. “An Introduction to ANN”, J M Zurada , Jaico Publishing House-2012
2. “Neural Networks”, Simon Haykins, Prentice Hall, 2nd edition-1998
3. Machine Learning: A Probabilistic Perspective, Kevin Murphy, MIT Press, 2012
4. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer 2009 (freely available online)

Reference Books:

1. “An Introduction to Fuzzy Control”, Driankov, Dimitra, Narosa Publication
2. “Genetic Algorithms”, Golding, Addison-Wesley Publishing Com
3. Pattern Recognition and Machine Learning, Christopher Bishop, Springer, 2007.

II Year – I Semester	OPERATIONS RESEARCH (Open Elective) (V232211555)	L	T	P	C
		3	0	0	3

S. No.	Course Outcomes	Blooms Taxonomy level
CO1	Apply the Basic optimization techniques	Apply
CO2	Analyze the Graphical solution revised simplex method & duality theory	Analyze
CO3	Solve the Nonlinear programming problem	Analyze
CO4	Solve the Scheduling and sequencing methods	Analyze
CO5	Solve the Competitive Models, Single and Multi-channel Problems, Sequencing Models	Analyze

UNIT I: Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT II: Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

UNIT III: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

UNIT IV: Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT V: Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

TEXT BOOKS:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.

REFERENCES:

1. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, Delhi, 2008
2. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
3. Pannerselvam, Operations Research: Prentice Hall of India 2010
4. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010