

M. TECH. PROGRAM CURRICULUM - 2025

(Applicable for the batches admitted from A.Y 2025-26)

Version 2.0

COMPUTER SCIENCE AND ENGINEERING

Version 1.0–Approved in the BoS meeting on 17-05-2025 & Academic Council meeting on 14-06-2025

Version 2.0–Approved in the BoS meeting on 05-06-2026 & Academic Council meeting on 20-06-2026



Aditya Nagar, ADB Road, Surampalem - 533 437

VISION & MISSION OF THE UNIVERSITY

VISION :

Aditya University aspires to be a globally recognised academic institution dedicated to quality education, cutting-edge research, and technological service to our country, and envisions itself as a beacon of holistic advancement and long-term impact, remaining dynamic in the ever-changing worlds of society, ecology, and economics..

MISSION:

- Aditya University pushes boundaries to design high-quality curricula and to provide students with a vibrant and relevant education that prepares them for a changing world. Our industry insights and creative teaching methods attempt to equip our students to be lifelong learners.
- Aditya University's learning environment encourages intellectual curiosity, critical thinking, and cooperation, with the goal of providing students with an immersive education that fosters creativity and innovation. Our cutting-edge facilities, interactive classrooms, and supportive faculty aim to motivate students to realise their full potential and contribute to society.
- Aditya University promotes cross-disciplinary inquiry and discovery and leads cutting-edge research and innovation. Through strategic partnerships, research grants, and a dedicated faculty, we aim to advance science, technology, and social sciences and empower students and faculty to conduct transformative research that solves real-world problems and elevates our institution globally.
- Aditya University is committed to producing world-changing business leaders and entrepreneurs through its emphasis on entrepreneurship, mentoring, and business incubation programmes.

VISION & MISSION OF THE DEPARTMENT

VISION

To emerge as a competent Centre of excellence in the field of Computer Science and Engineering for the industry and societal needs.

MISSION

- M1:** Impart quality and value-based education.
- M2:** Inculcate the interpersonal skills and professional ethics.
- M3:** Enable research through state-of-the-art infrastructure.
- M4:** Collaborate with industries, government and professional societies.

PROGRAM OUTCOMES (POs)

After successful completion of the program, the graduates will be able to

PO 1	Independently carry out research /investigation and development work to solve practical problems
PO 2	Write and present a substantial technical report/document
PO 3	Demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
PO 4	Learn; keep up with contemporary technologies and ways of working.
PO 5	Communicate effectively as an individual or a team leader in diverse and multidisciplinary groups.
PO 6	Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of finance for profitable project management.

PROGRAM SPECIFIC OUTCOMES (PSOs)

After successful completion of the program, the graduates will be able to

PSO 1	Understand, analyze and implement the optimistic solutions for various research problems in the sub domains of Computer Science & Engineering and multidisciplinary.
PSO 2	Enhance the knowledge by adapting new trends in computer science for solving challenging problems in the industry and society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates of the Program will

PEO 1	Engage in professional practice and promote the development of innovative systems to optimize the solutions for Computer Science and Engineering problems.
PEO 2	Achieve peer-recognition, as an individual or in a team through good analytical, research, design and implementation skills.
PEO 3	Contribute to society as broadly educated, expressive, ethical and responsible citizens with proven expertise.

Department of Computer Science and Engineering
Master of Technology in Computer Science and Engineering (CSE)

Program Curriculum 2025

Credit Division:

S.No	Category of Course	Credits
1	Program Core Courses (PCC)	30
2	Program Elective Courses (PEC)	15
3	University Elective Courses (UEC)	03
4	Technical Seminar (TS)	02
4	Technical Paper Publication (TPP)	02
5	Project – Part I & II (PROJ)	28
6	Audit Course (AUC)	0
Total Credits		80

Program Core Courses (PCC) (30 Credits)

Course Code	Course Title	L	T	P	C	CIE	SEE	Total	Pre-requisite
2502CS01	Mathematics for Computer Science	3	0	0	3	50	50	100	-
2502CS02	Data Structures and Algorithms	1	0	2	3	50	50	100	-
2502CS03	Operating Systems Theory and Practice	2	0	1	3	50	50	100	-
2502CS04	Data Science Fundamentals	2	0	1	3	50	50	100	-
2502CS05	Modern Computer Networks	2	0	1	3	50	50	100	-
2502CS06	Machine Learning Systems	1	0	2	3	50	50	100	ACS
2502CS07	Relational Database Management System	2	0	1	3	50	50	100	DSA
2502CS08	Computational Methods of Optimization	3	0	0	3	50	50	100	MCS
2502CS09	Robotics and Automation	2	0	1	3	50	50	100	MLS
2502CS10	Object Oriented Software Engineering	2	0	1	3	50	50	100	-

Program Elective Courses (PEC) (15 Credits)

Course Code	Course Title	L	T	P	C	CIE	SEE	Total	Pre-requisite
2502CS11	Artificial Cognitive Systems	2	0	1	3	50	50	100	MCS
2502CS12	Internet of Things	2	0	1	3	50	50	100	MCN
2502CS13	Fog and Edge Computing	3	0	0	3	50	50	100	IOT
2502CS14	Secure Cloud Computing	3	0	0	3	50	50	100	AICS
2502CS15	Soft Computing Techniques	2	0	1	3	50	50	100	DSF
2502CS16	AI for Cyber Security	2	0	1	3	50	50	100	ACS
2502CS17	AI for Language and Text Processing	2	0	1	3	50	50	100	MLS
2502CS18	Human Computer Interaction	2	0	1	3	50	50	100	MLS
2502CS19	Software Testing Methods	2	0	1	3	50	50	100	OOSE
2502CS20	Quality Assurance in Software Development	3	0	0	3	50	50	100	OOSE
2502CS21	Block Chain Technology	2	0	1	3	50	50	100	AICS
2502CS22	Software Reliability and Quality Management	3	0	0	3	50	50	100	OSTP, OOSE
2502CS23	Quantum Computational Methods	2	0	1	3	50	50	100	CMO
2502CS28	Computer Vision and Image Processing	2	0	1	3	50	50	100	MLS
2502CS24	Software Project Planning and Management	2	0	1	3	50	50	100	OOSE

University Elective Courses (UEC) (3 Credits)

Cour se Co de	Course Title	L	T	P	C	CIE	SEE	Total	Offered to PG Program	Pre- requisite
2502CE28	Metro Rail Transportation Design and Construction (L&T Edu Tech)**	3	0	0	3	50	50	100	All, except SE	-
2502CE26	Building Information Modelling in Architecture, Engineering and Construction (L&T Edu Tech)**	3	0	0	3	50	50	100	All, except SE	-
2502CE30	Basic Concrete Technology	3	0	0	3	50	50	100	All, except SE	-
2502CE31	Repair and Rehabilitation of Structures	3	0	0	3	50	50	100	All, except SE	-
2502EE28	Neural Networks and Fuzzy Logic	3	0	0	3	50	50	100	All, except PED	-
2502EE29	Hybrid Electric Vehicles	3	0	0	3	50	50	100	All, except PED	-
2502EE30	Electrical Power Distribution and Automation (L&T EduTech)**	3	0	0	3	50	50	100	All, except PED	-
2502EE31	Renewable Energy & Power Evacuation (L&T Edu Tech)**	3	0	0	3	50	50	100	All, except PED	-
2502ME26	Design of fire and life safety systems (L&T)**	3	0	0	3	50	50	100	All, except TE	-
2502ME27	Green Engineering Systems	3	0	0	3	50	50	100	All, except TE	-
2502ME28	IC Engines	3	0	0	3	50	50	100	All, except TE	-
2502EC24	CAD Tools for VLSI Design	3	0	0	3	50	50	100	All, except VLSID	-
2502EC25	FPGA Design for Embedded Systems	3	0	0	3	50	50	100	All, except VLSID	-
2502CS26	Artificial Intelligence	3	0	0	3	50	50	100	All, except CSE	-
2502CS27	Machine Learning Techniques	3	0	0	3	50	50	100	All, except CSE	-

**The syllabus for the industry partner courses will be released in the department as and when required

Technical Seminar (TS):

Course Code	Course Title	L	T	P	C	CIE	SEE	Total	Pre-requisite
2502CS25	Technical Seminar			02	02	100	-	100	-

Technical Paper Publication (TPP):

Course Code	Course Title	L	T	P	C	CIE	SEE	Total	Pre-requisite
2502CS29	Technical Paper Publication			02	02	100	-	100	-

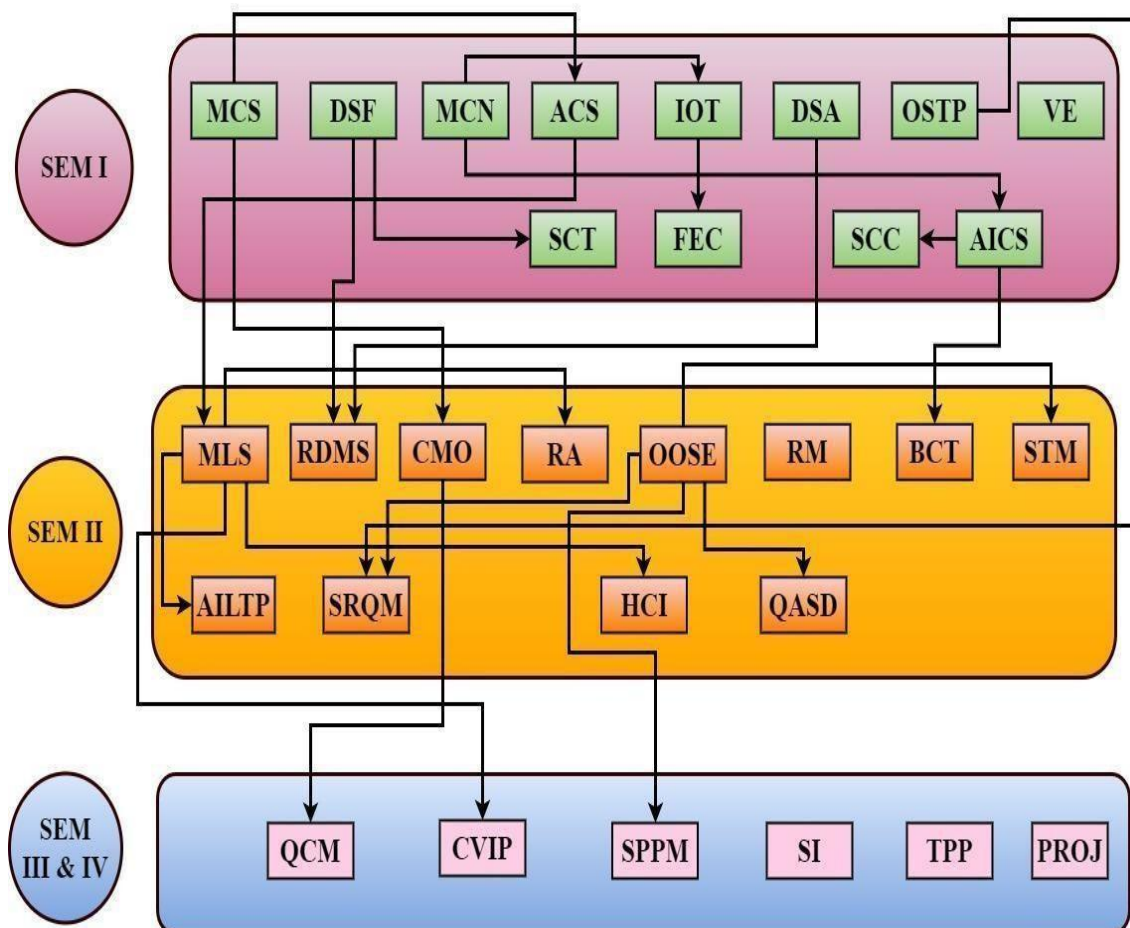
Project–Part I & II (PROJ):

Course Code	Course Title	L	T	P	C	CIE	SEE	Total	Pre-requisite
2502CS30	Project Part I			10	10	100	-	100	-
2502CS31	Project Part II			18	18	50	50	100	

Audit Courses (AUC):

Course Code	Course Title	L	T	P	C	CIE	SEE	Total	Pre-requisite
2502CE32	Value Education	2			0	100	-	100	-
2502CE33	Research Methodology	2			0	100	-	100	-

2025 M.Tech (CSE) Curriculum Prerequisite Flowchart



List of Courses	
MCS	Mathematics for Computer Science
DSF	Data Science Fundamentals
MCN	Modern Computer Networks
ACS	Artificial Cognitive Systems
IOT	Internet of Things
DSA	Data Structures and Algorithms
OSTP	Operating Systems Theory and Practice
VE	Value Education
SCT	Soft Computing Techniques
FEC	Fog and Edge Computing
SCC	Secure Cloud Computing
AICS	AI for Cyber Security
MLS	Machine Learning Systems
RDMS	Relational Database Management System
CMO	Computational Methods of Optimization
RA	Robotics and Automation
OOSE	Object Oriented Software Engineering
RM	Research Methodology
BCT	Block Chain Technology
STM	Software Testing Methods
AILTP	AI for Language and Text Processing
SRQM	Software Reliability and Quality Management
HCI	Human Computer Interaction
QASD	Quality Assurance in Software Development
QCM	Quantum Computational Methods
CVIP	Computer Vision and Image Processing
SPPM	Software Project Planning and Management
TS	Technical Seminar
TPP	Technical Paper Publication
PROJ	Project – Part I & II

Suggestive Semester wise Curriculum I Semester

Course Code	Course Title	Course Category	Credits				Total Hours
			L	T	P	Total	
2502CS01	Mathematics for Computer Science	PCC	3	0	0	3	3
2502CS04	Data Science Fundamentals	PCC	2	0	1	3	3
2502CS05	Modern Computer Networks	PCC	2	0	1	3	3
----	Professional Elective Course I	PEC	2	0	1	3	3
----	Professional Elective Course II	PEC	2	0	1	3	3
2502CS02	Data Structures and Algorithms	PCC	1	0	2	3	5
2502CS03	Operating Systems Theory and Practice	PCC	2	0	1	3	3
2502CE32	Value Education	AUC	2			0	2
Total			16	0	7	21	25

II Semester

Course Code	Course Title	Course Category	Credits				Total Hours
			L	T	P	Total	
2502CS08	Computational Methods of Optimization	PCC	3	0	0	3	3
2502CS09	Robotics and Automation	PCC	2	0	1	3	3
2502CS10	Object Oriented Software Engineering	PCC	2	0	1	3	3
-----	Professional Elective Course III	PEC	2	0	1	3	3
-----	Professional Elective Course IV	PEC	2	0	1	3	3
2502CS06	Machine Learning Systems	PCC	1	0	2	3	5
2502CS07	Relational Database Management System	PCC	2	0	1	3	3
2502CE33	Research Methodology	AUC	2			0	2
Total			16	0	7	21	25

III

Semester

Course Code	Course Title	Course Category	Credits				Total Hours
			L	T	P	Total	
-----	Professional Elective Course V	PEC	2	0	1	3	3
-----	University Elective Course	UEC	3	0	0	3	3
2502CS25	Technical Seminar	TS			2	2	-
2502CS30	Project Part -I	PROJ			10	10	18
Total			5	0	13	18	24

IV

Semester

Course Code	Course Title	Course Category	Credits				Total Hours
			L	T	P	Total	
2502CS29	Technical Paper Publication	TPP			02	02	06
2502CS31	Project Part-II	PROJ			18	18	34
Total					20	20	40

S.no	Course Code	Name of the Course
Professional Elective I (I Semester)		
1	2502CS11	Artificial Cognitive Systems
2	2502CS12	Internet of Things
3	2502CS13	Fog and Edge Computing
Professional Elective III (II Semester)		
S.no	Course Code	Name of the Course
1	2502CS17	AI for Language and Text Processing
2	2502CS18	Human Computer Interaction
3	2502CS19	Software Testing Methods
Professional Elective V (III Semester)		
S.no	Course Code	Name of the Course
1	2502CS23	Quantum Computational Methods
2	2502CS28	Computer Vision and Image Processing
3	2502CS24	Software Project Planning and Management

S.no	Course Code	Name of the Course
Professional Elective II (I Semester)		
1	2502CS14	Secure Cloud Computing
2	2502CS15	Soft Computing Techniques
3	2502CS16	AI for Cyber Security
Professional Elective IV (II Semester)		
S.no	Course Code	Name of the Course
1	2502CS20	Quality Assurance in Software Development
2	2502CS21	Block Chain Technology
3	2502CS22	Software Reliability and Quality Management

MATHEMATICS FOR COMPUTER SCIENCE

Course Code: 2502CS01

L	T	P	C
3	0	0	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Apply various probability distributions for both discrete and continuous random variables
- CO2:** Compute mean and variance of sample means with replacement, without replacement and maximum errors
- CO3:** Apply various tests to test the hypothesis concerning mean, Proportion and variance.
- CO4:** Apply the concepts of group theory and number theory.
- CO5:** Apply the knowledge of graph theory to solve real world problems like minimum spanning tree - traversal of binary tree

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	-	-	-	-
CO2	3	2	1	-	-	-
CO3	3	2	2	-	-	-
CO4	2	3	1	-	-	-
CO5	3	2	1	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	2
CO2	2	-
CO3	3	3
CO4	-	-
CO5	-	-

UNIT – I

Random variables and probability distributions: Probability-Conditional probability-Bayes's theorem- Random variables – Discrete and Continuous random variables – Distribution function – Mathematical Expectation, Variance and Moment generating function- Binomial, Poisson, Normal and Exponential distributions.

UNIT – II

Descriptive Statistics and Sampling Theory: Computation of mean, median, mode and variance of grouped and ungrouped data–Population and samples – Sampling with and without replacement- Sampling distribution of Means and Variance – Central limit theorem (without proof)-Point and Interval estimations – Maximum error of estimate.

UNIT – III

Tests of Hypothesis: Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance – One tail and two-tail tests – Tests concerning one mean and two means (Large and Small samples) – Tests on proportions, Z-test, t-test, F test and Chi-Square test.

UNIT – IV

Algebraic Structures and Number Theory: Algebraic Structures, Semi-Groups, Monoids, Groups, Subgroups, Abelian Group-Homomorphism, Isomorphism. Number Theory: Properties of Integers, Division Theorem, Greatest Common Divisor, Euclidean Algorithm, Least Common Multiple, Testing for Prime Numbers, The Fundamental Theorem of Arithmetic, Modular Arithmetic, Fermat's and Euler's Theorems.

UNIT – V

Sets & Graph Theory: Set Theory, Relations, Functions and operations, Partial orders, Hasse Diagram, Equivalence Relation and Partitions, Lattices and properties. Basic Concepts of Graphs, Matrix Representation of Graphs: Adjacency Matrix, Incidence Matrix, Isomorphic Graphs, Paths and Circuits, Euler and Hamilton Graphs, Planar Graphs, and Euler's Formula. Tree Properties, Spanning Trees, BFS Algorithm, DFS Algorithm, Minimal Spanning Trees, and Kruskal's Algorithm, Graph coloring, chromatic number.

Text Books:

- 1 Foundation Mathematics for Computer Science, John Vince, Springer 4th edition ISBN 9783031665486.
- 2 Probability & Statistics, 3rd Edition, Murray R. Spiegel, John J. Schiller and R. Alu Srinivasan, Schaum's Outline Series, Tata McGraw-Hill Publishers, 4th edition, ISBN 9780071795579.
- 3 Probability and Statistics with Reliability, K. Trivedi, Wiley, 2nd edition, ISBN 9780471333418.
- 4 Discrete Mathematics and its Applications with Combinatorics and Graph Theory, 7th Edition, H. Rosen, Tata McGraw Hill, 7th edition, ISBN 978-0070681880.

Reference Books:

- 1 Probability and Computing: Randomized Algorithms and Probabilistic Analysis, M. Mitzenmacher and E. Upfal, 2nd edition ISBN 9780511813603.
- 2 Applied Combinatorics, Alan Tucker, Wiley, 6th edition, ISBN 9780470458389.

Web Links:

- 1 <http://mathworld.wolfram.com/topics/NumberTheory.html/>
- 2 <http://nptel.ac.in/courses/106106094/>
- 3 <http://www.tutor.com/elementary-statistics/>
- 4 <http://mathworld.wolfram.com/topics/GeneralLogic.html/>

DATA STRUCTURES AND ALGORITHMS

Course Code: 2502CS02

L	T	P	C
1	0	2	3

Course Outcomes:

At the end of the Course, Student will be able to:

CO1: Illustrate mathematical preliminaries used in Data Structure and Algorithms.

CO2: Describe concepts of Sorting, BST and Priority queues.

CO3: Demonstrate concepts of data structures for disjoint sets.

CO4: Illustrate algorithms of dynamic programming

CO5: Analyze algorithms of string matching and number theory.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	-	1	-	-	-
CO2	2	1	1	-	2	-
CO3	1	1	1	-	1	-
CO4	2	1	1	-	2	-
CO5	2	1	1	-	2	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

UNIT – I

Mathematical preliminaries, time complexity and space complexity, worst-case and average-case analyses, use of order notations and related results, divide and conquer recurrences, recurrence relations: substitution method, recurrence trees, Master's theorem and its applications.

UNIT – II

Quick Sort and its analyses, Merge Sort recurrence, Strassen's matrix multiplication, fast multiplication of large integers, binary search trees, priority queues, Heaps and Heap Sort.

Practice:s

1. Write a C program to implement Quick Sort and analyze its time complexities.
2. Write a C program to implement Merge Sort and analyze its time complexities.
3. Write a C program to implement Binary Search Tree and its operations.

UNIT – III

Data structures for disjoint sets, Path compression, union by rank, Prim's and Kruskal's algorithms, Huffman coding, LZW coding, shortest paths, greedy activity selection, set cover and greedy heuristics.

Practice:

1. Write a C program for finding the biconnected components in a given graph.
2. Write a C program to implement Prim's algorithm for Minimum Cost Spanning Tree.
3. Write a C program to implement Kruskal's algorithm for Minimum Cost Spanning Tree.

UNIT – IV

Dynamic Programming basics, matrix chain multiplication, DP solution for traveling salesman and 0/1 Knapsack problems, least common subsequences, independent sets and backtracking algorithm, Breadth/depth-first algorithms.

Practice:

1. Write a C program to solve 0/1 Knapsack problem Using Dynamic Programming.
2. Write a C program to implement Breadth First Search algorithm.
3. Write a C program to implement Depth First Search algorithm.

UNIT – V

Topological sort, recursive graph algorithms, string matching: KMP algorithm, Rabin-Karp algorithm, number theory algorithms: basics, GCD and extended Euclidean algorithm, primality testing.

Practice:

1. Write a C program to sort the given elements using Topological sort.
2. Write a C program to find a pattern in a given text using KMP algorithm.
3. Write a C program to find a pattern in a given text using Rabin-Karp algorithm

Additional Practice:

1. Write a C program to implement Priority Queue using Min or Max heap.
2. Write a C program to find the shortest path in given graph using Dijkstra's algorithm.

Text Books:

- 1 Introduction to Algorithms, T.Cormen, C.Lieserson, R.Rivest, and C.Stein, 4th edition, Prentice- Hall/India, ISBN: 9780262046305.
- 2 Data Structures, Algorithms and Applications in java, Sartaj Sahni, 2/e, University Press, ISBN: 978-0929306339

Reference Books:

- 1 Data Structures and Algorithm Analysis, Mark Allen Weiss, 2/e, Pearson, ISBN: 978-8131714744
- 2 Data Structures and Algorithms in Java, Adam Drozdek, 3/e, Cengage, ISBN: 978-8131506554.
- 3 C and Data Structures: A Snap Shot Oriented Treatise Using Live Engineering Examples, N.B. Venkateswarulu, E.V. Prasad and S Chand & Co, ISBN: 978-8121932479.

Web Links:

- 1 <https://nptel.ac.in/courses/106102064/>
- 2 <https://nptel.ac.in/courses/106101060/>

OPERATING SYSTEMS THEORY AND PRACTICE

Course Code: 2502CS03

L	T	P	C
2	0	1	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Demonstrate Unix kernel data structures and its algorithms.
- CO2:** Analyze synchronization problems in uniprocessor and multiprocessor systems.
- CO3:** Describe existing file systems and their pros and cons of various systems.
- CO4:** Illustrate fundamental concepts of distributed operating systems
- CO5:** Apply protection and security in distributed operating systems.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1	-	-	-
CO2	2	1	1	-	1	-
CO3	2	1	1	-	1	-
CO4	2	1	1	-	1	-
CO5	1	1	1	-	1	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	1	-

UNIT – I

Introduction to UNIX: The process and the kernel, Mode, space and context, Process abstraction, kernel mode, synchronization by blocking interrupts, process scheduling.

Introduction to Threads: Fundamental abstractions, Lightweight process design, Issues to consider, User level thread libraries, scheduler activations
Signals: Signal generation and handling, Unreliable signals, Reliable signals, Signals in SVR4, Signals implementation, Exceptions, Process Groups

Process Scheduling: Clock interrupt handling, Scheduler Goals, Traditional UNIX scheduling.

Practice:

1. Explore synchronization mechanisms such as mutexes and semaphores in a multi-threaded program
2. Implement a multi-threaded program using semaphores to control access to a limited number of resources.

UNIT – II

Synchronization and Multiprocessing : Introduction, Synchronization in Traditional UNIX Kernels, Multiprocessor Systems, Multiprocessor synchronization issues, Semaphores, spin locks, condition variables, Read-write locks, Reference counts, Practice and solving problems on synchronization, process scheduling and threads.

Kernel Memory Allocators: Resource map allocator, Simple power-of-two allocator, McKusick-Karels Allocator, Buddy system, SVR4 Lazy Buddy allocator, OSF/1 Zone Allocator, Hierarchical Allocator, Solaris Slab Allocator.

Practice:

1. Implement signal handling and demonstrate its working in a C program.
2. Implement reference counting for resource management in a C program.

UNIT – III

File system interface and framework : The user interface to files, File systems, Special files, File system framework, The Vnode/Vfs architecture, Implementation Overview, File System dependent objects, Mounting a file system, Operations on files.

File System Implementations : System V file system (s5fs) implementation, Berkeley FFS, FFS functionality enhancements and analysis, Temporary file systems, Buffer cache and other special-purpose file systems.

Practice:

1. Understand and implement a simple resource map allocator in a C program.
2. Write a C program to mount a file system using the mount syscall.

UNIT – IV

I/O devices: polling, interrupt-driven, DMA; Application I/O interface: character and block devices, network devices; clocks and timers, nonblocking and asynchronous I/O, vectored I/O;

Kernel I/O interface: I/O scheduling, Buffering, Caching.

Distributed File Systems: Network File System (NFS), Remote File Sharing (RFS) Advanced File Systems: Limitations of traditional file systems, Sun-FFS, Journaling approach 4.4 BSD, Log-Structured file system, Meta logging Episode FS, Watchdogs.

Practice:

1. Write a C program that performs file operations and observe its impact on the buffer cache.
2. Obtain the source code of FreeBSD to explore the FFS implementation.

UNIT – V

Protection and security: Preliminaries, the access matrix model and its implementations. - Safety in matrix model, advanced models of protection. Data security, cryptography: Model of cryptography, conventional cryptography modern cryptography, private key cryptography, data encryption standard public key cryptography, multiple encryptions, authentication in distributed systems.

Practice:

1. Write a program to read from a character device (e.g., /dev/tty)
2. Write a program to read from a block device (e.g., /dev/sda).

Additional Practice:

1. Write a C program that reads and displays information from procfs
2. Write a C program that performs file operations and observe its impact on the buffer cache.

Text Books:

- 1 UNIX Internals, Thomas M. Cover and Uresh Vahalia, Pearson Education. ISBN: 9780131019089
- 2 Advanced Programming in the UNIX Environment, W. Richard Stevens, Stephen A. Rago, 3rd Edition, Pearson ISBN: 9789332575905
- 3 Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin and Greg Gagne. 9th edition, Wiley. ISBN: 9781118063330

Reference Books:

- 1 Operating Systems: A Design-Oriented Approach, Charles Crowley. Prentice-Hall India. ISBN: 9780074635513
- 2 A S Tanenbaum, Distributed Operating Systems, Pearson Education Asia. ISBN 13: 9788177581799
- 3 Advanced Concepts in Operating Systems, M Singhal and NG Shivaratri, Tata McGraw Hill Inc. ISBN: 9780070575721

Web Links:

- 1 <https://archive.nptel.ac.in/courses/106/105/106105214/>
- 2 <https://archive.nptel.ac.in/courses/106/102/106102132/>

DATA SCIENCE FUNDAMENTALS

Course Code: 2502CS04

L	T	P	C
2	0	1	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Make use of NumPy data manipulation and processing.
- CO2:** Apply pandas to effectively manage data loading and storage across multiple file formats.
- CO3:** Describe the importance of pre-processing techniques
- CO4:** Evaluate machine learning models using appropriate metrics
- CO5:** Apply Data Visualization for plotting of datasets.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	1	1	-
CO2	2	2	2	1	1	-
CO3	2	2	2	1	1	-
CO4	2	2	2	1	1	-
CO5	2	2	2	1	1	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	2
CO2	1	2
CO3	1	2
CO4	1	2
CO5	1	2

UNIT – I

Introduction to Data Science: Need for Data Science – What is Data Science - Data Science Process – Business Intelligence and Data Science – Prerequisites for a Data Scientist – Tools and Skills required.

NumPy Basics: The NumPy ndarray: A Multidimensional Array Object, Creating ndarrays, Data Types for ndarrays, Operations between Arrays and Scalars, Basic Indexing and Slicing, Boolean Indexing, Fancy Indexing, Data Processing Using Arrays, Expressing Conditional Logic as Array Operations, Methods for Boolean Arrays, Sorting, Unique.

Practice:

Creating a NumPy Array

1. Basic ndarray, Array Shape.
2. Array of zeros, Array Slicing.
3. Array of ones, Sorting, Searching.
4. Random numbers in ndarray, Array Join.

UNIT – II

Getting Started with pandas: Introduction to pandas, Library Architecture, Features, Applications, Data Structures, Series, DataFrame, Index Objects, Essential Functionality (Reindexing, Dropping entries from an axis, Indexing, selection, and filtering), Sorting and ranking, Summarizing and Computing Descriptive Statistics, Unique Values, Value Counts, Handling Missing Data, filtering out missing data.

Practice:

Perform following operations using pandas

1. Creating dataframe, Dataseries.
2. concat(), Grouping, Joining and merging.
3. Setting conditions
4. Adding a new column, Detect missing values.

UNIT – III

Plotting and Visualization: A Brief matplotlib API Primer, Figures and Subplots, Colors, Markers, and Line Styles, Ticks, Labels, and Legends, Annotations and Drawing on a Subplot, Saving Plots to File, Plotting Functions in pandas, Line Plots, Bar Plots, Histograms and Density Plots, Scatter Plots.

Practice:

Perform following visualizations using matplotlib

1. Bar Plot
2. Pie Chart
3. Box Plot
4. Histogram Plot

UNIT – IV

Data Loading, Storage, and File Formats : Reading and Writing Data in Text Format, Reading Text Files in Pieces, Writing Data Out to Text Format, Manually Working with Delimited Formats, JSON Data, XML and HTML: Web Scraping, Binary Data Formats, Using HDF5 Format, Reading Microsoft Excel Files, Interacting with Databases, Storing and Loading Data in Mongo DB.

Practice:

Read the following file formats using pandas

1. Text files
2. CSV files
3. Excel files
4. JSON files

UNIT – V

Data Wrangling : Combining and Merging Data Sets, Database style DataFrame Merges, Merging on Index, Concatenating Along an Axis, Combining Data with Overlap , Reshaping and Pivoting, Reshaping with Hierarchical Indexing, Data Transformation, Removing Duplicates, Replacing Values.

Machine Learning Fundamentals: Supervised Learning: Regression and Classification, Unsupervised Learning: Clustering and Dimensionality Reduction, Evaluation Metrics for Machine Learning, Overfitting and Underfitting, Model Selection and Hyperparameter Tuning

Practice:**Perform following operations using pandas**

1. Creating dataframe, Filtering data
2. Data replace, Remove duplication.
3. Setting conditions, merge operation.
4. Adding a new column, grouping method.

Text Books:

- 1 “Python for Data Analysis”, Wes McKinney, 2nd edition. O’REILLY, ISBN-13: 978-1491957660,
- 2 “Doing Data Science”, Rachel Schutt & Cathy O’neil, 1st edition O’REILLY, ISBN-10: 1449358659 ISBN-13: 978-1449358655

Reference Books:

- 1 “Data Science from Scratch: First Principles with Python”, Joel Grus, 2nd edition. O’Reilly Media ISBN-13: 978-1492041139 ISBN-10: 1492041130.
- 2 “Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization, Matt Harrison, O'Reilly ISBN: 9781533598240.
- 3 Introduction to Machine Learning with Python: A Guide for Data Scientists" by Andreas Müller and Sarah Guido ISBN: 9352134575.

Web Links:

- 1 https://en.m.wikipedia.org/wiki/Data_Science_and_Predictive_Analytics/
- 2 <https://nptel.ac.in/courses/106106179/>

MODERN COMPUTER NETWORKS

Course Code: 2502CS05

L	T	P	C
2	0	1	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Illustrate reference models with layers, protocols and interfaces.
- CO2:** Describe the routing algorithms, congestion control algorithms, Sub netting and Addressing of IPV4 and IPV6.
- CO3:** Explain TCP/UDP protocols and how they can be used to assist in network design and implementation.
- CO4:** Summarize the concepts Wireless LANS, WIMAX, IEEE 802.11, Cellular telephony and Satellite networks.
- CO5:** Extend the emerging trends in networks-MANETS and WSN.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	1	1	-
CO2	2	-	1	-	1	-
CO3	2	-	1	-	1	-
CO4	1	1	1	-	-	-
CO5	1	1	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	2
CO2	1	2
CO3	1	1
CO4	1	1
CO5	1	1

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.

Practice:

1. Write a program for congestion control using leaky bucket algorithm
2. Write a Program to implement Dijkstra's algorithm to compute the Shortest path through a graph.

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-ICMP, ARP, DHCP.

Practice:

1. Write a program to find the shortest path between vertices using bellman-ford algorithm.

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.

Practice:

- 1 Using TCP/IP sockets, write a client – server program to make the client send the file name and to make the server send back the contents of the requested file if present.
2. Write a program on datagram socket for client/server to display the messages on client side, typed at the server side

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 Computernetworks:

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, Behrouz A Fourzan, 4th edition, TMH, ISBN : 978-0070634145.
- 2 Computer networks, Andrew S Tanenbaum, 4th edition, Pearson, ISBN: 978-0130661029.
- 3 Computer networks, Mayank Dave, 1st edition, CENGAGE, ISBN: 978-8131509869.

Reference Books:

- 1 Computer networks, A system Approach, Larry L Peterson and Bruce S Davie, 5th ed, Elsevier, ISBN: 978-0123850591.

Web Links:

- 1 http://www.tutorialspoint.com/data_communication_computer_network/
- 2 <https://nptel.ac.in/courses/106105160/>

MACHINE LEARNING SYSTEMS

Course Code: 2502CS06

L	T	P	C
1	0	2	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Describe the types of machine learning algorithms.
- CO2:** Build regression and classification models for given data.
- CO3:** Demonstrate various types of ANN Architecture.
- CO4:** Apply Cluster techniques on high demand data to group similar data items.
- CO5:** Utilize unsupervised learning methods for clustering and dimensionality reduction.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	1	-	1	-
CO2	1	1	2	2	1	-
CO3	1	2	2	2	1	-
CO4	1	1	2	1	1	-
CO5	1	2	2	1	1	-

Mapping of Course Outcomes with Program Specific Outcomes:

	CO/PSO	PSO1	PSO2	
	CO1	1	2	
	CO2	1	2	
	CO3	1	2	
	CO4	1	2	
	CO5	1	2	

UNIT – I

Introduction: Understanding the need for AI and Machine Learning (ML), AI & Data, **Types of ML Algorithms:** Supervised, Unsupervised Learning and semi supervised learning, reinforcement learning, Evolutionary Computation ML Model development life cycle Deep Learning for Human Like Learning

Practice:

1. Building and Evaluating a Supervised Learning Model
2. Exploring Unsupervised Learning with K-means Clustering

UNIT – II

Regression Techniques: Regression for prediction, Gradient Descent and Ascent, Learning with Momentum, Loss Functions, Over fitting and under fitting, Model evaluation techniques **Types of Regression:** Linear Regression, Multi-variate, Polynomial – Gradient Descent and Normal Equation Method, Regression with Regularization, Hyper-parameters tuning, Dimensionality Reduction: PCA, Linear Discriminant Analysis.

Practice:

1. Implementing Linear Regression for Predictive Analysis
2. Evaluating Model Performance with Different Loss Functions

UNIT – III

Classification Techniques: Naïve Bayes Classification: Bayesian Learning, Naïve Bayes Classification, MAP, Bayesian Belief Networks, Decision Tree, K-Nearest Neighbors Support Vector Machines: Hard Margin and Soft Margin, Kernels and Kernel Trick, Evaluation Measures for Classification Techniques

Practice

1. Dimensionality Reduction using Principal Component Analysis.
2. Implementing Naïve Bayes Classifier for Text Classification.

UNIT – IV

Artificial Neural Networks (ANN): Biological Neurons and Biological Neural Networks, Perceptron Learning, Activation Functions, Multilayer Perceptron, Forward and Back Propagation, Types of ANN, Loss functions and hyper parameter tuning.

Practice:

1. Building and Evaluating Decision Trees for Classification.
2. Comparing Evaluation Measures for Classification Techniques (Accuracy, Precision, Recall, F1-Score)
3. Exploring Different Activation Functions in Neural Networks.

UNIT – V

Unsupervised Learning: Uses in Clustering, associations and dimensionality reduction Clustering, Hierarchical Agglomerative Clustering, k-means Algorithm.

Practice:

1. Implementing K-means Clustering for Customer Segmentation.
2. Comparing Different Clustering Techniques on Synthetic Datasets.

Additional Practice:

1. Understanding Forward and Back Propagation in Neural Networks.
2. Using Unsupervised Learning for Market Basket Analysis.

Text Books:

- 1 Machine Learning, Tom Mitchell, McGraw-Hill international editions, TMH, ISBN: 0071154671.
- 2 Pattern Recognition and Machine Learning C. Bishop, Springer, ISBN: 978-1493938438.
- 3 Elements of Artificial Neural Networks ,Kishan Mehrotra, Chilukuri Mohan and Sanjay Ranka, Penram International, ISBN: 9780262133289.

Reference Books:

- 1 Pattern Recognition, Techniques and Applications , Rajjan Shinghal, OXFORD Higher Education , ISBN:978-0195676853
- 2 Andrew Kelleher, Adam Kelleher, Applied Machine Learning for Data Scientist and Software engineers, Addison-Wesley Professional, ISBN:9780134116549

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc21_cs24/preview/
- 2 <https://www.udemy.com/course/machinelearning/>

RELATIONAL DATABASE MANAGEMENT SYSTEM

Course Code: 2502CS07

Course Outcomes:

L	T	P	C
2	0	1	3

At the end of the Course, Student will be able to:

- CO1:** Explain how to optimize query processing using various indexing techniques and Cost-based optimization methods.
- CO2:** Illustrate database performance through effective tuning techniques and Describe the principles of object-oriented database management systems (OODBMS).
- CO3:** Demonstrate distributed database systems, data replication, transaction management, and query processing.
- CO4:** Illustrate using robust database security by applying appropriate access control, authorization measures, and security protocols.
- CO5:** Design advanced data models incorporating active databases, temporal data concepts, and spatial and multimedia databases for specialized applications.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1	-	-	-
CO2	2	2	2	-	-	-
CO3	3	2	2	-	-	-
CO4	3	2	2	-	-	-
CO5	3	2	2	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	1	-
CO3	1	2
CO4	1	2
CO5	1	2

UNIT – I

Indexing – Primary & Secondary Index, Multilevel Indexing, B tree Indexing, B+ tree indexing, Hashing- Static & dynamic Query Processing- Measures of query cost, selection operations, Join operations, Evaluation of expressions Materialization, Pipelining. Query Optimization- Introduction, generating equivalence relation, Transformation of relational expression-equivalence rules, Choice of evaluation plans, Cost estimation- cost based optimization, Heuristic optimization, Statistical Information for Cost Estimation.

Practice:

1. Implementation of Index
2. Implementation of Joins

UNIT – II

Database Tuning- Database workload, Physical design and tuning decisions, Need for database tuning, Index selection, Tuning Indexes, Tuning the conceptual schema, Tuning queries and views, DBMS Benchmarks. Object Oriented Database System- properties, need for OODBMS, Structured types, Inheritance, Multiple Inheritance, Object identity, Object containment, Nested Relational Model.

Practice:

1. Implementation of Views
2. Study of Object Oriented DBMS

UNIT – III

Distributed Database System- Heterogeneous and Homogeneous Databases, Distributed Data Storage –Data replication, Data fragmentation, Distributed Transactions, Concurrency Control in Distributed Databases Commit Protocols -Two Phase commit, Three- Phase commit, Deadlock handling, Distributed Query Processing In R * System .

Practice:

1. Study of Distributed Transactions
2. Implementation of TCL commands

UNIT – IV

Database Security- Database Security and Authorization, Introduction to Database Security Issues, Types of Security, Database Security and DBA, Access Protection, User Accounts, and Database Audits Access Control and Grant & Revoke on Views and Integrity Constraints, Discretionary Access Control, Role of DBA, Security in Statistical Databases.

Practice:

1. Study of DCL Commands
2. Study of Database Security and DBA

UNIT – V

Enhanced Data Model for Advanced Applications- Active database concept and triggers and their design and implementation issues, Temporal data base concepts, Spatial and multimedia databases, Introduction to deductive databases, introduction to expert database system.

Practice:

1. Implementation of Triggers
2. Study of Expert Database System

Additional Practice:

1. Queries using Aggregate functions.
2. Normalization

Text Books:

- 1 "Database Concepts", Korth, Silberchatz, Sudarshan,, Addison Wesley, 7th Edition, ISBN : 978-0078022159.
- 2 "Database Management System" Majumdar & Bhattacharya, TMH, 7th Edition, and ISBN: 978-0074622391.
- 3 "Fundamentals of Database Systems", Elmasri, Navathe, Addison Wesley, 6th Edition, ISBN: 978-0-136-08620-8.

Reference Books:

- 1 "An Introduction to Database System", Date C.J., Addison Wesley, 7th Edition, ISBN : 978-0201385908.
- 2 "Concurrency Control & Recovery in Database Systems", Bernstein, Hadzilacous, Goodman, Addison-Wesley, ISBN: 978-0201107159.
- 3 "Distributed Databases principles & systems", Ceri & Palgatti, McGraw Hill, ISBN : 78-0070108295.

Web Links:

- 1 <https://www.guru99.com/indexing-in-database.html/>
- 2 <https://nptel.ac.in/courses/106105175/>

COMPUTATIONAL METHODS OF OPTIMIZATION

Course Code: 2502CS08

L	T	P	C
3	0	0	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Describe the fundamental concepts of optimization
- CO2:** Develop skills in formulating optimization problems.
- CO3:** Implement various optimization algorithms.
- CO4:** Analyze the performance and complexity of optimization algorithms.
- CO5:** Apply optimization methods to real-world problems

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	-	-	-	-
CO2	2	1	-	-	-	-
CO3	1	2	1	2	-	-
CO4	2	1	1	-	-	-
CO5	2	1	1	3	1	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	1	-
CO3	-	2
CO4	1	-
CO5	1	-

UNIT – I

Introduction to Optimization: Overview of optimization problems - Ingredients of Optimization Problems: objective function, constraints, variable bounds. Applications of optimization.

UNIT – II

Linear Programming: standard form of linear programming problem, canonical form, elementary operations, graphical methods, simplex method, dual simplex method, linear regression, Nonlinear Programming (NLP): Unconstrained optimization, Constrained Optimization.

UNIT – III

Convex Optimization: Convex sets and functions, convex and non-convex optimization, principles of multi-objective optimization, dominance and pareto-optimality, classical methods: weighted sum methods, weighted matrix methods.

UNIT – IV

Integer Programming (IP): Formulation of IP problems, Branch and bound method, Cutting planes method. Dynamic Programming: Principle of optimality, Applications in sequential decision making

UNIT – V

Stochastic Optimization: Introduction to stochastic processes, Stochastic gradient descent. Introduction to Meta-heuristic Optimization: Genetic Algorithms, Differential Evolution, Bee Colony Optimization, Particle Swarm Optimization, Applications of Heuristic and Meta-heuristic Optimization in Data Analytics

Text Books:

- 1 "Optimization Algorithms and Applications" by Rajesh Kumar Arora. 1st Edition ISBN-13: 978-1498721127
- 2 "Convex Optimization" by Stephen Boyd and Lieven Vandenberghe, Cambridge University Press 1st Edition ISBN-13: 978-0521833783
- 3 Numerical Optimization" by Jorge Nocedal and Stephen Wright. 2nd ed. ISBN-13: 978-0387303031

Reference Books:

- 1 Linear and Nonlinear Programming, D. G. Luenberger and Yinyu Ye, 1st ed. Springer. ISBN-13. 978-8181289346.

Web Links:

- 1 <https://www.geeksforgeeks.org/linear-programming/>
- 2 <https://cmo2019.github.io/cmo2019/>

ROBOTICS AND AUTOMATION

Course Code: 2502CS09

L	T	P	C
2	0	1	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Describe the types of automation, components of automation, strategies and levels of automation.
- CO2:** Explain the types of flow lines and quantitative analysis of flow lines.
- CO3:** Design of new robotic structure.
- CO4:** Explain about the homogeneous transformations and its applications in the analysis of a robotic structure.
- CO5:** Develop robot programming languages which may adopt in different applications of robot.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	2	1	-	-
CO2	2	2	2	1	-	-
CO3	2	2	2	1	-	-
CO4	2	2	2	1	-	-
CO5	1	2	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	2
CO2	1	2
CO3	1	2
CO4	1	2
CO5	1	2

UNIT – I

INTRODUCTION TO AUTOMATION

Basic elements of Automated system, Manufacturing Industries, Types of production, Functions in manufacturing, Organization and information processing in manufacturing, Automation strategies and levels of automation. Hardware components for automation and process control, mechanical feeders, hoopers, orienters, high speed automatic insertion devices.

UNIT – II

AUTOMATED FLOW LINES

Part transfer methods and mechanisms, types of Flow lines, Flow line with/without buffer storage, Quantitative analysis of flow lines.

ASSEMBLY LINE BALENCING

Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

UNIT – III

INTRODUCTION TO INDUSTRIAL ROBOTICS

Classification of Robot Configurations, functional line diagram, degrees of freedom, Components common types of arms, joints grippers.

Practice:

1. Forward Kinematics of PUMA 560
2. Inverse Kinematics of PUMA 560

UNIT – IV

ROBOT PROGRAMMING

Methods of programming, requirement and features of programming languages, software packages, Problems with programming languages.

Practice:

1. Robot programming and simulation for pick and place
2. Robot programming and simulation for colour identification
3. Robot programming and simulation for Shape identification

UNIT – V

ROBOT APPLICATION IN MANUFACTURING

Material Transfer – Material handling, loading and unloading – Process – spot and continuous arc welding & spray painting – Assembly and Inspection.

Practice:

1. Robot programming and simulation for machining (cutting, welding)
2. Robot programming and simulation for writing practice.
3. Robot Teaching Using VAL Programming

Text Books:

- 1 Automation, Production systems and Computer Integrated Manufacturing, M.P. Groover - Pearson publishers 4th edition. ISBN 9789332572492.
- 2 Industrial Robotics – Mikell P.Groover and Mitchell Weiss, Roger N.Nagel, Nicholas, G.Odrey – McGraw Hill. 2nd Edition ISBN-13. 978-1259006210.

Reference Books:

- 1 Robotics and control – R K Mittal and I J nagrath, Tata Mcgraw Hill. ISBN: 9780070482937
- 2 An Introduction to Robot Technology. Coiffet, P and Chirouze, M. Published by Kogan Page (1983). ISBN 10: 0850386373 ISBN 13: 9780850386370.
- 3 Robotic Engineering – Integrated approach by Klafter, Richard D. Chmielewski, Thomas A; Negin, Michael- Published by Prentice-Hall ISBN-13. 978-0134687520
- 4 Robotics: Fundamental Concepts and Analysis – Ashitave Ghosal, Oxford University Press. ISBN-13. 978-0195673913

Web Links:

- 1 <https://nptel.ac.in/courses/112101098/>
- 2 <https://nptel.ac.in/courses/112105249/>
- 3 <http://vlabs.iitkgp.ernet.in/mr/#/>

OBJECT ORIENTED SOFTWARE ENGINEERING

Course Code: 2502CS10

L	T	P	C
2	0	1	3

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

- CO1:** Apply the Object Oriented Software-Development Process to design software
- CO2:** Analyze and Specify software requirements through a SRS documents.
- CO3:** Design and Plan software solutions to problems using an object-oriented strategy.
- CO4:** Model the object oriented software systems using Unified Modeling Language
- CO5:** Estimate the cost of constructing object oriented software.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	1	-	-	-
CO2	1	-	1	2	-	1
CO3	1	2	1	-	-	-
CO4	1	2	1	2	-	1
CO5	1	-	1	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	-	1
CO4	2	1
CO5	2	1

UNIT – I

Introduction to Software Engineering: Software, Software Crisis, Software Engineering definition, Evolution of Software Engineering Methodologies, Software Engineering Challenges. Software Processes: Software Process, Process Classification, Phased development life cycle, Software Development Process Models, Process, use, applicability and Advantages/limitations

Practice:

- 1 Identifying the Requirements from Problem Statements
- 2 Study of UML Diagrams.

UNIT – II

Object oriented Paradigm, Object oriented Concepts, Classes, Objects, Attributes, Methods and services, Messages, Encapsulation, Inheritance, Polymorphism, Identifying the elements of object model, management of object oriented Software projects, Object Oriented Analysis, Domain Analysis, Generic Components of OOA model, OOA Process, Object Relationship model, Object Behavior Model.

Practice:

1. System Modeling Activity Diagrams

UNIT – III

Object Oriented Design: Design for Object- Oriented systems, The Generic components of the OO design model, The System design process, The Object design process, Design Patterns, Object Oriented Programming.

Practice:

1. OO Analysis
2. Interaction Diagrams

UNIT – IV

Object Oriented testing: Broadening the view of Testing, Testing of OOA and OOD models, Object-Oriented testing strategies, Test case design for OO software, testing methods applicable at the class level, Interclass test case design.

Practice:

1. Software Design
2. State Chart Diagram

UNIT – V

Technical Metrics for Object Oriented Systems: The Intent of Object Oriented metrics, The distinguishing Characteristics, Metrics for the OO Design model, Class-Oriented metrics, Operation Oriented Metrics, Metrics for Object Oriented testing, Metrics for Object Oriented Projects. CASE Tools.

Practice:

1. Component and Deployment Diagrams
2. Software Testing

Text Books:

- 1 Object oriented and Classical Software Engineering, Stephen R. Schach, and Edition. 7th Publisher. McGraw-Hill Higher Education ISBN-13. 978-0073191263
- 2 Object Oriented Software Engineering Practical Software Development using UML and Java, Timothy Lethbridge, Robert Laganieri, McGraw-Hill Higher Education, ISBN-13: 978-0077109080

Reference Books:

- 1 Software Engineering. A Practitioner's Approach. Roger S. Pressman, Seventh Edition. McGraw-Hill Higher Education ISBN-13. 978-9339212087

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc19_cs69/preview/
- 2 <https://archive.nptel.ac.in/courses/106/105/106105224/>
- 3 https://onlinecourses.nptel.ac.in/noc19_cs48/preview/
- 4 <https://archive.nptel.ac.in/courses/106/105/106105182/>

ARTIFICIAL COGNITIVE SYSTEMS

Course Code: 2502CS11

L T P C
2 0 1 3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Compare various traditional approaches with cognitive computing.
- CO2:** Demonstrate tools associated with cognitive computing.
- CO3:** Design computational models of cognitive system.
- CO4:** Describe business implications of cognitive computing.
- CO5:** Explain the Unstructured Information Management Architecture.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	-	1	-
CO2	1	1	-	-	1	-
CO3	2	1	2	2	1	-
CO4	2	1	-	-	1	2
CO5	2	1	-	-	1	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	2	-
CO3	1	2
CO4	2	-
CO5	2	-

UNIT – I

Introduction to Cognitive Science:

Understanding Cognition, Design for Human Cognition, Augmented Intelligence, Cognition Modeling Paradigms: Declarative/ logic-based computational cognitive modeling, connectionist models of cognition, Bayesian models of cognition, a dynamical systems approach to cognition

UNIT – II

Cognitive Models of memory and language, computational models of episodic and semantic memory, modeling psycholinguistics

Practice:

1. Cognitive Architectures
2. Perception and Sensory Processing

UNIT – III

Cognitive Modeling:

Modeling the interaction of language, memory and learning, Modeling select aspects of cognition classical models of rationality, symbolic reasoning and decision making.

Practice:

1. Learning Algorithms
2. Reasoning and Decision Making
3. Cognitive Modeling

UNIT – IV

Formal models of inductive generalization, causality, categorization and similarity, the role of analogy in problem solving, Cognitive Development, Child concept acquisition. Cognition and Artificial cognitive architectures such as ACT-R, SOAR, OpenCog, CopyCat, Memory Networks

Practice:

1. Natural Language Processing

UNIT – V

DeepQA Architecture, Unstructured Information Management Architecture (UIMA), Structured Knowledge, Business Implications, Building Cognitive Applications, Application of Cognitive Computing and Systems.

Practice:

1. Case study: IBM Watson

Text Books:

- 1 The Cambridge Handbook of Computational Psychology by Ron Sun, Cambridge University Press. ISBN-13. 978-0521674102
- 2 Learning IBM Watson Analytics, James D Miller, Packt Publishing Ltd. ISBN 13: 9781785880773

Reference Books:

- 1 Formal Approaches in Categorization by Emmanuel M. Pothos, Andy J. Wills, Cambridge University Press. ISBN-13. 978-0521190480
- 2 Cognition, Brain and Consciousness: Introduction to Cognitive Neuroscience by Bernard J. Bears, Nicole M. Gage, Academic Press. ISBN-13. 978-0123750709
- 3 Cognitive Computing and Big Data Analytics by Hurwitz, Kaufman, and Bowles, Wiley. ISBN-13. 978-1118896624

Web Links:

- 1 <https://www.techtarget.com/searchenterpriseai/definition/cognitive-modeling/>
- 2 <https://www.slideshare.net/slideshow/cognitive-modeling-92473833/92473833/>

INTERNET OF THINGS

Course Code: 2502CS12

L	T	P	C
2	0	1	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Describe the sensors and actuators for an IoT application
- CO2:** Optimizing IP for IoT using 6LoWPAN.
- CO3:** Make the Use of the RaspberryPi With Python Programming
- CO4:** Explain the difference between the Structured vs Unstructured Data to implement Multiple tools.
- CO5:** Summarize the important role of IOT in agriculture.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	2	-	-	1
CO2	1	2	1	-	-	-
CO3	1	2	2	-	-	2
CO4	1	2	1	-	-	-
CO5	1	-	1	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

	CO/PSO	PSO1	PSO2	
	CO1	1	2	
	CO2	2	2	
	CO3	1	2	
	CO4	2	2	
	CO5	1	-	

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

Practice :

1. Write a program to sense the available networks using in Arduino.

UNIT – II

IoT Protocols : IoT 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 LoRaWAN – 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.

Practice:

1. To write a program to measure the distance using ultrasonic sensor and make LED blink using Arduino.

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.

Practice:

1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation

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.

Practice:

1. To install MySQL database on Raspberry Pi and perform basic SQL queries.

UNIT – V

IoT Case Studies: Agricultural IoT, Components of an agricultural IoT, Advantages of IoT in agriculture, Case Studies, Vehicular IoT, Components of vehicular IoT, Advantages of vehicular IoT, Healthcare IoT, Components of healthcare IoT, Advantages and risk of healthcare IoT.

Practice:

1. Case Study on Agriculture IOT.

Text Books:

- 1 “The Internet of Things Connecting Objects to the Web” Hakima Chaouchi, Wiley Publications ISBN : 978-1-84821-140-7,
- 2 “The Internet of Things: Key Applications and Protocols”, Olivier Hersent, David Boswarthick, and Omar Elloumi, Wiley Publications ISBN-13: 978-1848214783.

Reference Books:

- 1 Introduction to IOT, Sudip Mishra, Anandarup Mukherjee, Arijit Roy, Cambridge University Press, ISBN: 978-1108495059.
- 2 “Enabling things to talk”, Bassi, Alessandro, et al, Springer-Verlag Berlin. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, ISBN: 978-3642379578.
- 3 “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, CISCO Press. ISBN: 978-1587144575.
- 4 Arduino Applied-Comprehensive Projects for Everyday Electronics, Neil Cameron, Apress ISBN: 978-1484209954

Web Links:

- 1 <https://www.javatpoint.com/iot-internet-of-things/>
- 2 https://www.tutorialspoint.com/internet_of_things/index.htm/

FOG AND EDGE COMPUTING

Course Code: 2502CS13

L	T	P	C
3	0	0	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Explore technologies behind the communication and management of fogs and edge resources.
- CO2:** Describe the orchestration of network slices across fog, edge, and cloud environments for optimized performance and resource management.
- CO3:** Design middleware solutions to enhance interoperability and efficiency in fog and edge computing environments.
- CO4:** Develop middleware to facilitate seamless communication and resource management in fog and edge computing systems.
- CO5:** Analyze applications leveraging fog and edge computing to enhance performance and efficiency in distributed systems

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	-	-	-	-
CO2	-	2	2	-	-	-
CO3	1	2	-	2	-	2
CO4	-	1	2	-	-	2
CO5	-	2	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

UNIT – I

Internet of Things (IoT) and New Computing Paradigm:

Introduction, Relevant Technologies, Fog and Edge Computing Completing the Cloud, Hierarchy of Fog and Edge Computing, Business Models, Edge Computing Platforms, Opportunities and Challenges, Methodology, Integrated C2F2T Literature by Modeling Technique, Integrated C2F2T Literature by Use , Case Scenarios , Integrated C2F2T Literature by Metrics – Threads, Standards.

UNIT – II

Orchestration of Network Slices in Fog, Edge, and Clouds:

Introduction, Background, Network Slicing, Network Slicing in Software, Defined Clouds Network Slicing Management in Edge and Fog, Internet of Vehicles (IoV): Architecture, Protocols and Seven-layer security model architecture for Internet of Vehicles, IoV: Network Models, Challenges and future aspects

UNIT – III

Optimization Problems in Fog and Edge Computing:

Preliminaries, The Case for Optimization in Fog Computing, Formal Modeling Framework for Fog Computing – Metrics, Further Quality Attributes, Optimization Opportunities along the Fog Architecture, Optimization Opportunities along the Service Life Cycle, Toward a Taxonomy of Optimization Problems in Fog Computing.

UNIT – IV

Middleware for Fog and Edge Computing:

Need for Fog and Edge Computing Middleware, Design Goals, State of the, Art Middleware Infrastructures, System Model, Case Study, Technologies, Fog Data Management, Smart Building , Predictive Analysis with FogTorch , Machine Learning in Fog Computing , Data Analytics in the Fog , Data Analytics in the Fog Architecture

UNIT – V

Applications of Fog and Edge Computing:

Exploiting Fog Computing in Health Monitoring, Smart Surveillance Video Stream Processing at the Edge for Real, Time Human Objects Tracking, Fog Computing Model for Evolving Smart Transportation Applications, Testing Perspectives of Fog , Based IoT Applications , Legal Aspects of Operating IoT Applications in the Fog.

Text Books:

- 1 Buyya, Rajkumar, and Satish Narayana Srirama, Fog and Edge computing: Principles and Paradigms, 2019, 1st edition, John Wiley & Sons, USA. ISBN-13. 978-1119524984.
- 2 Fog Computing: Theory and Practice by Assad Abbas, Samee U. Khan, Albert Y. Zomaya, Wiley Publication, ISBN-13. 978-1119551690.
- 3 IoT and Edge Computing for Architects, by Perry Lea, Second Edition, Publisher: Packt Publishing, 2020, ISBN: 9781839214806

Reference Books:

- 1 Cloud computing: A hands-on approach, Arshdeep Bahga and Vijay Madisetti, 2nd edition, CreateSpace Independent Publishing Platform, USA. ISBN-10. 0996025502

Web Links:

- 1 <https://nptel.ac.in/courses/106104449/>
- 2 <https://nptel.ac.in/courses/106104242/>

SECURE CLOUD COMPUTING

Course Code: 2502CS14

L	T	P	C
3	0	0	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Explain cloud computing fundamentals.
- CO2:** Describe cloud security challenges.
- CO3:** Explain threats and vulnerabilities to infrastructure, Data, and Access Control.
- CO4:** Demonstrate cloud computing and business continuity planning.
- CO5:** Summarize standards for security.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	-	-	-	-	-
CO2	1	2	1	2	-	-
CO3	1	-	2	2	-	2
CO4	1	2	2	-	-	-
CO5	1	-	-	-	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	2	-
CO3	1	-
CO4	2	-
CO5	1	-

UNIT – I

Cloud Computing Fundamentals - Definition, Evolution, Essential characteristics, Cloud Deployment Models, Cloud Service Models, Benefits, Cloud Architecture, Virtualization in Cloud, Cloud Data Centre, SLA, Cloud Applications.

UNIT – II

Cloud Security Challenges, Cloud Information Security Objectives, Cloud Security Services, Secure Cloud Software Requirements, Cloud Security Policy Implementation, Infrastructure Security, Data Security and Storage.

UNIT – III

Threats and Vulnerabilities to Infrastructure, Data, and Access Control; Risk Management and Risk Assessment in Cloud, Cloud Service Provider Risks, Virtualization Security Management in the Cloud.

UNIT – IV

Cloud Computing and Business Continuity Planning/Disaster Recovery, Cloud Audit and Compliance: Internal Policy Compliance, Regulatory/External Compliance.

UNIT – V

Standards for Security: SAML OAuth, OpenID, SSL/TLS, Encrypting Data and Key Management, Creating a Cloud Security Strategy.

Text Books:

- 1 "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Ronald L. Krutz, Russell Dean Vines, Wiley Publishing. ISBN: 9780470589878.
- 2 "Cloud Security and Privacy", Tim Mather, Subra Kumaraswamy, and Shahed Latif, Published by O'Reilly Media, Inc. ISBN: 9781449379513.

Reference Books:

- 1 Secure Cloud Computing by Sushil Jajodia , Krishna Kant, Pierangela Samarati , Anoop Singhal , Vipin Swarup , Cliff Wang, Publisher- Springer. ISBN-13. 978-1461492795.

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc21_cs14/preview/
- 2 <https://nptel.ac.in/courses/106105167/>

SOFT COMPUTING TECHNIQUES

Course Code: 2502CS15

L	T	P	C
2	0	1	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Elaborate fuzzy logic to handle uncertainty in engineering problems.
- CO2:** Make use of genetic algorithms to combinatorial optimization problems.
- CO3:** Distinguish artificial intelligence techniques, search heuristics, knowledge representation, planning and reasoning.
- CO4:** Illustrate and apply the principles of self-adopting and self-organizing neuro fuzzy inference systems.
- CO5:** Choose appropriate soft computing approach for a given problem.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	-	-	-	-
CO2	2	1	-	-	-	-
CO3	1	2	1	2	-	-
CO4	2	1	1	-	-	-
CO5	2	1	1	3	1	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	1	-
CO3	-	2
CO4	1	-
CO5	1	-

UNIT – I

Fuzzy Set Theory:

Introduction to Neuro, Fuzzy and Soft Computing, Fuzzy Sets, Basic function and Terminology, Set-theoretic Operations, Member Function Formulation and Parameterization, Fuzzy Rules and Fuzzy Reasoning, Extension Principle and Fuzzy Relations, Fuzzy If-Then Rules, Fuzzy Reasoning, Fuzzy Inference Systems, Tsukamoto Fuzzy Models, Input Space Partitioning and Fuzzy Modeling.

Practice

1. Fuzzy Membership Function Formulation
2. Fuzzy Inference System Design using Tsukamoto Fuzzy Models

UNIT – II

Optimization:

Derivative based Optimization, Descent Methods, and The Method of Steepest Descent, Classical Newton's Method, Step Size Determination, Derivative-free Optimization, Genetic Algorithms, Simulated Annealing, and Random Search.

Practice:

1. Gradient Descent for Minimizing a Simple Quadratic Function
2. Simulated Annealing for Solving the Traveling Salesman Problem (TSP)

UNIT – III

Artificial Intelligence:

Introduction, Knowledge Representation, Reasoning, Issues and Acquisition: Propositional and Predicate Calculus Rule Based knowledge Representation, Heuristic Search: Techniques for Heuristic search Heuristic Classification State Space Search: Strategies Implementation of Graph Search based on Recursion Patent-directed Search Production System and Learning.

Practice :

1. Implementing Propositional Logic in a Rule-Based Knowledge Representation System
2. Heuristic Search in a Maze Using a Simple Graph Search Algorithm

UNIT – IV

Neuro Fuzzy Modeling:

Adaptive Neuro-Fuzzy Inference Systems, Architecture Hybrid Learning Algorithm, Learning Methods that Cross-fertilize ANFIS and RBFN Coactive Neuro Fuzzy Modeling.

Practice:

1. Implementing a Basic Adaptive Neuro-Fuzzy Inference System (ANFIS)
2. Neuro-Fuzzy Coactive Modeling for Classification

UNIT – V

Applications of Computational Intelligence:

Printed Character Recognition, Inverse Kinematics Problems, Automobile Fuel Efficiency Prediction, Soft Computing for Coloripe Prediction.

Practice:

1. Printed Character Recognition using Neural Networks
2. Automobile Fuel Efficiency Prediction using Fuzzy Logic

Text Books:

- 1 “Neuro-Fuzzy and Soft Computing”, J.S.R.Jang, C.T.Sun and E.Mizutani, PHI Pearson Education ISBN-13 :978-0132610667
- 2 Artificial Intelligence by Saroj Koushik, Cengage Learning. ISBN : 9789355730428
- 3 “Artificial Intelligence and Intelligent Systems”, N.P.Padhy, Oxford University Press ISBN: 978-0195671544

Reference Books:

- 1 Artificial Intelligence, Second Edition, Elaine Rich & Kevin Knight, Tata McGraw Hill Publishing Comp., New Delhi ISBN: 0074600818
- 2 “Fuzzy Logic with Engineering Applications”, Timothy J.Ross, McGraw-Hill ISBN: 978-8126531264

Web Links:

- 1 <https://nptel.ac.in/courses/106105173/>
- 2 <https://cse.iitkgp.ac.in/~dsamanta/courses/archive/sca/Slides.htm/>

AI FOR CYBER SECURITY

Course Code: 2502CS16

L	T	P	C
2	0	1	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Explain fundamentals of AI&ML for cyber security.
- CO2:** Illustrate importance of AI for cyber security.
- CO3:** Summarize implications of AI&ML in security.
- CO4:** Apply tools and techniques to detect intrusion in networks to revealing abnormal patterns in datasets.
- CO5:** Analyse the trends of applications of Artificial Intelligence in cyber security.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	-	-	-
CO2	2	1	1	2	-	-
CO3	2	2	1	-	-	2
CO4	2	2	1	2	-	-
CO5	2	1	1	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	2
CO2	1	2
CO3	1	2
CO4	1	2
CO5	1	2

UNIT – I

Introduction: Understanding Cyber security, Looking at the Various Aspects of Cyber security, Social engineering and phishing , Introducing ransom ware, Malware intrusion, Non-malware intrusion, Detect, Respond, and Mitigate, Responding to and Recovering From Cyber attacks and Security Events, Meeting the Challenges of Cyber security.

Practice:

1. Study of different types of vulnerabilities for hacking a websites / Web Applications.
2. Analysis the security vulnerabilities of E-Mail Application

UNIT – II

Understanding Artificial Intelligence: Teaching Machines to be Smarter, Learning Algorithms, Supervised learning, Unsupervised learning, Being Smarter, Interacting with Humans, Natural Language Processing.

Practice:

1. Study of PROLOG Programming Language and its functions.
2. Implementation of depth first search for water jug problem.

UNIT – III

Discovering Machine Learning and Deep Learning: Deep Learning and Deeply Layered Neural Networks, Introducing cognitive computing, Structured and Unstructured Data.

Practice:

1. Write a python program to implement linear regression.
2. Implementation of Logistic regression
3. Build a deep neural network model start with linear regression using a single variable.

UNIT – IV

Applying Machine Learning and Deep Learning to Cyber security: Predictive Analytics, Taught Not Programmed, Uncovering the needle in the haystack, Introducing cognitive computing, Identifying root cause, A Smarter Adversary.

Practice:

1. Anomaly Detection
2. Malware Classification
3. Phishing Detection

UNIT – V

Using the Cognitive Capabilities to Investigate Security Incidents, Taking Intelligent Action, Understand, Reason and Learn, Detecting spam with Perceptron, Malware threat detection, Responding to Ransomware, Network anomaly detection with AI, Fraud prevention with cloud AI solutions, GANs - Attacks and Defenses.

Practice:

1. Intrusion Detection System (IDS)
2. Security Information and Event Management (SIEM)

Text Books:

- 1 Hands-On Artificial Intelligence for Cybersecurity, Implement smart AI systems for preventing cyber attacks and detecting threats and network anomalies by Alessandro Parisi. Packt Publishing ISBN: 9781789804027
- 2 AI in Cyber security by Leslie F. Sikos, Springer, Cham. ISBN-10. 3030075397

Reference Books:

- 1 Artificial Intelligence & Cyber security For Dummies, Ted Coombs, John Wiley & Sons, Inc, IBM Limited Edition. ISBN 978-1-119 50825-0.
- 2 Machine Learning for Computer and Cyber Security Principle, Algorithms, and Practices, Brij B. Gupta, Quan Z. Sheng, 1st Ed. CRC Press. ISBN-13. 978-1032707136
- 3 Artificial Intelligence for Security, Archie Addo, Srini Centhala, Muthu Shanmugam, Publisher(s): Business Expert Press ISBN: 9781951527273.

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc24_cs121/preview/
- 2 https://onlinecourses.nptel.ac.in/noc22_cs56/preview/

AI FOR LANGUAGE AND TEXT PROCESSING

Course Code: 2502CS17

L	T	P	C
2	0	1	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Apply the principles and Process of Human Languages such as English and other Indian Languages using computers
- CO2:** Realize semantics and pragmatics of English language for text processing
- CO3:** Select a suitable language modeling technique based on the structure of the language
- CO4:** Summarize morphology and NLP applications
- CO5:** Perform POS tagging for a given natural language

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	-	2	-	-
CO2	2	-	2	-	-	-
CO3	2	1	-	2	1	-
CO4	1	-	2	-	-	-
CO5	2	-	2	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	1
CO2	1	1
CO3	1	1
CO4	1	1
CO5	1	1

UNIT – I

Introduction to NLP:

Introduction to NLP - Various stages of NLP – The Ambiguity of Language: Why NLP Is Difficult Parts of Speech: Nouns and Pronouns, Words: Determiners and adjectives, verbs, Phrase Structure. Statistics Essential Information Theory: Entropy, perplexity, The relation to language, Cross entropy.

UNIT – II

Text Preprocessing:

Tokenization, Stemming, Text Preprocessing & Feature Representation Introduction to Corpora, Sentence Segmentation, Stemming: Porter Stemmer, Bag of words and Vector Space Model, Topic Modelling, Ngram Language Model, Smoothing.

Practice:

1. Word Analysis

UNIT – III

Language Modelling:

Words: Collocations- Frequency-Mean and Variance –Hypothesis testing: The t test, Hypothesis testing of differences, Pearson's chi-square test, Likelihood ratios. Statistical Inference: n -gram Models over Sparse Data: Bins: Forming Equivalence Classes- N gram model - Statistical Estimators- Combining Estimators

Practice:

1. Word Generation

UNIT – IV

Morphology:

Sequence Labeling for Parts of Speech and Named Entities, Part of Speech Tagging, Named Entities and Named Entity Tagging , HMM Part of Speech Tagging , Conditional Random Fields (CRFs), Evaluation of Named Entity Recognition Applications of NLP Machine Translation Encoder & Decoder Model, Attention Models, Question Answering Knowledge based Q&A Chatbots & Dialogue Systems, Automatic Speech Recognition and Text to Speech

Practice:

1. Morphology
2. N-Grams
3. N-Grams Smoothing

UNIT – V

Markov Model and POS Tagging:

Markov Model: Hidden Markov model, Fundamentals, Probability of properties, Parameter estimation, Variants, Multiple input observation. The Information Sources in Tagging: Markov model taggers, Viterbi algorithm, Applying HMMs to POS tagging, Applications of Tagging

Practice:

1. POS Tagging: Hidden Markov Model
2. POS Tagging: Viterbi Decoding
3. Building POS Tagger
4. Chunking
5. Building Chunker

Text Books:

- 1 Speech and Language Processing, Dan Jurafsky, James H. Martin Draft of 3rd Edition, Prentice Hall 2022, ISBN: 978-0130950697
- 2 Springer Handbook of Speech Processing, Jacob Benesty, M. M. Sondhi, Yiteng Huang Springer, ISBN: 978-3662533000

Reference Books:

- 1 Speech and Language Processing, Daniel Jurafsky and James H. Martin. 2020. 3rd Edition (draft), ISBN: 978-0135041963
- 2 Foundations of Statistical Natural Language Processing, Christopher, D. Manning and Hinrich Schütze, MIT Press, ISBN: 978-0262133609

Web Links:

- 1 <https://nptel.ac.in/courses/106105158/>
- 2 <https://nptel.ac.in/courses/106106211/>

HUMAN COMPUTER INTERACTION

Course Code: 2502CS18

L	T	P	C
2	0	1	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Explain human input-output channels, memory types, cognitive processes, and their impact on interactive system design.
- CO2:** Implement interaction design principles focusing on user needs, navigation, screen design, and usability engineering.
- CO3:** Apply design rules, usability principles, standards, guidelines, and golden rules to create effective user interfaces.
- CO4:** Develop and user interfaces using windowing systems, toolkits, and conduct through usability evaluations.
- CO5:** Utilize cognitive and collaboration models to design interactive systems for individual and group interactions.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	-	-	-	-
CO2	1	2	2	-	-	-
CO3	1	-	-	2	-	2
CO4	1	2	2	-	-	-
CO5	1	-	-	2	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	2	1
CO4	2	1
CO5	1	1

UNIT – I

BASICS:

The Human – Input-output channels – Human Memory – Thinking – emotions – Psychology & design of interactive systems; Computer – Text entry devices- Positioning, Pointing & drawing – Display devices for Virtual reality, 3D; Interaction – models – Frameworks & HCI, Ergonomics – Interaction styles – WIMP Interfaces – context; paradigms for Interaction

Practice:

1. To understand the trouble of interacting with machines - Redesign interfaces of home appliances.

UNIT – II

SOFTWARE PROCESS & DESIGN RULES:

Interaction design basics – user focus – scenarios – navigation – screen design & layout; HCI in software process – life cycle – Usability engineering – Interactive design & prototyping; Design rules – Principles for usability – standards – guidelines – golden rules – HCI patterns. **Practice:**

1. Design a system based on user-centered approach.
2. Understand the principles of good screen design
3. Redesign existing Graphical User Interface with screen complexity

UNIT – III

IMPLEMENTATION & USER SUPPORT:

Implementation support – Windowing system elements – using tool kits – user interface management; Evaluation techniques – goals – expert analysis – choosing a method; universal design principles – multimodal interaction; user support – requirements – Approaches – adaptive help systems – designing user support system.

Practice:

1. Design Web User Interface based on Gestalt Theory
2. Implementation of Different Kinds of Menus

UNIT – IV

COGNITIVE, COMMUNICATION & COLLABORATIVE MODELS:

Cognitive models – Goal & task hierarchies – Linguistic models – Physical & device models – architectures ; communication & collaboration models – Face-to-face communication – conversation – text based – group working; Task analysis – difference between other techniques – task decomposition – Knowledge based analysis – ER based techniques.

Practice:

1. Implementation of Different Kinds of Windows

UNIT – V

UBIQUITOUS COMPUTING, HYPERTEXT, WWW:

Ubiquitous computing application research – virtual & augmented reality – information & data visualization ; understanding hypertext – finding things – Web Technology & issues – Static Web content – Dynamic Web content; Groupware systems – Computer mediated communication – DSS – Frameworks for groupware.

Practice:

1. Design a system with proper guidelines for icons

Text Books:

- 1 “Human Computer Interaction”, Alan Dix, Janet Finlay, Gregory D.Abowd, Russell Beale, Third Edition, Pearson Education, ISBN : 0-13-046109-1.
- 2 “Human Computer Interaction in the New Millenium”, John M.Carrol, First Edition, Pearson Education, ISBN: 978-0201704471.

Reference Books:

- 1 User Interface Design, A Software Engineering Persepective, Soren Lauesen, 1st Edition, Pearson Education, ISBN: 978-0321181435.

Web Links:

- 1 <https://nptel.ac.in/courses/106103220>
- 2 <https://archive.nptel.ac.in/courses/106/106/106106177/>

SOFTWARE TESTING METHODS

Course Code: 2502CS19

L	T	P	C
2	0	1	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Apply software testing techniques in process of SDLC and engineering methods.
- CO2:** Examine various functionality problems by designing and selecting testing models and methods in software project management
- CO3:** Analyze the applications with various automation tools both functional and nonfunctional testing
- CO4:** To plan and execute a testing project for use modern software testing tools to support software testing projects.
- CO5:** Apply the knowledge on testing and creating test reports based on the automation tools

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	-	-	-	-
CO2	2	1	2	2	-	-
CO3	2	1	2	2	-	2
CO4	2	1	1	-	-	-
CO5	2	1	-	2	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	2
CO2	1	2
CO3	1	2
CO4	-	2
CO5	1	2

UNIT – I

Basic Concepts in Software Testing: Overview of Testing Techniques, Types of Software Testing, Role of Testing in SDLC, Testing Life Cycle (TLC), Testing Strategies and Tactics, Creating Test Plans and Test Cases, Test Scenarios, Test Data, Test Scripts, Test Requirements Specification, Requirements Gathering, Creating TRS and Test Procedure.

Practice:

1. Create and validate test cases for a given set of software requirements.
2. Develop a comprehensive test plan, including test scenarios and necessary test data.

UNIT – II

Life Cycle Testing & Test Project Management: SDLC Testing, Testing in the Requirement Phase, Logical & Physical Design Phase, Test Project Management - Estimating Test Costs and Duration, Staffing, Testing Team; Building a Software Testing Environment – Creating an environment supportive of software testing.

Practice:

1. Identify potential ambiguities in software requirements and ensure they are testable through a requirement-based test case matrix.
2. Estimate test costs, duration, and staffing for a test project, and develop a corresponding test schedule.

UNIT – III

Software Functional System Testing: Functional Testing, Automated Unit Testing, Test Plan & Scripts, White Box Testing, Black Box Testing, Creating Automated Test Procedures and Reports, Integration Testing, Creating & Maintaining Tested Databases

Software Non-Functional System Testing: Performance Testing, Load Testing, Endurance Testing, Scalability Testing, Volume Testing, Security Testing, Internationalization Testing, Creating Test Procedures and Reports, Test Plans, Creation of Data-pool, Bottleneck Identification, Performance Analysis and Reporting

Practice:

1. How do you apply Black Box and White Box testing techniques to a software module, and how do their results compare?
2. Conduct performance and load testing on a web application, and identify performance bottlenecks.

UNIT – IV

Tools and its application in specific Testing: Automated Testing Tools, Functional Testing, Rational Functional Tester, Selenium, Cucumber, Junit, Performance Testing Tools, Rational Performance Tester, HP Load Runner, Test Management Tools, Quality Center, Performance Center.

Practice:

1. Automate test cases for a web application using Selenium.
2. Use LoadRunner to create and execute a performance test scenario.

UNIT – V

Reports and Reviews: Reports and Control Issues, Types of Review, Component of Review Plans, Reporting Review Results, Evaluation of Software Quality

Advanced Concepts in Software Testing: Test Coverage and Test Metrics Management, Improving the Test Processes, Test Process Optimization, Empirical Software Testing and Analysis, SOA Testing, General Principles and Procedures, Data Warehouse Testing, Cloud Testing, Big Data Testing, Web Apps Testing.

Practice:

1. Prepare and review a comprehensive test report.
2. Identify inefficiencies in a testing process, suggest optimizations, and measure their impact.

Text Books:

- 1 The Art of Software Testing - Glenford J. Myers, Corey Sandler, Tom Badgett; 3rd Edition; ISBN-13: 978-1-118-031964, ISBN-10: 1118031962;
- 2 Foundations of Software Testing: Fundamental Algorithms and Techniques - Aditya P. Mathur; Pearson Education India; ISBN-13: 978-8131707954, ISBN-10: 8131707953

Reference Books:

- 1 Software Testing Concepts and Tools - Nageshwar Rao Pusuluri ; DreamTech Press, Reprint Edition; ISBN-13: 978-8177227125, ISBN-10: 817722712X
- 2 Guide to Advanced Software Testing - Anne Mette Jonassen Hass; 2nd Edition; Artech House; ISBN-13: 978-1608077321, ISBN-10: 1608077322
- 3 Effective Methods for Software Testing: Includes Complete Guideline - William E. Perry; 3rd Edition; Wiley Publications; ISBN-13: 978-0764577561, ISBN-10: 0764577562

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc22_cs61/preview/
- 2 https://onlinecourses.nptel.ac.in/noc20_cs19/preview/

QUALITY ASSURANCE IN SOFTWARE DEVELOPMENT

Course Code: 2502CS20

L	T	P	C
3	0	0	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Demonstrate software quality and its perspectives.
- CO2:** Analyze defect prevention and defect reduction in software quality assurance
- CO3:** Illustrate software quality engineering activities and its process
- CO4:** Analyze test activities for management and automation of software quality.
- CO5:** Make use of coverage and usage testing based on checklist and partitions

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	1	-	-	-
CO2	1	2	2	-	-	2
CO3	1	2	2	2	-	-
CO4	1	1	-	-	-	2
CO5	1	2	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	-	1
CO3	2	-
CO4	2	-
CO5	-	2

UNIT – I

Software Quality: Quality perspectives and expectations, Quality frameworks and ISO- 9126, correctness and defects: Definitions, properties and Measurements, A historical perspective of quality, software quality.

UNIT – II

Quality Assurance: Classification: QA as dealing with defects, Defect prevention- Education and training, Formal method, Other defect prevention techniques, Defect Reduction - Inspection: Direct fault detection and removal, Testing: Failure observation and fault removal, other techniques and risk identification, Defect Containment- software fault tolerance, safety assurance and failure containment

UNIT – III

Quality Engineering: Activities and process, Quality planning: Goal setting and Strategy formation, Quality assessment and Improvement, Quality engineering in software process.

UNIT – IV

Test Activities, Management and Automation: Test planning and preparation, Test execution, Result checking and measurement, Analysis and follow- up, Activities People and Management, Test Automation.

UNIT – V

Coverage and usage testing based on checklist and partitions: Checklist based testing and its limitations, Testing for partition Coverage, Usage based Statistical testing with Musa's operational profiles, Constructing operational profiles

Text Books:

- 1 Software Quality Engineering, Testing, Quality Assurance, and Quantifiable Improvement, Jeff Tian, ISBN:978-0471713456
- 2 Software Architecture: Foundations, Theory, and Practice, Richard N. Taylor, ISBN:978-470167748

Reference Books:

- 1 "Introduction to Software Testing" by Paul Ammann, Jeff Offutt, ISBN: 978-0471713456.
- 2 "Software Quality Assurance: from Theory to Implementation", Daniel Galin, Addison Wesley, ISBN: 978-0201709452

Web Links:

- 1 <https://archive.nptel.ac.in/courses/106/105/106105182/>
- 2 <https://nptel.ac.in/courses/106105150/>
- 3 <https://www.udemy.com/course/software-quality-assurance/>

BLOCK CHAIN TECHNOLOGY

Course Code: 2502CS21

L	T	P	C
2	0	1	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Demonstrate the foundation of the Blockchain technology
- CO2:** Identify the risks involved in building Blockchain applications.
- CO3:** Explain crypto currency relating with blockchain.
- CO4:** Illustrate the landscape of Ethereum Blockchain.
- CO5:** Summarize hyper ledger in blockchain

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	-	-	-	-	-
CO2	2	-	1	-	-	-
CO3	1	1	1	1	-	-
CO4	1	2	2	2	1	-
CO5	1	2	2	2	1	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	1	1
CO3	2	-
CO4	2	-
CO5	2	-

UNIT – I

Introduction: Introduction to Blockchain, Scenarios, Challenges Articulated, Blockchain, Blockchain Characteristics, Opportunities Using Blockchain, History of Blockchain.

Evolution of Blockchain : Evolution of Computer Applications, Centralized Applications, Decentralized Applications, Stages in Blockchain Evolution Public Blockchain Environments

Practice:

1. Understanding Blockchain Characteristics through a Simple Ledger Example
2. Simulating a Decentralized vs. Centralized Application

UNIT – II

Blockchain Concepts: Introduction, Changing of Blocks, Hashing, Consensus, Mining and Finalizing Blocks, security on blockchain, data storage on blockchain, wallets, Coding on Blockchain: Smart contracts, peer-to-peer network, types of blockchain nodes, risk associated with blockchain solutions, life cycle of blockchain transaction.

Practice:

1. Simulating Block Creation and Hashing in a Blockchain
2. Creating and Deploying a Basic Smart Contract using Solidity

UNIT – III

Architecting Blockchain solutions: Introduction, Obstacles for Use of Blockchain, Blockchain Relevance Evaluation Framework, Blockchain Solutions Reference Architecture, and Types of Blockchain Applications.

Crypto currency and Wallet: Types of Wallet, Desktop Wallet, App based Wallet, Browser based wallet, Metamask, Creating an account in Metamask, transfer of crypto currency in metamask.

Practice:

1. Evaluating the Use of Blockchain for a Simple Application
2. Setting Up a MetaMask Wallet and Transferring Cryptocurrency

UNIT – IV

Ethereum Blockchain Implementation: Introduction, Tuna Fish Tracking Use Case, Ethereum Ecosystem, Ethereum Development, Ethereum Tool Stack, Ethereum Virtual Machine, Smart Contract Programming, Integrated Development Environment, Truffle Framework, Ethereum Accounts, MyEtherWallet, Ethereum Networks/Environments, Ethereum Clients, Decentralized Application.

Practice:

1. Building a Simple Tuna Fish Tracking Smart Contract on Ethereum
2. Creating an Ethereum Account and Managing Funds with MyEtherWallet

UNIT – V

Hyperledger Blockchain Implementation, Introduction, Use Case – Car Ownership Tracking, Hyperledger Fabric, Hyperledger Fabric Transaction Flow, Invoking Chaincode Functions Using Client Application. Advanced Concepts in Blockchain: Introduction, InterPlanetary File System (IPFS), Blockchain Cloud Offerings, Blockchain and its Future Potential.

Practice:

1. Simulating Car Ownership Tracking Using Hyperledger Fabric
2. Exploring IPFS (InterPlanetary File System) for Blockchain Data Storage

Text Books:

- 1 Blockchain: Blueprint for a New Economy, Melanie Swan, O'Reilly ISBN : 978-1491920497
- 2 Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks by Imran Bashier, Packt publishing ISBN : 978-1787125445

Reference Books:

- 1 Mastering Ethereum: Building Smart Contracts and DApps by Andrews ISBN : 978-1491971949
- 2 Mastering Bitcoin: Programming the Open Blockchain, by Andreas M. Antonopoulos, O'Reilly ISBN : 978-9352135745

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc22_cs44/preview/
- 2 <https://github.com/blockchainedindia/resources/>
- 3 <https://github.com/HyperledgerHandsOn/trade-finance-logistics/>

SOFTWARE RELIABILITY AND QUALITY MANAGEMENT

Course Code: 2502CS22

L	T	P	C
3	0	0	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Describe Software Reliability during different phases of Software Development Life Cycle
- CO2:** Analyze Software Reliability parameters using Markovian Modeling
- CO3:** Evaluate performance of Binomial-Type, Poison-Type and Markovian Models
- CO4:** Predict Software Reliability using Intelligent Techniques
- CO5:** Design Quality Attributes for Software Quality Assurance (SQA)

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	2	1	1	1	1
CO2	-	2	1	-	-	1
CO3	-	2	1	1	1	1
CO4	-	2	1	1	-	-
CO5	-	2	1	-	1	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	-	1
CO3	2	-
CO4	2	-
CO5	-	2

UNIT – I

Introduction to Software Reliability: The Need for Software Reliability, Some Basic Concepts, Software Reliability and Hardware Reliability, Availability, Modelling and General Model Characteristics.

UNIT – II

Software Reliability Modeling: Halstead's Software Metric, McCabe's Cyclomatic Complexity Metric, Error Seeding Models, Failure Rate Models, Curve Fitting Models.

Advanced Software Reliability Modeling: Reliability Growth Models, Markov Structure Models, Time Series Models, Non-homogeneous Poisson Process Models

UNIT – III

Markovian Models: General Concepts, General Poison-Type Models, Binomial-Type Models, Poison-Type Models, Comparison of Binomial-Type and Poison-Type Models, Fault Reduction Factor for Poison-Type Models

UNIT – IV

Software Reliability Prediction and Parameter Estimation: Descriptions of Specific Models, Parameter Estimation, Comparison of Software Reliability Models, Software Reliability Prediction

UNIT – V

Software Quality Management and Verification & Validation: Software Quality Attributes, Quality Measurement & Metrics, Verification & Validation Techniques, Verification & Validation in the Life Cycle, Software Quality Assurance functions, Tool support for SQA

Text Books:

- 1 Software Reliability Modelling, M. Xie, World Scientific. ISBN: 978-981-02-0640-6
- 2 Software Reliability Measurement, Prediction, Application. John D.Musa,Anthony Iannino, Kazuhira Okumoto,McGraw-Hill Book Company. ISBN-13. 978-0070440937

Reference Books:

- 1 System Software Reliability, Hoang Pham, Springer.ISBN: 978-1852339500
- 2 Object-Oriented Software Engineering:An Agile Unified Methodology, David C.Kung, McGraw- Hill Education (India) Edition. ISBN-13: 978-0073376257

Web Links:

- 1 <https://archive.nptel.ac.in/courses/106/105/106105087/>
- 2 <https://archive.nptel.ac.in/courses/106/105/106105218/>

QUANTUM COMPUTATIONAL METHODS

Course Code: 2502CS23

L	T	P	C
2	0	1	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Comprehend the principles of classical vs. quantum computing and various quantum computing hardware implementations
- CO2:** Demonstrate the operations of quantum gates, understand quantum circuits and their notation, and design quantum circuits for everyday operations
- CO3:** Explain quantum algorithms and analyzing their time complexity, parallelism, and error correction in quantum computing.
- CO4:** Apply quantum programming languages and tools.
- CO5:** Explore quantum applications such as cryptography, machine learning, chemistry simulations, optimization, and ongoing research challenges.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	-	1	-	1	-
CO2	1	2	-	-	1	-
CO3	-	2	2	-	1	-
CO4	1	2	-	-	1	-
CO5	-	-	1	-	1	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	1	-
CO3	2	-
CO4	2	-
CO5	1	-

UNIT – I

Overview of classical vs. quantum computing, Quantum superposition, and entanglement (entangled states and their properties, Bell's theorem and the violation of Bell inequalities, Applications of entanglement in quantum information tasks.) Quantum Measurement, Quantum Teleportation, Quantum bits (qubits) and quantum gates, Quantum Computing Hardware, physical implementations of qubits (Superconducting, Trapped Ion, Photonic Qubits).

Practice:

1. Introduction to Qubits and Quantum Gates.
2. Constructing and Simulating Quantum Circuits

UNIT – II

Quantum gates and their operations: Hadamard Gate, Pauli-X Gate, Pauli-Y Gate, Pauli-Z Gate, CNOT Gate, Toffoli Gate, SWAP Gate, Rabi Gate Quantum circuits and circuit diagrams and notation, Quantum circuits for everyday operations.

Practice:

1. Constructing and Simulating Quantum Circuits
2. Quantum Algorithms

UNIT – III

Shor's factoring algorithms, Grover's search algorithm, the adiabatic algorithms, Quantum oracle and its use in Grover's algorithm, Analysing the time complexity of quantum algorithms, Quantum parallelism, Quantum error correction, and its importance.

Practice:

1. Quantum Error Correction

UNIT – IV

Quantum Programming Languages and Tools, Introduction to quantum programming languages (Qiskit, Cirq), Writing simple quantum programs, Debugging and simulating quantum circuits, Accessing and using quantum hardware.

Practice:

1. Quantum Simulation and Measurement

UNIT – V

Quantum Applications, Quantum cryptography, Quantum machine learning, Quantum chemistry and simulations, Quantum optimization, Open problems and ongoing research.

Practice:

1. Quantum Cryptography
2. Quantum Machine Learning

Text Books:

- 1 Quantum Computation and Quantum Information, Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press ISBN: 9781107002173
- 2 Quantum Computing: A Gentle Introduction, Eleanor Rieffel and Wolfgang Polak, MIT Press ISBN: 9780262526678

Reference Books:

- 1 Programming Quantum Computers, Eric R. Johnston, Nic Harrigan, and Mercedes Gimeno-Segovia, O'Reilly ISBN-10. 1492039683

Web Links:

- 1 <https://nptel.ac.in/courses/106106232/>
- 2 <https://learn-xpro.mit.edu/quantum-computing/>

COMPUTER VISION AND IMAGE PROCESSING

Course Code: 2502CS28

L	T	P	C
2	0	1	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Classify Image representations.
- CO2:** Apply Image transformation methods
- CO3:** Implement image processing algorithms.
- CO4:** Design the face detection and recognition algorithms.
- CO5:** Summarize information, knowledge about the objects in the scene.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	2	-	-	-
CO2	1	2	1	-	-	-
CO3	1	2	2	2	-	2
CO4	1	2	1	-	-	-
CO5	1	2	2	2	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	1	-
CO3	1	2
CO4	3	-
CO5	3	-

UNIT – I

Introduction about computer vision: Advantages and disadvantages of computer vision, general applications of computer vision, Feature detection and matching. Review of basics of Digital image processing.

UNIT – II

The image model and acquisition, image shape, sampling, intensity images, color images, Range images, image capture, scanners. Statistical and spatial operations, Gray level transformations, histogram equalization, multi image operations.

Practice:

1. Image Arithmetic
2. Affine Transformation
3. Point Operations

UNIT – III

Spatially dependent transformations, templates and convolution, window operations, directional smoothing, other smoothing techniques. Segmentation and Edge detection, region Operations, Basic edge detection, second order detection, crack edge detection, edge following, gradient operators, compass & Laplace operators.

Practice:

1. Neighbourhood Operations
2. Image Histogram
3. Fourier Transform

UNIT – IV

Morphological and other area operations, basic morphological operations, opening and closing operations, area operations, morphological transformations. Image compression: Types and requirements, statistical compression, spatial compression, contour coding, quantizing compression.

Practice:

1. Morphological Operations
2. Image Segmentation
3. Image Processing Test Bench

UNIT – V

Representation and Description, Object Recognition, 3-D vision and Geometry, Digital Watermarking. Texture Analysis.

Practice:

1. Case studies of computer vision projects such as content-based image retrieval face recognition etc.

Text Books:

- 1 Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, 2nd Edition Pearson Education. ISBN-13. 978-9332550117
- 2 Digital Image Processing and Computer Vision, Milan Soanka, Vaclav Hlavac and Roger Boyle, Cengage Learning. ISBN-13. 978-8131505557
- 3 Digital Image Processing, R.C. Gonzalez and R.E. Woods, 4th Edition, Pearson Education. ISBN-13, 978-9353062989

Reference Books:

- 1 “Computer Vision: Algorithms and Applications” by “Richard Szeliski” Springer. ISBN-13 978-1848829343
- 2 “Fundamentals Of Machine Vision”, by “Harley R. Myler” PHI Learning. ISBN 13: 9780819430496
- 3 “Computer Vision: A Modern Approach” by Forsyth David A., Ponce Jean, Prentice Hall of India, ISBN 13: 9788120323728

Web Links:

- 1 <https://nptel.ac.in/courses/108103174/>
- 2 <https://cse19-iiith.vlabs.ac.in/>

SOFTWARE PROJECT PLANNING AND MANAGEMENT

Course Code: 2502CS24

L	T	P	C
2	0	1	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Explain Software Project Management fundamentals and Planning activities.
- CO2:** Apply various methods of Cost Estimation.
- CO3:** Illustrate Software Quality Management concepts.
- CO4:** Demonstrate various Software Project Management Metrics.
- CO5:** Analyze various Project Evaluation metrics and Emerging Trends.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	2	-	1	-	2
CO2	-	2	-	1	-	2
CO3	-	2	-	1	-	2
CO4	-	1	-	-	-	2
CO5	-	2	-	1	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	-	1
CO3	2	-
CO4	2	-
CO5	-	2

UNIT – I

PROJECT CONCEPTS AND ITS MANAGEMENT: Project life cycle models-ISO 9001 model-Capability Maturity Model-Project Planning-Project tracking-Project closure. Evolution of Software Economics – Software Management Process Framework: Phases, Artifacts, Workflows, Checkpoints – Software Management Disciplines: Planning / Project Organization and Responsibilities / Automation / Project Control – Modern Project Profiles.

Practice:

1. Prepare Functional and non-functional requirements of term project.

UNIT – II

COST ESTIMATION: Problems in Software Estimation – Algorithmic Cost Estimation Process, Function Points, SLIM (Software Life cycle Management), COCOMO II (Constructive Cost Model) – Estimating Web Application Development – Concepts of Finance, Activity Based Costing and Economic Value Added (EVA) – Balanced Score Card.

Practice:

1. Estimate your term project cost using COCOMO

UNIT – III

SOFTWARE QUALITY MANAGEMENT: Software Quality Factors – Software Quality Components – Software Quality Plan – Software Quality Metrics – Software Quality Costs – Software Quality Assurance Standard – Certification – Assessment.

Practice:

1. **Project Planning and Scheduling:** Creating project plans, Gantt charts.

UNIT – IV

SOFTWARE MANAGEMENT AND METRICS: Software Configuration Management – Risk Management: Risk Assessment: Identification / Analysis / Prioritization – Risk Control: Planning / Resolution / Monitoring – Failure Mode and Effects Analysis (FMEA) – Defect Management – Cost Management. Software Metrics – Classification of Software Metrics: Product Metrics: Size Metrics, Complexity Metrics, Halstead's Product Metrics, Quality Metrics, and Process metrics.

Practice:

1. **Risk Management:** Identifying and mitigating risks.

UNIT – V

PROJECT EVALUATION AND EMERGING TRENDS: Strategic Assessment– Technical Assessment–Cost Benefit Analysis–Cash Flow Forecasting– Cost Benefit Evaluation Technique–Risk Evaluation–Software Effort Estimation. Emerging Trends: Import of the internet on project Management –people Focused Process Models.

Practice:

1. **Case Studies:** Analyzing real-world projects.

Text Books:

- 1 Software Project Management, Walker Royce, Pearson Education, ISBN 978-0321734020
- 2 Software Project Management, Bob Hughes, 4th edition, Mike Cotterell, TMH, ISBN :978-0077109899

Reference Books:

- 1 Software Project Management, Joel Henry, Pearson Education, ISBN: 978-8131717929.
- 2 Software Project Management in practice, Pankaj Jalote, Pearson Education, ISBN 978-0201737219: .
- 3 Effective Software Project Management, Robert K. Wysocki, Wiley, ISBN: 978-0470446539.

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc18_mg08/preview/
- 2 https://www.tutorialspoint.com/software_engineering/software_project_management.htm/

BASIC CONCRETE TECHNOLOGY

Course Code: 2502CE30

L T P C
3 0 0 3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Understand the chemical composition, hydration, and physical properties of Portland cement.
- CO2:** Evaluate the effects of mineral and chemical admixtures on concrete performance.
- CO3:** Classify and assess aggregates based on mechanical properties, grading, and thermal behavior.
- CO4:** Analyze workability and setting characteristics of fresh concrete, including relevant testing methods.
- CO5:** Design and proportion concrete mixes using BIS and ACI methods, ensuring quality control.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	1	-	-	-
CO2	2	1	3	-	-	-
CO3	2	1	3	-	-	-
CO4	2	1	3	-	-	-
CO5	2	2	3	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT – I

Cement: Portland cement – chemical composition – Hydration, Setting of cement – Structure of hydrate cement – Test on physical properties – Different grades of cement. Admixtures: Types of admixtures – mineral and chemical admixtures.

UNIT - II

Aggregates: Classification of aggregate – Particle shape & texture –, strength & other mechanical properties of aggregate – Specific gravity, Bulk density, porosity, adsorption & moisture content of aggregate – Bulking of sand – Deleterious substance in aggregate – Soundness of aggregate – Alkali aggregate reaction – Thermal properties – Sieve analysis – Fineness modulus – Grading curves – Grading of fine & coarse Aggregates – Gap graded aggregate – Maximum aggregate size.

UNIT – III

Fresh Concrete: Workability – Factors affecting workability – Measurement of workability by different tests – Setting times of concrete – Effect of time and temperature on workability – Segregation & bleeding – Mixing and vibration of concrete – Steps in manufacture of concrete – Quality of mixing water.

UNIT - IV

Hardened Concrete : Water / Cement ratio – Abram’s Law – Gelspaoe ratio – Nature of strength of concrete – Maturity concept – Strength in tension & compression – Factors affecting strength – Relation between compressive & tensile strength - Curing. Testing Of Hardened Concrete: Compression tests – Tension tests– Flexure tests – Splitting tests – Pull-out test, Non- destructive testing methods – codal provisions for NDT. Elasticity, Creep & Shrinkage – Modulus of elasticity – Dynamic modulus of elasticity – Poisson’s ratio – Creep of concrete – Factors influencing creep.

UNIT – V

Mix Design: Factors in the choice of mix proportions – Durability of concrete – Quality Control of concrete – Statistical methods – Acceptance criteria – Proportioning of concrete mixes by IS codes mix design. Special Concretes: Introduction to light weight concrete – Cellular concrete

Text Books:

1. Properties of Concrete by A. M. Neville Pearson 5th edition Education ltd. (ISBN: 9780273755807)
2. Concrete Technology by M. S. Shetty. – S. Chand & Co. (ISBN: 9788121900034)
3. Concrete Technology by Job Thomas -Cengage learning India Pvt Ltd.(ISBN: 9788131521099)

References:

1. Concrete Technology by M.L. Gambhir. – Tata Mc. Graw Hill Publishers, New Delhi. (ISBN: 9780070141100)
2. Concrete: Microstructure, Properties and Materials – P. K. Mehta and J. M. Monteiro, McGraw Hill Publishers. (ISBN: 9780071797870)

Web Links:

1. <https://nptel.ac.in/courses/105102012/>
2. www.archive.nptel.ac.in/noc/courses/noc15/SEM1/noc15-ce01/
3. <https://archive.nptel.ac.in/courses/105/102/105102012/>

REPAIR AND REHABILITATION OF STRUCTURES

Course Code: 2502CE31

L	T	P	C
3	0	0	3

Course Outcomes:

At the end of the Course, Student will be able to

- CO 1:** Identify the causes of deterioration of concrete structures.
- CO 2:** Illustrate the various materials for repair and rehabilitation techniques.
- CO 3:** Construct the various strengthening and stabilization techniques.
- CO 4:** Determine various repair techniques of damaged structures.
- CO 5:** Evaluate the usage of different types of concretes and durability aspects.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	2	-
CO2	3	2	2	2	2	-
CO3	3	2	2	2	2	-
CO4	3	2	2	2	2	-
CO5	3	2	2	2	2	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT-I

Materials for Repair and Rehabilitation:

Admixtures- types of admixtures- purposes of using admixtures- chemical composition- Natural admixtures- Fibers- wraps- Glass and Carbon fiber wraps- Steel Plates-Non destructive evaluation: Importance- Concrete behavior under corrosion, disintegrated mechanisms- moisture effects and thermal effects – Visual investigation- Acoustical emission methods-Corrosion activity measurement-chloride content– Depth of carbonation- Impact echo methods- Ultrasound pulse velocity methods- Pull out tests.

UNIT-II

Strengthening and Stabilization:

Techniques- design considerations-Beam shear capacity strengthening- Shear Transfer strengthening-stress reduction techniques- Column strengthening-flexural strengthening- Connection stabilization and strengthening, Crack stabilization.

UNIT-III

Bonded Installation Techniques:

Externally bonded FRP- Wet layup sheet, bolted plate, near surface mounted FRP, fundamental debonding mechanisms-intermediate crack debonding- CDC debonding- plate end debonding-strengthening of floor of structures.

UNIT-IV

Fibre Reinforced Concrete:

Properties of constituent materials- Mix proportions, mixing and casting methods-Mechanical properties of fiber reinforced concrete- applications of fibre reinforced concretes-Light weight concrete- properties of light weight concrete-No fines concrete-design of light weight concrete- Flyash concrete- Introduction- classification of flyash- properties and reaction mechanism of flyash- Properties of flyash concrete in fresh state and hardened state- Durability of flyash concretes.

UNIT-V

High Performance Concrete:

Introduction- Development of high performance concretes-Materials of high performance concretes- Properties of high performance concretes - Self Consolidating concrete-properties- qualifications.

Text Books:

1. Concrete repair and maintenance illustrated-Peter Emmons, published by Brandon W. Emmons.(ISBN: 9780876291916)
2. Experimental Techniques and Instrumentation,Dr.M.Sreenivasa Reddy, Dr.S.Govindarajan and Dr.S.Pachaiappan, Charulatha Publications, 2022.

Reference Books:

1. Rehabilitation of Concrete Structures, Dr. B. Vidivelli, Standard Publishers Distributors. (ISBN: 978-8180140276)
2. Concrete technology, M S Shetty, S. Chand Publications.(ISBN: 9788121900034)
3. Concrete technology, Neville & Brooks, pearson education ltd.(ISBN: 9788131708384)

Web Links:

1. <http://nptel.ac.in/courses/112101095/38>
2. <http://www.nptel.ac.in/courses/105105041/module%206.pdf>
3. https://www.youtube.com/watch?v=N4KrZ_DczrE

NEURAL NETWORKS AND FUZZY LOGIC

Course Code: 2502EE28

L	T	P	C
3	0	0	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO 1:** Explain artificial neuron models.
- CO 2:** Explain various learning methods of ANN.
- CO 3:** Apply different algorithms of ANN.
- CO 4:** Distinguish between Classical and Fuzzy Sets.
- CO 5:** Apply application of fuzzy logic control to real time systems.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	1	1	-	-
CO2	3	-	1	1	-	-
CO3	3	-	1	1	-	-
CO4	3	-	1	1	-	-
CO5	3	-	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT-I: Introduction to Neural Networks

Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Applications of ANN.

UNIT-II: Essentials of Artificial Neural Networks

Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN, Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application.

UNIT-III: Multilayer feed forward Neural Networks

Credit Assignment Problem, Generalized Delta Rule, Derivation of Back propagation (BP) Training, Summary of Backpropagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements, Radial Basis Function (RBF) Neural Network – Kohonen Self Organising feature Map (KSOM).

UNIT-IV: Classical & Fuzzy Sets

Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

UNIT-V: Fuzzy Logic Modules

Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

Text Books:

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and Rai – PHI Publication. (ISBN: 9788120353343)
2. Introduction to Neural Networks using MATLAB 6.0 - S.N.Sivanandam, S.Sumathi, S.N.Deepa, TMH. (ISBN: 9780070591127)

Reference Books:

1. Neural Networks, James A Freeman and Davis Skapura, Pearson Education.(ISBN: 9780201513769)
2. Fuzzy sets University and information, J.Klin and T.A.Folger, Prentice Hall.(ISBN: 9789353065782)
3. Introduction to artificial neural systems, J.M.Zurada, Jaico Publication house. ISBN: (9780314933911)

Web Links:

1. <http://nptel.ac.in/courses/108104049/16>
2. www.archive.nptel.ac.in/courses/127/105/127105006/
3. www.geeksforgeeks.org/fuzzy-logic-introduction/

HYBRID ELECTRIC VEHICLES

Course Code: 2502EE29

L	T	P	C
3	0	0	3

Course Outcomes:

At the end of the Course, Student will be able to:

CO 1: Analyze the architectures of HEVs with various components.

CO 2: Illustrate the concept of Electric Vehicle and Hybrid Electric Vehicles.

CO 3: Explain the Plan concept of Plug-in Electrical Vehicles.

CO 4: Analyze the power electronics converters for HEVs.

CO 5: Apply various energy storage technologies in Hybrid Vehicles.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	-	3	2	-	-
CO2	1	-	3	2	-	-
CO3	1	-	3	2	-	-
CO4	1	-	3	2	-	-
CO5	1	-	3	2	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT-I: Introduction

Introduction to Electric Vehicles: History of electric vehicles, social and environmental importance of electric vehicles, impact of modern drive-trains on energy supplies-Challenges and Key Technologies of EVs – Challenges for EV Industry in India

UNIT-II: Hybridization of Automobile

Fundamentals of vehicle, components of conventional vehicle and propulsion load, Drive cycles and drive terrain, Concept of electric vehicle and hybrid electric vehicle, Plug-in hybrid vehicle, constituents of PHEV, comparison of HEV and PHEV; Fuel Cell vehicles and its constituents.

UNIT-III: Plug-in Hybrid Electric Vehicle

PHEVs and EREVs, PHEV Architectures, equivalent electric range of blended PHEVs, Fuel economy and power management of PHEVs, end-of-life battery for electric power grid support, vehicle to grid technology, battery charging.

UNIT-IV: Power Electronics in HEVs

Rectifiers and Buck converter used in HEVs, isolated and non-isolated bidirectional DC-DC converter, regenerative braking, voltage source inverter, current source inverter, PWM rectifier in HEVs, EV and PHEV battery chargers.

UNIT-V: Battery and Storage Systems:

Energy Storage Parameters; Lead–Acid Batteries; Ultra capacitors; Flywheels - Superconducting Magnetic Storage System; Pumped Hydroelectric Energy Storage; Compressed Air Energy Storage - Storage Heat; Energy Storage as an Economic Resource.

Text Books:

1. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press.(ISBN: 9781138072855)
2. Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Hussein, CRC Press. (ISBN: 9780367693930)

Reference Books:

1. Introduction to Hybrid Vehicle System Modeling and Control, Wei Liu, Wiley.(ISBN: 9788126556205)
2. Electric and Hybrid Vehicles Technologies, Modelling and Control: A Mechatronic Approach”, Amir Khajepour, Saber Fallahand Avesta Goodarzi, John Wiley & Sons Ltd. (ISBN: 9781118341513)

Web Links:

- 1 <https://archive.nptel.ac.in/courses/108/103/108103009/>
2. https://ndl.iitkgp.ac.in/he_document/nptel/nptel/IN_N_1_E_E_12391_I_t_H_a_E_V_1402_4_D_o_H_E_v_14030_14031

GREEN ENGINEERING SYSTEMS

Course Code: 2502ME27

L	T	P	C
3	0	0	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO 1: Distinguish the various solar energy collection methods and measuring instruments
- CO 2: Explain the different methods of solar energy storage and their applications.
- CO 3: Illustrate the various types of wind mills and performance characteristics.
- CO 4: Explain the principle of Biomass production, Geothermal energy sources and Ocean thermal energy conversion
- CO 5: Illustrate the various types of electrical systems and mechanical systems.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1	1	-	-
CO2	2	2	1	1	-	-
CO3	2	2	2	1	-	-
CO4	2	1	-	1	-	-
CO5	2	1	-	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT – I

Introduction: Solar Radiation: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on tilted surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems. Photo voltaic energy conversion – types of PV cells, I-V characteristics
Solar Energy Collection: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT – II

Solar Energy Storage and Applications: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney.

Wind Energy: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement.

UNIT – III

Bio-Mass: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, bio fuels, I.C. engine operation and economic aspects.

Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India.

Ocean Energy: OTEC, Principles of utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

UNIT – IV

Electrical Systems: Energy efficient motors, energy efficient lighting and control, selection of luminaire, variable voltage variable frequency drives (adjustable speed drives), controls for HVAC (heating, ventilation and air conditioning), demand site management.

Mechanical Systems: Fuel cells- principle, thermodynamic aspects, selection of fuels & working of various types of fuel cells, Environmentally friendly and Energy efficient compressors and pumps.

UNIT – V

Energy Efficient Processes: Environmental impact of the current manufacturing practices and systems, benefits of green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of efficient and sustainable green production systems with examples like environmentally friendly machining, vegetable based cutting fluids, alternate casting and joining techniques, zero waste manufacturing.

Green Buildings: Definition, features and benefits. Sustainable site selection and planning of building for maximum comfort. Environmentally friendly building materials like bamboo, timber, rammed earth, hollow blocks, lime & lime pozzolana cement, agro materials and industrial waste.

Text Books:

- 1 Solar Energy – Principles of Thermal Collection and Storage/Sukhatme S.P. and J.K. Nayak/ TMH.
- 2 Non-Conventional Energy Resources/ Khan B.H/ Tata McGraw Hill, New Delhi,

Reference Books:

1. Renewable Energy Technologies /Ramesh & Kumar /Narosa.
2. Renewable Energy Resources-2 Edition/ J. Twidell and T. Weir/ BSP Books Pvt. Ltd.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc17_me33
2. <https://nptel.ac.in/courses/105107176/20>

IC ENGINES

Course Code: 2502ME28

L	T	P	C
3	0	0	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1: Summarize the finite element methods
- CO2: Analyse one-dimensional problems in trusses and beams
- CO3: Solve structural problems using CST and axis - symmetric formulation
- CO4: Apply finite elements to higher order, Iso-parametric elements, and one-dimensional heat transfer analysis.
- CO5: Apply finite element methods to dynamic analysis.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1	1	-	-
CO2	2	2	1	1	-	-
CO3	2	2	2	1	-	-
CO4	2	1	-	1	-	-
CO5	2	1	-	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT – I: Gas Exchange Processes

Inlet and exhaust processes in the four stroke cycle volumetric efficiency quasi static effects combined quasi static and dynamic effects variation with speed and valve area and timing- flow through valves poppet valve geometry and timing flow rate and discharge efficient, residual gas fraction exhaust gas flow rate and temperature variation, scavenging in wni ke eyelid engines, scavenging parameters and mdeluctual scavenging processes. Flow through parts supercharging and turbo changing methods of power buying abusive relationships compressors, turbines wave compression devices.

UNIT – II: Charge Motion Within The Cylinder

Intake Jet Flow, Mean velocity and turbulence characteristics definitions application to engine velocity data swirl swirl measurement, swirl generation during induction swit modification within the cylinder squish pre chamber engine flow crevice flows and blowby News nerated by piston-cylinder wall interaction

UNIT – III: Combustion In S.I And C.I Engines

Review of normal and abnormal combustion in SI and CI engine cyclic variation in combustion of St engine analysis of cylindrical pressure data in SI and CI engine. EMP Flix SI engines common rail fuel injection system in Ci engines fuel spray behavior in CI engine

UNIT – IV: Electric Vehicles

Introduction Limitations of IC Engines as prime mover. History of EV, Components of EV. and AC electric machines: Introduction and basic structure, Electric vehicle drive train, advantages and limitations Permanent magnet and switched reluctance motors.

UNIT – V: Hybrid Vehicles

Configurations of hybrid, Series and parallel, advantages and limitations, Hybrid drive trains, sizing of components Initial acceleration, rated vehicle velocity, Maximum velocity and maximum gradeability, Hydrogen: Production, Hydrogen storage systems, reformers.

Fuel Cell Vehicles: Introduction, Fuel cell characteristics, Thermodynamics of Fuel cells, Fuel cell types; emphasis on PEM fuel cell.

Text Books:

- 1 Internal Combustion Engine Fundamentals, J.B. Heywood, Mc Graw Hill Co, (ISBN:978-1259002076)
- 2 Build your own electric vehicle, Seth Leitman and Bob Brant. McGraw Hill, Co, 3 rd edition, (ISBN: 978-0071770569)

Reference Books:

- 1 Engineering Fundamentals of IC Engine, H.N. Gupta, 2nd edition PHI Pvt. Ltd. (ISBN 9788120346802)
- 2 PEM Fuel Cells-Theory and Practice, F. Barbir Elsevier Academic Press, (ISBN 9780128102398)

Web Links:

- 1 <http://nptel.ac.in/courses/112101097/>
- 2 www.thermopedia.com/content/786

CAD TOOLS FOR VLSI DESIGN

Course Code: 2502EC24	L	T	P	C
	3	0	0	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1: Comprehend the insight of CAD Tools in modern design.
- CO2: Develop combinational logic circuits by using CAD tools
- CO3: Build sequential logic circuits using Verilog HDL operators
- CO4: Analyze the performance of logic schematics using CAD simulation tools
- CO5: Infer the performance of logic circuits in terms of DRC, LVS and PEX.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	3	1	2	2	1
CO2	2	3	1	2	1	2
CO3	2	2	3	2	2	1
CO4	2	3	1	2	2	1
CO5	2	3	2	2	2	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT – I

Understanding the working platform with Xilinx Vivado and its device, family and package Selection. Design and Implementation of Combinational Circuits Priority Encoder and Comparator using data flow & structural style.

UNIT – II

Design and Implementation of Sequential Circuits to detect a given sequence using with and without overlapping (mealy & Moore machines). Design and Implementation of a traffic light controller in three road & four road junctions.

UNIT – III

Exercise on Concatenation, Replication operators, Reduction and Conditional operators in Verilog HDL. Performance characteristics of an n-channel and p-channel MOSFET.

UNIT – IV

Working with Schematic for Ring Oscillator with variable amounts of Pull up to pull down ratios. Design a full adder by instantiating the logic gates. Make a comment on design style on its performance.

UNIT – V

Design a NAND gate by using NMOS, PMOS and CMOS technologies and make a comment on its performance. Design a Schematic, stick and layout for given logic.

Text Books:

1. S. M. Kang and Y. Leblebici, CMOS Digital Integrated Circuits : Analysis and Design, Third Edition, MH, (ISBN Number-0072460539)
2. Plummer, Deal , Griffin “Silicon VLSI Technology: Fundamentals, Practice & Modeling”PH, (ISBN Number-0130850373)

Reference Books:

1. P. VanZant , “Microchip Fabrication”, 5th Edition, MH, (ISBN Number-6053901308)
2. R. J. Baker, H. W. Li and D. E. Boyce, CMOS Circuit Design, Layout and Simulation, PH, (ISBN Number-1119481511)

Web Links:

1. <https://themosisservice.com/university-support>
2. <https://youtu.be/OF3Zwfu6Ngc>
3. <https://newsroom.ibm.com/2021-05-06-IBM-Unveils-Worlds-First-2->

FPGA DESIGN FOR EMBEDDED SYSTEMS

Course Code: 2502EC25

L	T	P	C
3	0	0	3

Course Outcomes:

At the end of the Course, Student will be able to:

CO1: Outline the concepts of Embedded System and Hardware Description Languages

CO2: Develop an embedded system using FPGA

CO3: Explain FPGA platforms and cross development tools.

CO4: Illustrate Parallelism and scheduling concepts

CO5: Interpret the parallelism with in FPGA hardware core.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	3	1	-	-
CO2	3	-	2	-	-	-
CO3	1	-	2	-	-	-
CO4	1	-	2	-	-	-
CO5	1	-	2	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT – I: Embedded System Overview & Hardware Description Languages:

H/W-FPGA-Embedded SoC and use of VLSI circuit technology-platform FPGA's-Altera, Cyclone, Hardware Description Languages - VHDL , Verilog , Other High-Level HDLs, From HDL to Configuration Bit-stream

UNIT – II: System Design using FPGA:

Principles of system design-Design quality, Modules and interfaces, Abstraction and state, Cohesion and coupling, Designing and Reuse, Control flow graph, Design-Origins of platform FPGA designs.

UNIT – III: FPGA Platform:

Components, adding to platform FPGA systems, assembling custom compute cores. Software Design-System Software Options, Root File system, Cross-Development Tools, Monitors and Boot-loader.

UNIT – IV: Partitioning, Scheduling & Communication:

Overview of Partitioning Problem, Analytical Solution to Partitioning-Basic definitions, expected performance gain, resource considerations, Analytical Approach, Communication-Invocation/Coordination, Transfer of State, Practical Issues- Profiling Issues, Data Structures Manipulate Feature Size.

UNIT – V: Spatial Design:

Principles of Parallelism-Identifying Parallelism - Spatial Parallelism with Platform FPGAs Parallelism within FPGA Hardware Cores, Parallelism within FPGA Designs

Text Books:

1. Embedded Systems Design with Platform FPGAs, Ron Sass, Andrew G Schmidt Principles and Practices, First Edition, Tata McGraw Hill, India, ISBN Number-0123743338
2. Digital Systems design using VHDL, Charles H Roth. Jr, Re-Print, PWS publishing company (Thomson Books), USA, ISBN Number-9788131518304

Reference Books:

1. Design with VHDL, V A. Padroni Circuit First Edition, MIT Press Cambridge, England, ISBN Number-0262162245
2. FPGA Based System Design, Wayne Wolf, First Edition, Prentices Hall Modern Semiconductor Design Series, USA, ISBN Number-0131424610

Web Links:

- 1 <https://www.coursera.org/learn/intro-fpga-design-embedded-systems>
- 2 <https://www.colorado.edu/ali/fpga-design-embedded-systems-specialization>

ARTIFICIAL INTELLIGENCE

Course Code: 2502CS26

L	T	P	C
3	0	0	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO 1: Describe fundamentals of Artificial Intelligence and its applications
- CO 2: Solve basic AI based problems and construct logical building blocks for problem Formulation
- CO 3: Apply various logical systems inferencing different logical problems.
- CO 4: Illustrate knowledge representation using predicate logic and predicate rules.
- CO 5: Design expert systems that leverage domain knowledge effectively.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	-	-	1	-
CO2	2	1	2	-	1	-
CO3	2	1	2	2	1	2
CO4	2	1	2	-	1	-
CO5	2	1	-	-	1	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT – I

Introduction to Artificial Intelligence:

Introduction, History, Intelligent Systems, Foundations of AI, Applications, Tic-Tac-Toe Game playing, Development of AI Languages, Current trends in AI

UNIT – II

Problem Solving: State-Space Search And Control Strategies:

Introduction, General Problem Solving, Characteristics of problem, Exhaustive Searches, Heuristic Search Techniques, Iterative- Deepening A*, Constraint Satisfaction.

Problem Reduction And Game Playing: Problem Reduction, Game Playing, Minimax algorithm, Alpha- Beta Pruning, Two-player perfect information games.

UNIT – III: Logic Concepts

Introduction, Propositional calculus, Propositional logic, Representing facts in logic, functions and predicates, Axiomatic System, Semantic Tableau System in Propositional logic, Resolution Refutation in propositional logic, predicate logic.

UNIT – IV: Knowledge Representation

Knowledge Representation Using Predicate logic, Knowledge Representation using Semantic Network, Knowledge Representation using Frames.

Representing Knowledge Using Rules: Procedural Versus Declarative knowledge, Logic Programming, Forward versus Backward Reasoning

UNIT – V: Expert System

Representing and using Domain Knowledge, Reasoning with knowledge, Expert System Shells, Support for explanation examples, Knowledge acquisition-examples.

Text Books:

1. Artificial Intelligence- Saroj Kaushik, 1st edition CENGAGE Learning, ISBN: 9789355730428.
2. Artificial intelligence, A modern Approach, Stuart Russel, Peter Norvig, Pearson Education Ltd, 2nd ed, ISBN-13. 978-81203238.
3. Artificial Intelligence- Elaine Rich, Kevin Knight, Shivashankar B Nair, 3rd ed, McGraw Hill Education, ISBN-13. 978-0070087705

Reference Books:

- 1 Artificial intelligence structures and strategies for complex problem solving, George F Luger, 5th Edition, Addison Wesley. ISBN-13: 978-0321263186

Web Links:

- 1 https://www.tutorialspoint.com/artificial_intelligence/index.htm/
- 2 <https://www.slideshare.net/slideshow/logic-in-ai/5005940/>
- 3 <https://www.slideshare.net/slideshow/artificial-intelligence-3638681/3638681/>

MACHINE LEARNING TECHNIQUES

Course Code: 2502CS27

L	T	P	C
3	0	0	3

Course Outcomes:

At the end of the Course, Student will be able to:

- CO1: Describe the need for AI and ML, and the types of ML algorithms..
- CO2: Apply regression techniques and dimensionality reduction methods.
- CO3: Implement and evaluate various classification techniques.
- CO4: Describe and implement Artificial Neural Networks.
- CO5: Utilize unsupervised learning methods for clustering and dimensionality reduction

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	-	-	-	-
CO2	2	1	2	-	-	-
CO3	2	1	2	2	-	2
CO4	2	1	2	-	-	-
CO5	2	1	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	2
CO2	1	2
CO3	1	2
CO4	1	2
CO5	1	2

UNIT – I

Introduction: Understanding the need for AI and Machine Learning (ML), AI & Data, Types of ML Algorithms: Supervised, Unsupervised Learning and semi supervised learning, reinforcement learning, evolutionary computation ML Model development life cycle Deep Learning for Human Like Learning

UNIT – II

Regression Techniques: Regression for prediction, Gradient Descent and Ascent, Learning with Momentum, Loss Functions, Over fitting and under fitting, Model evaluation techniques
Types of Regression: Linear Regression.

UNIT – III

Classification Techniques: Naïve Bayes Classification: Bayesian Learning, Naïve Bayes Classification, MAP, Bayesian Belief Networks, Decision Tree, K-Nearest Neighbors Support Vector Machines: Hard Margin and Soft Margin, Kernels and Kernel Trick, Evaluation Measures for Classification Techniques

UNIT – IV

Classification Techniques: Naïve Bayes Classification: Bayesian Learning, Naïve Bayes Classification, MAP, Bayesian Belief Networks Decision Tree K-Nearest Neighbors Support Vector Machines: Hard Margin and Soft Margin, Kernels and Kernel Trick, Evaluation Measures for Classification Techniques

UNIT – V

Unsupervised Learning: Uses in Clustering, associations and dimensionality reduction Clustering, Hierarchical Agglomerative Clustering, k-means Algorithm

Text Books:

- 1 Machine Learning, Tom Mitchell, McGraw-Hill international editions, TMH, (ISBN: 0071154671)
- 2 Pattern Recognition and Machine Learning C. Bishop, Springer, (ISBN: 9781493938438)
- 3 Elements of Artificial Neural Networks , Kishan Mehrotra, Chilukuri Mohan and Sanjay Ranka, Penram International, (ISBN: 9780262133289).

Reference Books:

- 1 Pattern Recognition, Techniques and Applications , Rajjan Shinghal, OXFORD Higher Education , (ISBN:9780195676853)
- 2 Andrew Kelleher, Adam Kelleher, Applied Machine Learning for Data Scientist and Software engineers, Addison-Wesley Professional, (ISBN:9780134116549)

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc21_cs24/preview/
- 2 <https://www.udemy.com/course/machinelearning/>

VALUE EDUCATION

Course Code: 2502CE32

L	T	P	C
2	0	0	0

Course Outcomes:

At the end of the Course, Student will be able to:

CO 1: Understand value of education and self- development.

CO 2: Explain the need of good values in students.

CO 3: Developing the overall personality.

CO 4: Explain the need of character in a student.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1			2	
CO2	3	2	1	1	3	
CO3	3	3	2	2	2	
CO4	2	1	1	1	2	

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-

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 judgements.

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 Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship.

UNIT – IV

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. Chak ro borty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi. (ISBN: 9780195643077)

Reference Books:

1. Value Education and Professional Ethics by R.P. Shukla ISBN: 978-8183560995
2. Value Education: A Textbook for Schools by Dr. N. Venkataiah ISBN: 978-8120731965
3. Value Education: Theory and Practice by G. Rajagopal ISBN: 978-8182475191

Web Links:

1. <https://nptel.ac.in/courses/109/104/109104068/>
2. <https://nptel.ac.in/courses/109/105/109105116/>
3. <https://nptel.ac.in/courses/109/104/109104107/>

RESEARCH METHODOLOGY

Course Code: 2502CE33

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Course Outcomes:

At the end of the Course, Student will be able to:

- CO 1: Explain the characteristics and process of research.
- CO 2: Choose the research problem by applying problem identification techniques.
- CO 3: Develop and execute research design process.
- CO 4: Show the results of research process adhering to professional ethics.
- CO 5: Analyze the results of research using statistical measures of central tendency & coefficient of variation, correlation and regression

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	-	-	2	-
CO2	3	2	1	1	3	-
CO3	3	3	2	2	2	-
CO4	2	1	1	1	2	-
CO5	3	2	2	2	2	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT – I: Meaning of Research

Function of Research - Characteristics of Research – Steps involved in Research – Research in Pure and Applied Sciences - Inter Disciplinary Research. Factors which hinder Research – Significance of Research - Research and scientific methods – Research Process– Criteria of good Research – Problems encountered by Researchers – Literature review.

UNIT – II: Identification of Research Problem

Selecting the Research problem – Necessity of defining the problem – Goals and Criteria for identifying problems for research. Perception of Research problem – Techniques involved in defining the problem.

UNIT – III: Research Design

Formulation of Research design – Need for Research design – Features of a good design – Important concepts related to Research design.

UNIT – IV: Interpretation and Report Writing

Meaning and Technique of interpretation – Precautions in interpretation, Significance of report writing – Different steps in writing a report – Layout of a Research report.

UNIT – V: Statistical Techniques and Tools

Introduction of statistics – Functions – Limitations – Measures of central tendency - Arithmetic mean – Median – Mode – Standard deviation – Co-efficient of variation (Discrete series and continuous series) – Correlation – Regression.

Text Books:

1. Research Methodology Methods & Techniques, C.R. Kothari – New Age international Publishers (ISBN: 9789386649225).
2. A Hand Book of Methodology of Research, Rajammall, P. Devadoss and K. Kulandaivel, RMMVidyalaya press.(ISBN: 9780367135720)

Reference Books:

1. Thesis and Assignment Writing, J. Anderson, Wiley Eastern Ltd.(ISBN: 9780471339274)
2. Research Methodology, Mukul Gupta, Deepa Gupta – PHI Learning Private Ltd., New Delhi. (ISBN: 9788120343818)
3. Fundamentals of Mathematical statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand & Sons, New Delhi.(ISBN: 9788180545283)

Web Links:

1. <https://nptel.ac.in/courses/127106227/>
2. <https://www.coursera.org/learn/research-methodologies/>