BMS COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

BACHELOR OF ENGINEERING

DEPARTMENT
OF
INFORMATION SCIENCE AND ENGINEERING

SCHEME & SYLLABUS

III - VIII SEMESTERS

Batch 2023-2027

INSTITUTE VISION

Promoting Prosperity of mankind by augmenting Human Resource Capital through Quality Technical Education & Training**.**

INSTITUTE MISSION

Accomplish Excellence in the field of Technical Education through Education, Research and Service needs of society.

DEPARTMENT VISION

Promote Quality Human Resource Capital by inculcating in every student the art of Creativity and Productivity in the field of Information Technology.

DEPARTMENT MISSION

Offer High Quality Graduate, Post Graduate Programme in Information Technology to prepare students for higher studies and professional career in industry.

Provide good Teaching and Research environment for Quality Education in the field of Information Technology.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Excel as IT Professional with Proficiency in designing solutions to Information Engineering problems.

PEO2: Pursue higher studies with the sound knowledge of basic concepts and skills in science and IT disciplines.

PEO3: Exhibit professionalism, team work and expose to current trends towards continuous learning.

PROGRAMME OUTCOMES (POs)

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

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

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

PO6: The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-Long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

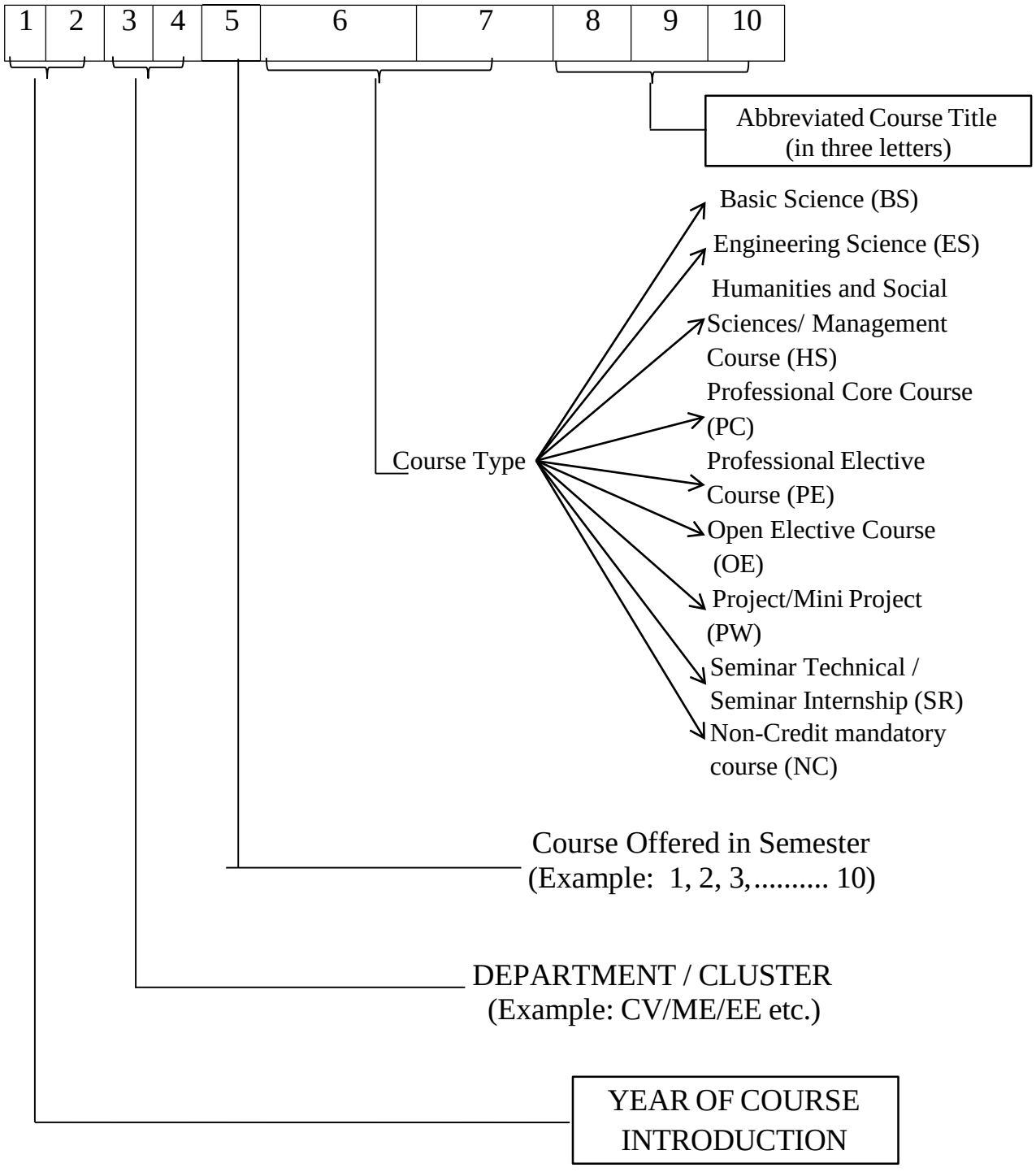
PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Apply and Analyze the concepts of Computer Networks to provide solution for evolving needs in Information Technology

PSO2: Demonstrate knowledge of Software Engineering with competence in programming languages to solve real-world problems.

PSO3: Apply principles of information systems in the field of engineering for proficient solutions

NOMENCLATURE FOR THE COURSE CODE



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Semester-III

No.	Course Type	Code	Course Title	Credits			Total Credits	Total Hours
				L	T	P		
1	BS	23MA3BSSDM	Statistics and Discrete Mathematics	2	1	0	3	4
2	PC	23IS3PCCOA	Computer Organization and Architecture	3	0	0	3	3
3	PC1	23IS3PCDSC	Data Structures	3	0	1	4	5
4	PC2	23IS3PCOOP	Object Oriented Programming using C++	3	0	1	4	5
5	PC3	23IS3PCDLD	Digital Logic Design	2	1	0	3	4
6	PC4	23IS3PCOPS	Operating Systems	3	1	0	4	5
7	AE/SDC	23IS3AEUSP	UNIX System Programming	0	0	1	1	2
8	NCMC	23IS3PENCM	NSS YOGA Physical Edu. (Sports and Athletics)	0	0	0	NP/PP	0
	TOTAL			16	3	3	22	28

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Semester-IV

No.	Course Type	Code	Course Title	Credits			Total Credits	Total Hours
				L	T	P		
1	BS	23MA4BSLIA	Linear Algebra	2	1	0	3	4
2	ES	23IS4ESTFC	Theoretical Foundations of Computation	2	1	0	3	4
3	PC5	23IS4PCDBM	Database Management System	3	0	1	4	5
4	PC6	23IS4PCADA	Analysis and Design of Algorithms	3	0	1	4	5
5	PC7	23IS4PCSEG	Software Engineering	2	0	0	2	2
6	PC8	23IS4PCJAV	Java Programming	3	0	1	4	5
7	UHV	23MA4AEUHV	Universal Human Values	0	1	0	1	2
8	AE	23IS4AECPG	Competitive Programming	0	0	1	1	2
9	NCMC	23IS4PENCM	NSS YOGA Physical Edu. (Sports and Athletics)	0	0	0	NP/PP	0
	TOTAL			15	3	4	22	29

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Semester – V

Course Type	Code	Course Title	Credits			Total Credits	Total Hours
			L	T	P		
PC9	23IS5PCCN1	Computer Networks – 1	3	0	1	4	5
PC10	23IS5PCMLG	Machine Learning	3	0	1	4	5
PC11	23IS5PCCNS	Cryptography and Network Security	3	0	0	3	3
PC12	23IS5PCSTG	Software Testing	3	0	0	3	3
PE1	23IS5PENLP	Natural Language Processing	3	0	0	3	3
	23IS5PEBCT	Block Chain Technology					
	23IS5PEAIS	Artificial Intelligence					
	23IS5PEADS	Advanced Data Structures and Algorithm					
	23IS5PEITM	Product, services and IT service management	3	0	0	3	3
PW1	23IS5PWAPP	Advance Python Programming	0	0	2	2	4
HS	23IS5HSEVS	Environmental Studies (CV/CH)	1	0	0	1	1
AE3	23IS5AERML	Research Methodology	2	0	0	2	2
NCMC	23IS5PENCM	NSS	0	0	0	NP/PP	0
		YOGA					
		Physical Edu. (Sports and Athletics)					
TOTAL			17	1	4	22	27

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Semester – VI

Course Type	Code	Course Title	Credits			Total Credits	Total Hours
			L	T	P		
BS	23IS6BSBIO	Bioinformatics	0	1	0	1	2
PC13	23IS6PCCN2	Computer Networks - 2	3	0	1	4	5
PC14	23IS6PCCLC	Cloud Computing	3	0	1	4	5
PC15	23IS6PCMAD	Mobile Application Development	0	0	2	2	4
PC16	23IS6PCOMD	Object Oriented and Modelling Design Patterns	2	0	0	2	2
PE2	23IS6PESNA	Social Network Analysis	2	0	1	3	4
	23IS6PEBDA	Big Data Analytics					
	23IS6PEDLG	Deep Learning					
	23IS6PESOA	Service Oriented Architecture					
OE1	23IS6OEWTS	Web technologies	3	0	0	3	3
	23IS6OEDSA	Data Structures and Algorithms					
	23IS6OECNS	Cryptography and Network Security					
	23IS6OERPA	Robotic Process Automation Design and Development					
PW2	23IS6PWPW1	Project work -1	0	0	2	2	4
AE4	23IS6AEFSD	Full Stack Development	0	0	1	1	2
NCMC	23IS6PENCM	NSS	0	0	0	NP/PP	0
		YOGA					
		Physical Edu. (Sports and Athletics)					
TOTAL			13	1	8	22	31

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Semester – VII

Course Type	Code	Course Title	Credits			Total Credits	Total Hours
			L	T	P		
PC- 17	23IS7PCGCT	Green Computing	2	0	0	2	2
PC-18	23IS7PCPME	Project Management & Entrepreneurship	2	0	0	2	2
PC-19	23IS7PCCSL	Cyber Security and Cyber Law	3	0	0	2	2
HS	25MA7HSIKL	Indian Knowledge Systems	1	0	0	1	1
PE-3	23IS7PEDVS	DevOps	0	0	2	3	4
	23IS7PEIOT	Internet of Things					
	23IS7PEM5G	Mobile Computing and 5G Technologies					
	23IS7PEDVR	Data Visualization and Reporting					
OE-2	23IS7OEICS	Introduction to Cyber Security	3	0	0	3	3
	23IS7OEAIS	Artificial Intelligence					
PW-3	23IS7PWPW2	Project Work-2	0	0	7	7	16
TOTAL			11	0	9	20	29

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Semester – VIII

Course Type	Code	Course Title	Credits			Total Credits	Total Hours
			L	T	P		
PE-4	23IS8PERPA	Robotic Process Automation Design and Development	3	0	0	3	4
	23IS8PEDSE	Data Science for Software Engineering					
	23IS8PEDFS	Digital Forensic					
	23IS8PEGAI	Generative AI					
OE-3	23IS8OEPDA	Python for Data Analysis	3	0	0	3	3
	23IS8OESEG	Software Engineering					
INT	23IS8SRINT	Internship	0	0	6	6	12
TOTAL			6	0	6	12	19

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Statistics and Discrete Mathematics**				
Course Code	**23MA3BSSDM**	**Credits**	**3**	**L-T-P**	**2-1-0**
CIE	**50**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**4**	**Total Lecture Hours**	**25**		

UNIT - 1
GRAPH THEORY: Basic concepts: Types of graphs, order and size of a graph, in-degree andout-degree, connected and disconnected graphs, Eulerian graph, Hamiltonian graphs, sub-graphs, isomorphic graphs. Matrix representation of graphs: adjacency matrix, incidence matrix. Trees: spanning tree, minimal spanning tree: Kruskal's algorithm and shortest path-Dijkstra's algorithm
UNIT - 2
PROBABILITY DISTRIBUTIONS: **Theoretical distributions: Discrete and continuous random variables** Discrete distributions: Poisson distribution, Geometric distributions. Continuous distributions: Exponential, Gaussian, Uniform Distribution and Gamma distributions.
UNIT - 3
JOINT PROBABILITY AND MARKOV CHAIN: Joint Probability Distributions: Discrete and continuous joint random variables, Mathematical expectations, Covariance and Correlation. **Markov Chain:** Probability vector, stochastic matrix, fixed point vector, regular stochastic matrix. Higher transition probabilities, stationary distribution of regular Markov chain.
UNIT - 4
STATISTICAL INFERENCE: Introduction, procedure for testing of hypothesis, level of significance. **Large sample:** Test of significance for single mean and difference between two means. **Small sample:** Test of significance for single mean, difference between two means, paired t-test, ratio of variances (F-distribution) and Chi-Square goodness of fit.
UNIT - 5
COMBINATORICS: Introduction, Binomial and multinomial theorems, Catalan numbers, the principle of inclusion and exclusion, Derangements, Rook Polynomials, Generating functions.

Text Books:

1. Graph Theory and Combinatorics, D. S. Chandrasekharaiah, 4th Edition, Prism Engineering Education Series, 2011-12
2. Higher Engineering Mathematics, B. V. Ramana, Tata McGrawHill, 2007
3. Discrete Mathematics and its applications, Kenneth H. Rosen, 7th Edition, McGraw Hill Publishers.
4. Kenneth H. Rosen, Elementary number theory and its applications, 5th edition, Pearson publications.

Reference Books:

1. Discrete Mathematics, Kolman, BusbyRoss, 5th edition, Prentice Hall, 2004.
2. Graph Theory with Applications to Engineering and Computer Science, Narsingh Deo, Eastern Economy Edition, PHI Learning Pvt., Ltd.
3. Mathematics for Machine Learning, Marc Peter Deisennorth, A. Aldo Faisal, Cheng Soon Ong, Cambridge University Press. 2020.

e- Books:

1. Math 725 (Graph Theory), Spring 2016, https://jlmartin.ku.edu/~jlmartin/courses/math725S16/.
2. An Introduction to Combinatorics and Graph Theory, David Guichard, https://www.whitman.edu/mathematics/cgt_online/cgt.pdf.

MOOCs:

1. Introduction to Probability and Data with R, https://www.coursera.org/learn/probability-intro.
2. Discrete Mathematics, https://nptel.ac.in/courses/111104026/.
3. Combinatorics, https://nptel.ac.in/courses/111106086/.

COURSE OUTCOMES (COs)

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

CO1	Apply the concept of Discrete Mathematics and Statistics in Computer and allied engineering science.
CO2	Demonstrate the Importance of Discrete Mathematics and Statistics using modern tools.

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Course Title	**Computer Organization and Architecture**				
Course Code	**23IS3PCCOA**	**Credits**	**3**	**L-T-P**	**3-0-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**3**	**Total Lecture Hours**	**40**		

UNIT - 1
Basic Structures of Computers: Computer Types, Functional Units, Basic Operational Concepts, Bus Structures, Software, Performance. **Machine Instructions and Programs**: Numbers, Arithmetic Operations and Characters, Memory Locations and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes.
UNIT - 2
Basic Processing Unit: Some Fundamental Concepts-Register Transfers, performing an Arithmetic or Logic Operation, Fetching a Word from Memory, Storing a Word in Memory, Execution of a Complete Instruction-Branch Instruction, Multiple-Bus Organization, Hardwired Control-A Complete Processor.
UNIT - 3
Arithmetic: Addition and Subtraction of Signed Numbers, Multiplication of Positive Numbers, Signed-Operand Multiplication, Fast Multiplication-Bit Pair Recoding Multipliers, Integer Division, Floating-Point Numbers.
UNIT - 4
Input/output Organization: Accessing I/O Devices, Interrupts-Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Exceptions, Direct Memory Access-Bus Arbitration, Buses-Synchronous and Asynchronous.
UNIT - 5
Pipelining: Basic Concepts - Role of Cache Memory, Pipeline Performance, Multistage Pipelining. **Memory System**: Some Basic Concepts, Speed, Size and Cost, Cache Memories - Mapping Functions, Replacement Algorithms.

Text Books:

1. Computer Organization, Carl Hamacher, 5th Edition, McGraw Hill Publishers.

Reference Books:

1. Computer Organization & Architecture, William Stallings 10th Edition, Pearson, 2015.
2. Computer Organization and Design. The Hardware/SoftwareInterface, David A.Patterson and John L.Hennessy, fifth Edition, Morgan Kaufman Publishers.

e- Books:

1. Computer Organization and Architecture, William Stallings 10th Edition, http://home.ustc.edu.cn/~louwenqi/reference_books_tools/Computer%20Organization%20and%20 Architecture% 2010th % 20-%20William%20Stallings.pdf.
2. Computer Organization and Architecture, Atul P. Godse, Dr. Deepali A. Godse, https://books.google.co.in/books?id=cp4eEAAAQBAJ&printsec=%20copyright&redir_esc=y#v=onepage&q&f=false.

MOOCs:

1. Computer architecture and organization, https://onlinecourses.nptel.ac.in/noc21_cs61/preview.
2. Computation Structures 3: Computer Organization, https://learning.edx.org/course/course-v1:MITx+6.004.3x_2+1T2017/home.
3. High Performance Computer Architecture, https://www.udacity.com/course/high-performance-computer-%20architecture--ud007.

COURSE OUTCOMES (COs)

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

CO1	Comprehend the concepts of basic architecture of a computer, instruction execution, interrupts, bus structures, control signals, memory organization, arithmetic unit operations and Pipelining concepts.
CO2	Apply the operational concepts for instruction execution, addressing modes, arithmetic operations, control signals, memory operations and data transfer methods on various problems.
CO3	Analyse types of addressing modes, interrupts, arithmetic and logic circuits, memory, pipeline performance ,bus architectures and its timing diagrams.
CO4	Enhance the knowledge skills and technological aspects on various processor architectures.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Data Structures**				
Course Code	**23IS3PCDSC**	**Credits**	**4**	**L-T-P**	**3-0-1**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**5**	**Total Lecture Hours**	**40**		

UNIT - 1

Introduction to Data Structures: Definition and its classification, Dynamic Memory allocation. **Linked Lists:** Definition, Basic Operations on Singly Linked List, singly linked List with Header Nodes, Applications of Singly Linked Lists.

UNIT - 2

Linked List: Doubly Linked Lists, Circular Linked List – Implementation and Applications. **Stacks:** Definition, Operations, Implementation using Arrays and Linked list, Applications **of Stack** – Infix to postfix conversion, Evaluation of postfix expression.

UNIT - 3

Recursion: Definition, Writing recursive programs, Efficiency of Recursion. **Queues:** Definition, Operations, Implementation using Arrays and Linked list. **Types of queues** – Circular queue, Deque and priority queue, Applications of queues.

UNIT - 4

Binary Trees: Binary Tree properties and representations, traversals and other operations. **Binary Search Trees:** Definition, Operations on BST, Threaded binary trees, Applications.

UNIT - 5

Balanced Trees: AVL Trees, Splay trees, Red- Black Trees – Definitions, Rotation and other basic operations.

Text Books:

1. Data Structures using C and C++, Yedidyah, Augenstein,Tannenbaum, 2nd Edition, Pearson Education, 2007.
2. Data Structures using C, Reema Thareja, Oxford UniversityPress 2nd Edition, 2011.

Reference Books:

1. Fundamentals of Data Structures in C, by Horowitz, Sahni, Anderson-Freed, 2nd Edition, Universities Press, 2007.

2. Data Structures A Pseudocode Approach with C, Richard F. Gilberg and Behrouz A. Forouzan, Cengage Learning, 2005.

e- Books:

1. https://www.mta.ca/~rrosebru/oldcourse/263114/Dsa.pdf
2. https://ebooks.lpude.in/computer_application/mca/term_2/DCAP407_DATA_STRUCTURE.pdf

MOOCs:

1. Data Structures: An Active Learning Approach, https://www.edx.org/learn/computer-science/the-university-of-california-san-diego-data-structures-an-active-learning-approach.
2. Data Structures and Algorithms Specialization https://www.coursera.org/specializations/data-structures- algorithms.

COURSE OUTCOMES (COs)

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

CO1	Apply principles of Data Structures for solving problems.
CO2	Analyze and Develop operations on linear and non-linear data structures.
CO3	Design and formulate various methods of organizing data.

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Course Title	Object Oriented Programming Using C++				
Course Code	23IS3PCOOP	Credits	4	L-T-P	3-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	5	Total Lecture Hours	40		

UNIT - 1

Introduction: Overview to Object Oriented Programming, Benefits and applications of Object Oriented Programming.

Beginning with C++: Program structure, c_{in} and c_{out} objects, namespace, identifiers, variables, constants, operators, reference types, typecasting, control structures.

Objects and Classes: Basics of object and class in C++, private and public members, Specifying a class, C++ program with a class, arrays within a class, memory allocation to objects, Array of objects.

UNIT - 2

Functions in C++: Functions, Inline Function, function overloading, Default arguments, Friend functions, static data and function members, Objects as function arguments, returning objects, constant member functions and objects, this pointer.

Constructors and Destructors: Constructors and its types – Default constructors, Parameterized constructors, multiple constructors in a class, Constructors with default arguments, dynamic initialization of objects, Copy constructor, Dynamic constructors, Destructors.

UNIT - 3

Operator overloading and Type conversion: Defining Operator overloading, Overloading Unary operators, Binary Operators using friend functions and Member functions, Overloading Special operators, Comma operator, new and delete operators, Rules for overloading operators, Type conversion.

Inheritance: Concept of Inheritance, types of inheritance - single, multiple, multilevel, hierarchical, hybrid, protected members, overriding, virtual base class.

UNIT - 4

Polymorphism: Pointers, Pointes to Objects, pointers to members and member functions, Pointers to derived classes, virtual and pure virtual functions.

I/O and File Management: Concept of streams, C++ stream classes, Unformatted and formatted I/O, manipulators, C++ File stream classes, File management functions, File modes, Binary and Random Files.

UNIT - 5
Templates: Introduction to templates, function templates and class templates. Introduction to exception: try-catch throw, multiple catch, catch all, rethrowing exception, User defined exceptions. **Introduction to Standard Template Library:** Components of STL - Containers, Algorithms, Iterators, Application of Container classes.
Text Books:
1. Object Oriented Programming with C++ by E Balaguruswamy, 6th Edition, Tata McGraw Hill, 2013. 2. C++ - The Complete Reference by Herbert Schildt, 4th Edition, Tata McGraw Hill, 2015.
Reference Books:
1. C++ Primer by Stanley B Lippman, Josee Lajoie, Barbara E Moo, 6th Edition, Addison Wesley Professional. 2. Object-Oriented Programming in C++ by Robert Lafore, 4th Edition, Pearson Education.
e- Books:
1. https://fac.ksu.edu.sa/sites/default/files/ObjectOriented ProgramminginC4th Edition. 2. C++ Primer Fifth Edition, https://zhjwpku.com/assets/pdf/books/C++.Primer.5th.Edition_2013.pdfe-Book.
MOOCs:
1. Programming in C++, https://onlinecourses.nptel.ac.in/noc19_cs38/preview 2. IIT BombayX: Object-Oriented Programming, https://www.edx.org/learn/object-oriented-programming/iitbombay-object-oriented-programming

COURSE OUTCOMES (COs)

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

CO1	Apply the concepts of data abstraction, encapsulation, polymorphism, inheritance, templates and file handling.
CO2	Identify the usage of reusability, polymorphism and exception handling for solving problems.
CO3	Develop solutions using object oriented programming concepts for a given problem.

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Course Title	**Digital Logic Design**				
Course Code	**23IS3PCDLD**	**Credits**	**3**	**L-T-P**	**2-1-0**
CIE	**50**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**4**	**Total Lecture Hours**	**25**		

UNIT - 1

Boolean Algebra and Combinational Networks: Definition of a Boolean Algebra, Boolean Formulas and Functions, Canonical Formulas, Gates and Combinational Networks, Incomplete Boolean Functions and Don't Care Conditions. **(Text 1 –** 3.1, 3.4 3.5, 3.7, 3.8**)**

Simplification of Boolean Expressions: Formulation of the Simplification Problem, Prime Implicants and Irredundant Disjunctive Expressions, Prime Implicates and Irredundant Conjunctive Expressions, Karnaugh Maps, Using K-Maps to Obtain Minimal Expressions for Complete Boolean Functions and Incomplete Boolean Functions, The Quine-McCluskey Method of Generating Prime Implicants and Prime Implicates. **(Text 1 –** 4.1 to 4.6, 4.8**)**

UNIT - 2

Data Processing Circuits: Binary Adder and Subtracters, Carry Look Ahead Adder, Decimal Adders, Comparators, Decoders, Encoders, Multiplexers. **(Text 1-**5.1, 5.1.1, 5.1.2, 5.2 to 5.6**)**

UNIT - 3

Flip-Flops: RS Flip-Flops, Gated Flip-Flops, Edge-triggered RS Flip-Flops, Edge Triggered D Flip-Flops, Edge-triggered JK Flip-Flops, JK Master-Slave Flip-Flops, Various Representations of Flip- Flops. **(Text 2 –** 8.1 to 8.5, 8.8, 8.10**)**

UNIT – 4

Registers: Types of Registers - SISO, SIPO, PISO, PIPO, Universal Shift Register, Applications of Shift Registers. **(Text 2 –** 9.1 to 9.7**)**

Counters: Binary Ripple Counters, Synchronous Binary Counters, Design of Synchronous Counters and self-correcting counters. **(Text** 1 – 6.8, 6.9)

UNIT - 5

Design of Synchronous Sequential Circuits: Model Selection, State Transition Diagram, State Synthesis Table, Design Equations and Circuit Diagram, State Reduction Techniques.
(Text 2 – 11.1 to 11.4, 11.7**)**

Text Books:
1. Digital Principles & Design, Donald D Givone, Tata McGraw Hill, 2011. 2. Digital Principles and Applications, Donald P Leach, Albert Paul Malvino & Goutam Saha,7th Edition, Tata McGraw Hill, 2010.
Reference Books:
1. Illustrative Approach to Logic Design, R D Sudhaker Samuel, Sanguine-Pearson, 2010. 2. Digital Logic and Computer Design, M Morris Mano 10th Edition, Pearson Education, 2008.
e - Books:
1. Digital Logic and Computer Design, https://shorturl.at/tuxGM. 2. Digital Principles and Design, https://bit.ly/2YgpMHr.
MOOCs:
1. Digital Circuits, https://onlinecourses.nptel.ac.in/noc19_ee51/preview. 2. Introduction to Digital Systems Design, https://nptel.ac.in/courses/117105080/.

COURSE OUTCOMES (COs)

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

CO1	Comprehend basic logic gates, combinational logic circuits and sequential logic circuits.
CO2	Apply digital logic for simplification of Boolean functions and realization of data processing circuits.
CO3	Analyse combinational and sequential circuits using flip-flops, registers and counters.
CO4	Design sequential circuits based on synchronous modes.

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Course Title	**Operating System**				
Course Code	**23IS3PCOPS**	**Credits**	**4**	**L-T-P**	**3-1-0**
CIE	**50**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**5**	**Total Lecture Hours**	**40**		

UNIT - 1

Introduction: What Operating systems do? Computer structure organisation- Interrupts: Interrupt timeline for a single program, I/O structure (1.2.3), Visualisation, Kernel data structures, Computing environments.

Operating System structure: Operating System Services, User Operating System Interface.

UNIT – 2

Processes: Process Concept, Process scheduling, Interprocess communication-in shared memory systems, Interprocess communication-in Message passing systems.

Process Synchronization: The critical Section problem, Peterson's solution, Mutex Locks, Semaphores, Classical problems of synchronization.

Multithreaded programming: Multithreading models.

UNIT - 3

CPU Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms.

Deadlocks: System Model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection and recovery from deadlock.

UNIT – 4

Main Memory: Background, swapping, Contiguous memory allocation, Segmentation, Paging, Structure of page table.

Virtual Memory: Background, Demand paging, Copy on write, Page replacement algorithms, Allocation of frames, Thrashing.

UNIT - 5

Storage management: Mass Storage structure- Overview of Mass storage structure (11.1.1), HDD Scheduling.

File system Interface: File Concept, Access Methods, Directory Structure.

Text Books:
1. Operating System Concepts, by Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, 10th Edition, Wiley India, 2018.
Reference Books:
1. Operating Systems, A Concept-Based Approach, by DM Dhamdhere, 3rd Edition, Tata McGraw-Hill, 2012. 2. Modern Operating Systems, by Andrew S. Tanenbaum and Herbert Bos, 4th Edition, Pearson, 2015.
e - Books:
1. http:// csc- knu. github. io/ svs- prog/ books/ Andrew% 20 S. %20Tanenbaum%20-%20Modern%20Systems.pdf. 2. http://ebooks.lpude.in/computer_application/mca/terms_1/DCAP403_OPERATING_SYSTEM.pdf.
MOOCs:
1. https://www.cs.uic.edu/~jbell/CourseNotes/OperatingSystems/ index.html. 2. https://www.udacity.com/course/introduction-to-operatingsystems--ud923.

COURSE OUTCOMES (COs)

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

CO1	Understand the basic concepts of operating system structures, services and functionalities.
CO2	Apply various concepts to solve problems related to synchronization, deadlocks, memory management, in Operating Systems.
CO3	Analyze different algorithms of CPU scheduling, Page replacement, storage management and disk scheduling
CO4	Select appropriate algorithms for the given CPU processes, deadlock occurrences and memory management.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**UNIX System Programming**				
Course Code	**23IS3AEUSP**	**Credits**	**1**	**L-T-P**	**0-0-1**
CIE	**25 Marks**	**SEE**	**50 marks**		
Contact Hours/ Week	**2**	**Total Lecture Hours**	**30**		

Working with UNIX commands Basic Operating System commands, file attributes, file creation and file handling, directories, Processes, Filters such as find, cut, Grep & EGrep, Handling Jobs, SSH.

- Log in to a Linux system and run simple commands using the shell.
- Managing Files from the Command Line: Copy, move, create, delete, and organize files while working from the Bash shell, Archiving and Transferring Files.
- Managing Local Users and Groups: Gaining Superuser Access, Controlling Access to Files.
- Shell scripts Introduction to shell, command substitution, Command Line arguments, Conditional & Looping, Functions.
- Exploring File API's: Open, Close, Read, Write, LSeek, Stat, FStat, fcntl, chmod, Emulate commands mv, cp, ls, ln.
- Directory, opendir, readdir, rmdir.
- Programs on Process management using API's.
- Programs related to Signals and Signal handling using Signal API's.

Projects:

Sample Projects on topics like Inter process communications using various IPC's, Task Management, File Management, Schedulers, File transfer using IPC's.

Text Books:

1. UNIX Concepts and Applications, Sumitabha Das, Second Edition, TMGH, 2002.
2. Unix System Programming Using C++, by Terrence Chan – Prentice Hall India, 1999.

Reference Books:

1. Advanced Programming in the UNIX Environment, by Stephen A. Rago, W. Richard Stevens, 2 Edition, Pearson Education / PHI, 2005
2. Linux System Programming, 2nd Edition by Robert Love Publisher: O'Reilly Media, In

e- Books:
1. http://catb.org/~esr/writings/taoup/html/ 2. http://oopweb.com/CPP/Documents/DebugCPP/VolumeFrames.html.
MOOCs:
1. http://www.coursera.org/learn/unix 2. http://www.pluralsight.com/courses/linux-systems-programming 3. http://www.edx.org/course/introduction-linux-linuxfoundationx-lfs101x-1 4. https://rha.ole.redhat.com.

COURSE OUTCOMES (COs)

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

CO1	Comprehend UNIX commands and API's for files, process, and signals, inter process communication and sockets
CO2	Apply the API's for implementing UNIX commands and process control
CO3	Identify System call interface for process management, multitasking programs, IPC in UNIX
CO4	Develop solutions for problems using appropriate API's and IPC methods
CO5	Make an effective oral presentation in a team on files and process of UNIX system.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**LINEAR ALGEBRA**				
Course Code	**23MA4BSLIA**	**Credits**	**3**	**L-T-P**	**2-1-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**4**	**Total Lecture Hours**	**25**		

UNIT - 1
CONTINUOUS OPTIMIZATION – 1 : Local and global optima, convex sets and functions separating hyperplanes, application of Hessian matrix in optimization, Optimization using gradient descent/ascent and NR method.
UNIT - 2
CONTINUOUS OPTIMIZATION-2: Sequential search 3-point search and Fibonacci search. Constrained Optimization, Method of Lagrange multipliers, duality, KKT optimality conditions.
UNIT - 3
INNER PRODUCT SPACES: Inner products, inner product spaces, length and orthogonality, orthogonal sets and Bases, projections, Gram-Schmidt orthogonalization process, QR-factorization, least squares problem and least square error. Curve fitting – Principle of least squares, fitting a straight line and fitting a parabola.
UNIT - 4
EIGENVALUES AND EIGENVECTORS : Introduction, Polynomials of Matrices, Cayley-Hamilton Theorem, eigen spaces of a linear transformation, Characteristic and Minimal Polynomials of Block Matrices, Jordan Canonical form.
UNIT - 5
MATRIX DECOMPOSITION AND THEIR APPLICATIONS: Diagonalization, Orthogonal diagonalization of real symmetric matrices, quadratic forms and its classifications, signature, index, Singular value decomposition. Dimensional reduction – PCA.
Text Books:
1. Linear Algebra and its applications, David C. Lay, Steven R. Lay, Judi J Mc. Donald, 6th Edition, 2021, Pearson Education. 2. Linear Algebra and its Applications, Gilbert Strang, 4th edition, 2005, Brooks Cole. 3. Linear Algebra: An Introduction, Richard Bronson & Gabriel B. Costa, 2nd edition, Academic press.

Reference Books:
1. Schaum's outline series -Theory and problems of linear algebra, Seymour Lipschutz, Marc Lipson, 6th edition, 2017, McGraw-Hill Education. 2. Mathematics for Machine learning, Marc Peter Deisennroth, A. Aldo Faisal, Cheng Soon Ong, 2020, Cambridge University Press. 3. Linear Algebra, Kenneth Hoffman, Ray Kunze, 2nd edition, Pearson.
e- Books:
1. Linear Algebra, https://ocw.mit.edu/courses/mathematics/18-06sc-linear-algebra-fall-2011/index.htm 2. Linear Algebra in Twenty Five Lectures, Tom Denton and Andrew Waldron, https://www.math.ucdavis.edu/~linear/linear.pdf
MOOCs:
1. Mathematics for Machine Learning: Linear Algebra, https://www.coursera.org/learn/linear-algebra-machine-learning 2. Linear Algebra, https://nptel.ac.in/syllabus/111106051/

COURSE OUTCOMES (COs)

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

CO1	Apply the concepts of linear algebra in Computer and allied Engineering Sciences.
CO2	Demonstrate the applications of computer science and allied engineering Science applications using Linear algebra tools.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Theoretical Foundations Of Computation**				
Course Code	**23IS4ESTFC**	**Credits**	**3**	**L-T-P**	**2-1-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**4**	**Total Lecture Hours**	**25**		

UNIT - 1
Introduction to Finite Automata: Introduction to Finite Automata, Concepts of Automata Theory, Deterministic Finite Automata (DFA),Nondeterministic Finite Automata (NFA) and ε-NFA, ε-closures, Equivalence of ε-NFA, NFA and DFA, Minimization of DFA.
UNIT - 2
Regular Expressions and Regular Languages: Relation between Regular Expressions and Regular Languages, Pumping Lemma for regular languages, Conversion of finite automata to Regular expression using state elimination method, Regular Expression to ε-NFA
UNIT - 3
Context Free Grammars and Languages: Relation between Context Free Grammars and Context Free Languages, Parse trees, Ambiguity in Grammars, Simplification of Context Free Grammar, Chomsky Normal Form
UNIT - 4
Push Down Automata: Construction of PDA, Acceptance by final state, Acceptance by empty stack, Equivalence of PDA and CFG, Non- Deterministic and Deterministic Pushdown Automata.
UNIT - 5
Turing Machines: Introduction to Turing Machine, Construction of Turing Machines as language acceptors and transducers, combining Turing machines for complicated tasks.
Text Books:
1. Introduction to Automata Theory, Languages and Computation by John E. Hop croft, Rajeev Motwani, Jeffrey D.Ullman: Pearsoneducation, 3rd Edition, 2007. 2. An Introduction to formal Languages and Automata by Peter Linz, Jones& Bartlett Learning, 6th Edition, 2016.
Reference Books:
1. Introduction to Languages and Automata Theory by John C Martin,Tata McGraw-Hill, 4th Edition, 2010.

2. Introduction to Theory of Computation, Michael Sipser, Cengage Learning,3rd Edition, 2014.
e- Books:
1. Automata, Computability and Complexity: Theory and Applications, Elaine Rich, https://www.cs.utexas.edu/~ear/cs341/automatabook/AutomataTheoryBook.pdf 2. https://online.kmsdasuya.in/wp-content/uploads/2020/09/TOC-Theory- of-Computer-Science-Automata- Languages- and- Computation-3e-KLP-Mishra-N-Chandrasekaran.pdf
MOOCs:
1. Fundamentals of Automata Theory, https://www.udemy.com/course/fundamentals-of-automata-theory/ 2. Automata Theory, https://www.classcentral.com/course/stanford-openedx-automata-theory-376

COURSE OUTCOMES (COs)

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

CO1	Understand the fundamental concepts of formal languages and automata.
CO2	Analyse the concepts of formal languages and automata in recognizing languages and in solving related problems.
CO3	Design grammars and automata for different levels of formal languages and simulate using modern tools.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Database Management System**				
Course Code	**23IS4PCDBM**	**Credits**	**4**	**L-T-P**	**3-0-1**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**5**	**Total Lecture Hours**	**40**		

UNIT - 1
Databases and Database Users- Introduction, Characteristics of the Database Approach, Advantages of using the DBMS Approach, Three-Schema Architecture and Data Independence, The Database System Environment. **Data Modeling Using the Entity-Relationship Model-** Entity Types, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets, Roles and Structural Constraints, Weak Entity Types, ER Diagrams, A Sample Database Application, Relationship Types of Degree Higher than Two. Relational Database Design Using ER-to Relational Mapping.
UNIT - 2
The Relational Data Model and Relational Database Constraints- Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions and Dealing with Constraint. **Basic SQL-** SQL Data Definition and Data Types, Specifying Constraints in SQL, Basic Retrieval Queries in SQL, INSERT, DELETE and UPDATE Statements in SQL, Additional Features of SQL, More Complex SQL Retrieval Queries, Views, Schema Change Statements in SQL.
UNIT - 3
The Relational Algebra- Unary Relational Operations**:** SELECT, PROJECT, Relational Algebra Operations from Set Theory, Binary Relational Operations-JOIN, DIVISION, Additional Relational Operations, Examples of Queries in Relational Algebra. **NoSQL Databases –** Introduction to NoSQL Systems, The CAP Theorem, Document-Based NoSQL Systems & Mango DB.
UNIT - 4
Basics of Functional Dependencies and Normalization for Relational Databases- Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form.
UNIT - 5

Introduction to Transaction Processing Concepts and Theory-Introduction to Transaction Processing, Transaction and System Concepts, Desirable Properties of Transactions, Characterizing Schedules Based on Recoverability, Characterizing Schedules Based on Serializability, Transaction Support in SQL, Two-Phase Locking Techniques for Concurrency Control.

Text Books:

1. Fundamentals of Database Systems, Ramez Elmasri & Shamkant B. Navathe, Published by Pearson India Education Services Pvt. Ltd, 7th Edition, 2017.
2. Professional NOSQL, Shashank Tiwari, Published by John Wiley &Sons, Inc,2017

Reference Books:

1. Database System Concepts, Abraham Silberschatz, HenryF. Korth, S.Sudarshan, Sixth Edition, Tata McGraw-Hill,2010
2. An Introduction to Database Systems, C.J.Date, A.Kannan,S.Swamynathan, 8th Edition, Pearson Education, 2006
3. Database Management Systems, Ramakrishnan and Gehrke, 3rd Edition McGraw Hill2014

e- Books:

1. Database Management System, https://mrcet.com/downloads/digital_notes/ECE/III%20Year/DATABASE%20MANAGEMENT%20SYSTEMS.pdf
2. https://ebooks.lpude.in/management/mba/term_3/DCAP204_%20MANAGING_DATABASEDCAP402_DATABASE_MANAGEMENT_SYSTEMS.pdfe-Book 4

MOOCs:

1. Database Systems, https://ocw.mit.edu/courses/6-830-database-systems-fall-2010/pages/lecture-notes/
2. Database Management Courses, https://www.udemy.com/topic/database-management/
3. Data Base Management System (IIT, Kharagpur and NPTEL via Swayam, https://www.classcentral.com/course/swayam-data-base-management-system-9914

COURSE OUTCOMES (COs)

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

CO1	Comprehend the fundamentals of database management systems, ER model, relational algebra, SQL, NoSQL, design principles and Transaction management.
CO2	Analyse the concepts of database management principles, Entity–Relationship model, relational algebra, database design principles and transaction management properties
CO3	Synthesize sophisticated queries to extract the information from the given database using SQL and NoSQL.
CO4	Design and demonstrate the given application without anomalies using ER modelling and Normalizations in a diverse team using appropriate tools.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Analysis and Design of Algorithms**				
Course Code	**23IS4PCADA**	**Credits**	**4**	**L-T-P**	**3-0-1**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**5**	**Total Lecture Hours**	**40**		

UNIT - 1

Fundamentals of Algorithm Analysis: Definition of algorithm, Algorithmic Problem Solving, Framework for Analysis of algorithm efficiency, Asymptotic Notations, Mathematical Analysis of Non-recursive algorithms and Recursive algorithms.

Brute Force: Bubble Sort, Selection Sort, String Matching.

UNIT - 2

Divide and Conquer: Mergesort, Quicksort, Strassen's matrix multiplication, Multiplication of large integers, Master's Theorem.

Decrease and conquer: Depth First Search (DFS), Breadth First Search (BFS), Applications of DFS and BFS, Topological Sorting.

UNIT - 3

Greedy Technique: Prim's Algorithm, Dijkstra's Algorithm, Huffman trees.

Dynamic Programming: Computing a Binomial Coefficient, Floyd's Algorithm, Knapsack Problem and Memory functions.

UNIT - 4

Space and Time Trade-offs: Boyer Moore Algorithm, Hashing.

Transform and Conquer: Pre-sorting, AVL Trees, Heaps and Heapsort.

UNIT – 5

Limitations of Algorithm Power: Basic concepts of P, NP and NP-Complete and NP – Hard Classes.

Backtracking: N-queen's problem, Sum of subset problem

Branch and bound: 0/1 Knapsack Problem, Assignment problem

Text Books:

1. Introduction to the design and analysis of algorithms, Anany Levitin, Pearson Education, 3rd Edition, 2011.
2. Computer Algorithms, Horowitz E., Sahani S., Rajasekharan S.,Universities Press, 2nd Edition,2008.

Reference Books:
1. Introduction to Algorithms, Cormen T.H, Leiserson C. E, Rivest R.L, Stein C, PHI, 3rd Edition, 2010. 2. Introduction to Algorithms, Cormen T.H, Leisersonby Mark Allen Weiss, PHI, 2013.
e- Books:
1. Design and Analysis of Algorithms, Zhiqiang Gu https://www.cs.duke.edu/courses/fall08/cps230/Book.pdf 2. Design and Analysis of Algorithms, https://www.tutorialspoint.com/design_and_analysis_ofalgorithms/design_and_analysis_of_algorithms_tutorial.pdf
MOOCs:
1. Algorithms, Part I, https://www.coursera.org/learn/algorithms-part1 2. Design and Analysis of Algorithms, https://nptel.ac.in/courses/106106131

COURSE OUTCOMES (COs)

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

CO1	Demonstrate solving of a computing problem for various datasets to aid the visualization of the algorithm
CO2	Examine the working of the algorithm and infer its time complexity by applying suitable techniques.
CO3	Design and implement algorithms to solve real time computing problems using suitable algorithmic design techniques.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Software Engineering**				
Course Code	**23IS4PCSEG**	**Credits**	**2**	**L-T-P**	**2-0-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**2**	**Total Lecture Hours**	**25**		

UNIT - 1
OVERVIEW: Introduction: Professional software development, Software engineering ethics. Case Studies- An insulin pump control system. **Software processes:** Software process models, Process activities, Coping with change.
UNIT - 2
Agile Software Development: Agile methods, Plan-driven and agile development, Extreme programming: Testing in XP, Pair programming, Agile project management, Scaling agile methods.
UNIT - 3
Requirements engineering: Functional and non-functional requirements, The software requirements document, Requirements specification, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management.
UNIT - 4
Architectural design: Architectural design decisions, Architectural views, Architectural patterns: Layered architecture, Repository architecture, Client–server architecture, Pipe and filter architecture, Application architectures: Transaction processing systems, Information systems, Language processing systems
UNIT-5
Project management: Risk management: Risk identification, Risk analysis, Risk planning, Risk monitoring. Managing people: Motivating people, Teamwork: Selecting group members, Group organization, Group communications. **Project Planning**: Software pricing and Project scheduling.
Text Books:
1. Software Engineering by Ian Somerville, 9th edition, Pearson Education, 2007.
Reference Books:
1. Software Engineering: A Practitioners Approach by Rogers S Pressman, 7th edition, MCGrawHill, 2007 2. Software Engineering theory and Practice by shari Lawrence Pfleeger, Joanne m Atlec, 3rd edition, Pearson Education, 2006. 3. Software Engineering Principles and Practice by Waman.S.Jawadekar, Tata McGrawhill, 2004.
e- Books:
1. https://www.ece.rutgers.edu/~marsic/books/SE/book-SE_marsic. pdf 2. https://friendkvvk.files.wordpress.com/2015/08/friendkvvk-ooad.pdf

MOOCs:
1 https://www.edx.org/learn/software-engineering 2 https://www.coursera.org/courses?query=software%20 3 https://www.coursera.org/courses?query=software%20engineering

COURSE OUTCOMES (COs)

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

CO1	Design a software system, component, or process to meet desired needs within realistic constraints.
CO2	Apply Software Engineering practices and assess professional and ethical responsibility.
CO3	Analyze the System requirements, various design and testing techniques for a given system.
CO4	Use the techniques, skills, and modern engineering tools necessary for engineering practice.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Java Programming**				
Course Code	**23IS4PCJAV**	**Credits**	**4**	**L-T-P**	**3-0-1**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**5**	**Total Lecture Hours**	**40**		

UNIT - 1

Introduction to Java: Java's Lineage, The Bytecode, The Java Buzzwords.
An overview of Java: Object oriented programming, Structure of a Java Program, Datatypes and Arrays.
Introducing classes: Class fundamentals, declaring objects, assigning object reference variables, Introducing methods, Constructors, this keyword, Garbage Collection, A Stack class.

Methods and classes: Overloading methods, Objects as parameters, argument passing, Returning objects.

UNIT - 2

Inheritance: Basics, using super, Multilevel hierarchy, when constructors are executed, Method overriding, Dynamic method dispatch, Abstract classes, Using final with inheritance.

Packages and Interfaces: Packages, Access Protection, Importing packages, Interfaces, Default interface methods.

UNIT - 3

Exception Handling: Fundamentals, types, Uncaught exceptions, Try and catch blocks, multiple catch, nested try, throw, throws, finally, Creating own exceptions.

Multithreaded programming: Java thread model, The main thread, Creating a thread and multiple threads, Using isAlive() and join(), Thread Priorities, Synchronization.

UNIT – 4

File I/O Basics, reading console input, writing console output, Print writer class, Reading and writing files, Closing a file.

String Handling: The String Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String, Changing the Case of Characters Within a String, Joining Strings, StringBuffer.

UNIT – 5
Generics: Type Wrappers, Auto boxing, A simple generic example, Generic Class with two type parameters, The General Form of a Generic Class. **Collections Framework:** Overview, Collection classes - ArrayList Class, LinkedList Class, HashSet Class, TreeSet Class, ArrayDeque Class.
Text Books:
1. Java: The Complete Reference by Herbert Schildt, McGraw-Hill Education, 11th edition 2018. 2. Programming with Java A Primer by E.BalaGuruSwamy, McGraw Hill Education, 6th edition, 2014.
Reference Books:
1. Introduction to Java Programming by Y. Daniel Liang, Pearson, 11th edition, 2017 2. Object Oriented Programming with Java: Essentials and Applications by Rajkumar Buyya, Thamarai Selvi, Xing, Tata McGraw Hill Education, 2009

COURSE OUTCOMES (COs)

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

CO1	Comprehend the concepts of objects, classes, packages, interfaces, strings and collections.
CO2	Apply the principles of object oriented programming to solve problems
CO3	Identify the usage of constructs for reusability, abstraction, exception handling and multithreading
CO4	Develop computer programs to handle runtime errors, concurrency, files, generics and graphical user interface components
CO5	Demonstrate coding skills on a competitive programming platform.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Universal Human Values**				
Course Code	**23MA3HSUHV / 23MA4AEUHV**	**Credits**	**1**	**L-T-P**	**0-1-0**
CIE	**25 marks**	**SEE**	**50 marks**		
Contact Hours/ Week	**2**	**Total Lecture Hours**	**30**		

Course Objectives:

To develop a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence. Understanding (or developing clarity) of the harmony in the human being,family, societyandnature/existence.

UNIT - 1

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from UniversalHuman Values-I
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self- exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being withtheircorrectpriority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and livinginharmonyat various levels.

Include practice sessions to discuss natural acceptance in human being asthe innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based onliking-disliking

UNIT - 2

Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' andthematerial'Body'
2. Understanding the needs of Self ('I') and 'Body' - happiness andphysicalfacility
3. Understanding the Bodyas an instrument of 'I' (Ibeing the doer, seerandenjoyer)
4. Understanding the characteristics and activities of 'I' and harmonyin'I'
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physicalneeds, meaningof Prosperityindetail
6. Programstoensure Sanyamand Health.

Include practice sessions to discuss the role others have played in makingmaterial goods available

to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuringhealthvsdealingwithdisease

UNIT - 3

Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the others a lient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society,UniversalOrder- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students lives

UNIT - 4

Understanding Harmony in the Nature and Existence – Whole existence as Coexistence

1. Understanding the harmony in the Nature
2. Holistic perception of harmony at all levels of existence.

UNIT - 5

Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Text Books:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G PBagaria, Excel Books, New Delhi, 2010.

Reference Books (Materials):

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan,Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi,2004.

3. The Storyof Stuff(Book).
4. The Story of My Experiments with Truth - by Mohandas KaramchandGandhi
5. Smallis Beautiful- E. FSchumacher.
6. Slowis Beautiful- Cecile Andrews
7. Economyof Permanence- JCKumarappa
8. Bharat Mein Angreji Raj– PanditSunderlal
9. Rediscovering India- by Dharampal
10. India Wins Freedom- Maulana Abdul Kalam Azad
11. Vivekananda- Romain Rolland(English)

COURSE OUTCOMES (COs)

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

CO1	Conduct self-exploration and distinguish between values and skills, happiness and accumulation of physical facilities, the self and the body, Intension and Competence of an individual
CO2	Analyze the value of harmonious relationship based on trust and respect in personal and professional life
CO3	Examine the role of a human being in ensuring harmony in society and nature
CO4	Apply the understanding of ethics in life and profession

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Competitive Programming**				
Course Code	**23IS4AECPG**	**Credits**	**1**	**L-T-P**	**0-0-1**
CIE	**50 Marks**	**SEE**	**50 Marks**		
Contact Hours/ Week	**2**	**Total Lecture Hours**	**30**		

About the Course

The course is designed to enhance programming and computational thinking skills of students. They would be enabled to develop solutions for non-trivial computing problems of real-world scenarios. The students are given exposure to coding platforms for practice to augment their higher order cognitive skills.

The course is taught in a problem driven fashion, where Object Oriented Programming features are demonstrated. The students are enabled to transform conceptual knowledge to efficient programs in solving open- ended questions.

Online Resources:

1. Competitive Programming, Ravi Ojha, https://www.hackerearth.com/getstarted-competitive-programming/
2. Competitive Programming – A Complete Guide, https://www.geeksforgeeks.org/competitive-programming-a-complete-guide/

e- Books:

1. Competitive Programmer's Handbooke-Book 1, Antti Laaksonen, https://cses.fi/book/book.pdf
2. Programming Challenges: The Programming Contest Training Manual, Steven S. Skiena & Miguel Revilla, https://www.pdfdrive.com/programming-challenges-the-programming-contest-training-manual-e167992721.html

MOOCs:

1. Getting Started with Competitive Programming, https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-cs99/
2. Competitive Programming, https://www.udemy.com/course/competitive-programming/

COURSE OUTCOMES (COs)

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

CO1	Identify and apply most appropriate object oriented programming paradigm for solving new programming challenges as an individual or as a team member.
CO2	Analyse and develop efficient solutions to programming problems while working under hard deadlines
CO3	Design solutions for contests on coding platforms

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Computer Networks – 1**				
Course Code	**23IS5PCCN1**	**Credits**	**4**	**L-T-P**	**3-0-1**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**5**	**Total Lecture Hours**	**40**		

UNIT - 1

Introduction and Overview: Growth of Computer Networking, Protocol Suites and Layering Models, How Data Passes Through Layers, Headers and Layers, ISO and the OSI Seven Layer Reference Model.

Information Sources and Signals: Analog and Digital Signals, Converting A Digital Signal to Analog, The Bandwidth of a Digital Signal, Line Coding, Manchester Encoding Used in Computer Networks, Converting an Analog Signal to Digital, The Nyquist Theorem and Sampling Rate.

Transmission modes: Serial Transmission, Parallel Transmission, Asynchronous Transmission, Synchronous Transmission, Isochronous Transmission, Simplex, Half-Duplex and Full-Duplex Transmission.

UNIT – 2

Data Link Layer: Design issues, Services Provided to Network Layer, Framing, Error Control, Flow Control, Error Detection Codes, Elementary data link protocols: A Simplex Stop-and-Wait Protocol for an Error-Free Channel, A Simplex Stop-and Wait Protocol for a Noisy Channel, sliding window protocols: One-bit Sliding Window Protocol, Protocol Using Go-Back-N and Selective Repeat.

UNIT - 3

Medium access control sublayer: Channel allocation problem: Static Channel Allocation, Assumptions for Dynamic Channel Allocation, Multiple access protocols: Aloha, CSMA, Ethernet, Ethernet Physical layer, Ethernet Sub-MAC layer, Wireless LAN: 802.11- architecture, Protocol stack, MAC sublayer protocol, frame structure.

UNIT - 4

Internetworking Concepts, Architectures, and Protocols: Internetworking, The IP Addressing Scheme, The IP Address Hierarchy, Classes of IP addresses, Subnet and Classless Addressing.

Data Forwarding: Connectionless Service, Virtual Packets, The IP Datagram Header Format, Forwarding an IP Datagram, Network Prefix Extraction and Datagram Forwarding, Longest Prefix match, Destination Address and Net-Hop Address, Best-Effort Delivery, IP Encapsulation, MTU and Datagram Fragmentation and Reassembly.

UNIT - 5

Support Protocols and Technologies: The Address Resolution Protocol (ARP), ARP Message Format, Internet Control Message Protocol (ICMP), ICMP Message Format and Encapsulation, Dynamic Host Configuration Protocol, DHCP Protocol Operation and Optimizations, DHCP Message Format, Network Address Translation (NAT), NAT Operation and Private Addresses.
The Future IP(IPV6): IPV6 Features, IPV6 Datagram Format, IPV6 Base Header Format, IP Addressing.
Internet Routing and Routing Protocols: Static VS Dynamic Routing, The two types of Internet Routing Protocols, Routes and Data Traffic, The Border Gateway Protocol (BGP), The Routing Information Protocol(RIP), RIP Packet Format, The Open Shortest Path First Protocol.

Text Books:

1. Computer Networks and Internets, Douglas E. Comer, Pearson Education, 5th Edition, 2008
2. Computer Networks, Andrew S Tannenbaum and David J Wetherall, Pearson, 5th Edition, 2014.

Reference Books:

1. Communication Networks - Fundamental Concepts and Key architectures, Alberto Leon-Garcia and IndraWidjaja, 2nd Edition Tata McGraw-Hill, 2004.
2. Data Communication and Networking, Behrouz A. Forouzan, McGraw-Hill, 5th Edition,2017
3. Computer Networking and the Internet, Fred Halshall, Pearson Education, 5th Edition,2005

e- Books:

1. Introduction to Data Communications.
   https://www.ebooksdirectory.com/details.php?ebook=3502
2. Data Communication and Networks.
   https://www.freetechbooks.com/data-communication-and-networks-f31.html

MOOCs:

1. Networking.
   https://www.coursera.org/learn/data-communication-network-services
2. Fundamentals of Network Communication.
   https://www.coursera.org/learn/fundamentals-network-communications

COURSE OUTCOMES (COs)

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

CO1	Acquire knowledge about the various principles of communication.
CO2	Apply the data link layer and Network Layer protocols to solve real life problems.
CO3	Analyse the protocols used in MAC and IP layer.
CO4	Using internetworking concepts and protocols design networks for packet transmission

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Machine Learning**				
Course Code	**23IS5PCMLG**	**Credits**	**4**	**L-T-P**	**3-0-1**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**5**	**Total Lecture Hours**	**40**		

UNIT - 1

The Machine Learning Landscape: Introduction-What Is Machine Learning? Why Use Machine Learning? Examples of Applications, Types of Machine Learning Systems- Supervised/Unsupervised Learning, Batch and Online Learning, Instance-Based Versus Model-Based Learning, Main Challenges of Machine Learning.

Classification: MNIST**,** training a Binary Classifier, Performance Measures- Measuring Accuracy Using Cross-Validation, Confusion Matrix, Precision and Recall, Precision/Recall Trade-off, The ROC Curve, Multiclass Classification, Error Analysis.

Training Models: Linear Regression- The Normal Equation, Computational Complexity, Gradient Descent - Batch Gradient Descent, Stochastic Gradient Descent, Mini-batch Gradient Descent, Polynomial Regression, Regularized Linear Models - Ridge Regression, Lasso Regression, Elastic Net, Early Stopping, Logistic Regression-Estimating Probabilities, Training and Cost Function, Decision Boundaries, Softmax Regression.

UNIT - 2

Decision trees: Introduction, Univariate trees - Classification Trees, Regression Trees, Pruning, Rule extraction from trees, Learning rules from data, Multivariate trees.

UNIT - 3

Bayesian Learning: Introduction, Bayes Theorem – An Example, Bayes Theorem and Concept Learning- Brute-Force Bayes Concept Learning, MAP Hypothesis and Consistent Learners, Maximum Likelihood And Least-Squared Error Hypotheses, Minimum Description Length Principle, Bayes Optimal Classifier, Naive Bayes Classifier.

UNIT - 4

Ensemble Learning and Random Forests: Voting Classifiers, Bagging and Pasting, Random Forests- Extra-Trees, Feature Importance, Boosting-AdaBoosting, Gradient Boosting.

Dimensionality Reduction: The Curse of Dimensionality, Main Approaches for Dimensionality Reduction-Projection, Manifold Learning, PCA-Preserving the Variance, Principal Components, Projecting Down to d Dimensions, Using Scikit-Learn, Explained Variance Ratio, Choosing the Right Number of Dimensions.

Unsupervised Learning Techniques: Clustering- k-means, Limits of K-Means, DBSCAN.

UNIT - 5

Artificial Neural Network- Introduction- Biological Motivation, Neural Network Representations, Appropriate Problems for Neural Network Learning, Perceptron's- Representational Power of Perceptron's, The Perceptron Training Rule, Gradient Descent and the Delta Rule, Multilayer Networks and the Backpropagation Algorithm-A Differentiable Threshold Unit, The Backpropagation Algorithm.

Text Books:

1. Introduction to Machine Learning by Ethem Alpaydin, MIT Press, Fourth Edition, 2020.
2. Machine Learning, Tom Mitchell, McGraw Hill, 3rd Edition, 1997
3. "Hands-On Machine Learning with Scikit-Learn & Tensor Flow", 2nd Edition, Aurelian Geron

Reference Books:

1. MACHINE LEARNING - An Algorithmic Perspective, Stephen Marsland, 2 ndEdition, 2015.
2. Introduction to Machine Learning with Python, A Guide for Data Scientists, Andreas C.Miller and Sarah Guido, O'Reilly Media, 2017.

e- Books:

1. Introduction to Machine Learning by Ethem Alpaydin, MIT Press,https://dl.matlabyar.com/siavash/ML/Book/Ethem%20Alpaydin-Introduction%20to%20Machine%20Learning-The%20MIT%20Press%20(2014).pdf

MOOCs:

Machine Learning – Introduction to everyone Coursera
https://www.coursera.org/learn/machine-learning-introduction-for-everyone

Introduction to Machine Learning NPTEL
https://archive.nptel.ac.in/courses/106/106/106106139/

Unit 1 & Unit 4- from Text book 3,
Unit 2– from Text book 1,
Unit 3 & Unit 5 - from Text book 2

COURSE OUTCOMES (COs)

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

CO1	Acquire knowledge on basic concepts of Machine Learning techniques such as supervised and unsupervised learning.
CO2	Apply the concepts of Classification, Regression, Clustering and Dimensionality reduction algorithms to a given problem.
CO3	Identify Machine Learning techniques suitable for a given problem
CO4	Design and Develop applications using Machine Learning techniques.
CO5	Demonstrate the implementation of Machine Learning algorithms using modern tools

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Cryptography And Network Security**				
Course Code	**23IS5PCCNS**	**Credits**	**3**	**L-T-P**	**3-0-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**3**	**Total Lecture Hours**	**40**		

UNIT - 1
Introduction: Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for Network Security. **Classical Encryption Techniques:** Symmetric Cipher Model, Substitution Techniques – Caesar Cipher, Monoalphabetic Ciphers, Play fair Cipher, Hill Cipher, Polyalphabetic Ciphers, One-Time Pad, Transposition Techniques.
UNIT - 2
Block Ciphers: Traditional Block Cipher Structure – Stream Ciphers and Block Ciphers, Motivation for the Feistel Cipher Structure, The Feistel Cipher, Block Cipher Design Principles, The Simplified Data Encryption Standard (S-DES) – S-DES Encryption, S-DES Decryption, S-DES Key Generation. **Stream Ciphers:** Stream Ciphers, RC4 – Initialization of S, Stream Generation, Strength of RC4.
UNIT - 3
Public-Key Cryptosystems: Principles of Public-Key Cryptosystems – Public-Key Cryptosystems, Applications for Public-Key Cryptosystems, Requirements for Public-Key Cryptosystems, Public-Key Cryptanalysis, The RSA Algorithm – Description of the Algorithm, Computational Aspects, The Security of RSA, Diffie-Hellman Key Exchange – The Algorithm, Key Exchange Protocols, Man-in-the-Middle Attack. **Cryptographic Hash Functions:** Secure Hash Algorithm (SHA) – SHA-512 Logic, SHA-512 Round Function, Examples.
UNIT - 4
Key Management and Distribution: Symmetric Key Distribution using Symmetric Encryption, Symmetric Key Distribution using Asymmetric Encryption, Distribution of Public Keys. **Transport-Level Security:** Transport Layer Security – Architecture, Record Protocol, Change Cipher Spec Protocol, Alert Protocol, Handshake Protocol, Cryptographic Computations, Heartbeat Protocol, SSL/TLS Attacks, HTTPS – Connection Initiation, Connection Closure.

UNIT - 5

Digital Signatures: Digital Signatures – Properties, Attacks and Forgeries, Digital Signature Requirements, Direct Digital Signature, SCHNORR Digital Signature Scheme, NIST Digital Signature Algorithm.

IP Security: IP Security Overview – Applications, Benefits, Routing Applications, IPsec Documents, IPsec Services, IP Security Policy – Security Associations and its Database, Security Policy Database, IP Traffic Processing, Encapsulating Security Payload – ESP Format, Encryption and Authentication Algorithms.

Text Book:

1. Cryptography and Network Security – Principles and Practice by William Stallings, Person, 7th Edition, 2017.

Reference Books:

1. Network Security Essentials Applications and Standards, William Stallings, Pearson, 4th Edition, 2012.
2. Network Security Private Communication in a Public world, Charlie Kaufman, Radia Perlman and Mike Speciner, 2nd Edition, PHI, 2013.
3. Network Security and Management, Brijendra Singh, 3rd Edition, PHI, 2013.

e- Books:

1. Cryptography and Network Security-Principles and Practice, William Stallings. https://dl.hiva-network.com/Library/security/Cryptography-and-network-securityprinciples-and-practice.pdf
2. Network Security. https://imcs.dvfu.ru/lib.int/docs/Networks/Security/Network%20Security%20Foundations.pdf

MOOCs:

1. Network Security, https://www.mooc-list.com/course/network-security-wma
2. Cryptography 1, https://www.coursera.org/learn/crypto
3. Applied Cryptography, https://www.coursera.org/specializations/applied-crypto

COURSE OUTCOMES (COs)

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

CO1	Understand the basic concepts of classical encryption techniques, block ciphers, stream ciphers, cryptographic functions, key management and IP security.
CO2	Apply the knowledge of classical encryption techniques to solve cryptographic problems, public key cryptosystems, hash functions and key distribution techniques.
CO3	Analyze the structure of various block ciphers, stream ciphers, transport level security, IP security and digital signatures.
CO4	Make an effective communication and presentation in a team on different algorithms or tools used in cryptography and network security.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Software Testing**				
Course Code	**23IS5PCSTG**	**Credits**	**3**	**L-T-P**	**3-0-0**
CIE	**50 Marks**	**SEE**	**100 Marks(50% Weightage)**		
Contact Hours/ Week	**3**	**Total Lecture Hours**	**40**		

UNIT - 1

Basic Concepts and Preliminaries - Software Quality, Role of Testing, Verification and Validation, Failure, Error, Fault, and Defect, Notion of Software Reliability, Objectives of Testing, What Is a Test Case? Expected Outcome, Concept of Complete Testing, Central Issue in Testing, Testing Activities, Test Levels, Sources of Information for Test Case Selection, White-Box, Black-Box and Gray-Box Testing, Test Planning and Design,

Agile Tool – JIRA

UNIT - 2

A Perspective on Testing - Basic Definitions, Test Cases, Identifying Test Cases, Specification-Based Testing, Levels of Testing. **Unit Testing:** Concept of Unit Testing, Static Unit Testing, Defect Prevention, Dynamic Unit Testing, Mutation Testing, Debugging, JUnit: Framework for Unit Testing.

Unit Testing Tool - Junit

UNIT - 3

Boundary Value Testing- Normal Boundary Value Testing, Robust Boundary Value Testing, Worst-Case Boundary Value Testing, Test Cases for the Triangle Problem.

Equivalence Class Testing- Equivalence Classes, Traditional Equivalence Class Testing, Improved Equivalence Class Testing, Equivalence Class Test Cases for the Triangle Problem.

Automation tool - Selenium

UNIT - 4

System Integration Testing -Concept of Integration Testing, Different Types of Interfaces and Interface Errors, Granularity of System Integration Testing, System Integration Techniques, Test Plan for System Integration.

Integration Testing tool – Katalon

Functional testing tool – Jmeter

UNIT - 5

User Acceptance Testing(UAT), Need for User Acceptance Testing, UAT Process, UAT Test Planning, User Acceptance Testing Design, Test Execution. Smoke Testing, Regression Testing.

SOFTWARE QUALITY- Five Views of Software Quality, McCall's Quality Factors and Criteria, ISO 9126 Quality Characteristics, ISO 9000:2000 Software Quality Standard

Text Books:

1. Software Testing and Quality Assurance Theory and Practice, Kshirasagar Naik and Priyadarshi Tripathy, 2nd Edition, 2010.
2. Software Testing, A Craftsman's Approach, C Paul C. Jorgensen, Auerbach Publications, 4th Edition,2014

Reference Books:

1. Foundations of Software Testing, Aditya P Mathur, Pearson, 2013.
2. Software Testing and Analysis – Process, Principles and Techniques, Mauro Pezze, Michal Young, John Wiley & Sons, 2008

e- Books:

1. https://index-of.co.uk/Software-Testing/STQA_book.pdf
2. www.softwaretestinghelp.com/what-is-user-acceptancetesting-uat/ (Reference link)

MOOCs:

1. https://nptel.ac.in/courses/106/105/106105150/
2. https://nptel.ac.in/courses/106/101/106101163/

COURSE OUTCOMES (COs)

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

CO1	Understand the importance of software testing fundamentals, methodologies and tools.
CO2	Apply the knowledge of software testing strategies and methodologies for various types of testing.
CO3	Analyze the given problem using various types of testing such as Unit Testing, Boundary value testing, Equivalence testing, data flow testing, object oriented testing, System integration testing , Functional testing and user acceptance testing.
CO4	Design effective test cases to achieve requirement specification.
CO5	Investigate various testing strategies to find bugs in the software.
CO6	Demonstrate the usage of modern testing tools to write automation scripts.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Natural Language Processing**				
Course Code	**23IS5PENLP**	**Credits**	**3**	**L-T-P**	**2-1-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**4**	**Total Lecture Hours**	**25**		

UNIT - 1
Introduction: NLP in the real world, what is Language? Regular Expressions, Words, Corpora, Text Normalization, Minimum Edit Distance. **N-gram Language Models:** N-grams, evaluating language model, Smoothing.
UNIT – 2
Sequence Labeling for Parts of Speech and Named Entities: English Word Classes, The Penn Treebank Part-of-Speech Tag set, HMM Part-of-Speech Tagging. **Syntactic Analysis:** Constituency, Context-Free Grammars, Some Grammar Rules for English, Treebanks, Grammar Equivalence and Normal Form, Lexicalized Grammars, Dependency parsing.
UNIT - 3
Semantic Analysis: Lexical Semantics, Vector Semantics, Words and Vectors, Cosine for measuring similarity, TF-IDF: Weighing terms in the vector, Applications of the TF-IDF vector model, Word2vec, Visualizing Embeddings, Semantic properties of embeddings, Bias and Embeddings, Evaluating Vector Models.
UNIT - 4
Word Senses and WordNet: Word Senses, Relations Between Senses, WordNet: A Database of Lexical Relations, Word Sense Disambiguation. **Coreference Resolution:** Coreference Phenomena: Linguistic Background, Coreference Tasks and Datasets, Mention Detection, Architectures for Coreference Algorithms.
UNIT - 5
Applications of Natural Language Processing: NLP for Social Data, Memes and Fake News, E-commerce Catalog, Search in E-commerce, Review Analysis.

Text Books:

1. Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition by Daniel Jurafsky and James H Martin, 3rd Edition, Prentice Hall, 2019.

2. Practical Natural Langauge Processing , A Comprehensive Guide to Building Real-World NLP Systems, Sowmya Vajjala, Bodhisattwa Majumder,Anuj Gupta, & Harshit Surana, O'Reilly,2020.

Reference Books:

1. Natural Language Processing: Python and NLTK by Deepti Chopra, Jacob Perkins, and NitinHardeniya, Packt Publishing, Nov 2016.
2. Natural Language Processing Recipes by AkshayKulkarni, Adarsha Shivananda, Apress, 2019.

e-Books:

1. Foundations of Statistical Natural Language Processing by Christopher Manning, HinrichSchutze, MIT Press, 2000 https://www.cs.vassar.edu/~cs366/docs/Manning_Schuetze_Statis ticalNLP.pdf 2.
2. Applied Text Analysis with Python by Benjamin Bengfort, Tony Ojeda, Rebecca Bilbro, O'Reilly Media, June 2018. https://github.com/Jessinra/READING-Data-Science-II/blob/ master/ Applied% 20Text% 20Analysis%20with%20Python.pdf.

MOOCs:

1. Natural Language Processing by PawanGoyal, IIT Kharagpur, https://swayam.gov.in/nd1_noc19_cs56/preview
2. Natural Language Processing offered by deeplearning.ai on Coursera https://www.coursera.org/specializations/natural-language-processing.

COURSE OUTCOMES (COs)

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

CO1	Understand the theoretical foundations of natural language processing in linguistics and formal language theory
CO2	Apply existing mathematical models and algorithms to build NLP stages and applications.
CO3	Analyze NLP tasks like text pre-processing, part-of-speech tagging, syntax parsing and semantic role labeling using existing algorithms and frameworks.
CO4	Design and Develop models to implement building blocks of NLP application using modern tools.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Block Chain Technology**				
Course Code	**23IS5PCBCT**	**Credits**	**3**	**L-T-P**	**2-1-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**4**	**Total Lecture Hours**	**25**		

UNIT - 1
Introduction to BlockChain: Introduction to Blockchain, Backstory of Blockchain, what is Blockchain? Centralized vs. Decentralized Systems, Centralized Systems, Decentralized Systems, Layers of Blockchain, Application Layer, Execution Layer, Semantic Layer, Propagation Layer, Consensus Layer, why is Blockchain Important? Limitations of Centralized Systems, Blockchain Adoption So Far, Blockchain Uses and Use Cases.
UNIT - 2
How BlockChain Works: Laying the Blockchain Foundation, Cryptography, Symmetric Key Cryptography, Cryptographic Hash Functions, MAC and HMAC, Asymmetric Key Cryptography, Diffie-Hellman Key Exchange, Symmetric vs. Asymmetric Key Cryptography.
UNIT - 3
Game Theory: Nash Equilibrium, Prisoner's Dilemma, Byzantine Generals' Problem, Zero-Sum Games, why to Study Game Theory. Computer Science Engineering, The Blockchain, Merkle Trees, Putting It All Together, Properties of Blockchain Solutions, Blockchain Transactions, Distributed Consensus Mechanisms, Blockchain Applications, Scaling Blockchain, Off-Chain Computation, Shading Blockchain State.
UNIT - 4
How Bitcoin Works: The History of Money, Dawn of Bitcoin, What Is Bitcoin? Working with Bitcoins, The Bitcoin Blockchain, Block Structure, The Genesis Block, The Bitcoin Network, Discovery for a New Node, Bitcoin Transactions, Consensus and Block Mining, Block Propagation, Putting it all Together. Bitcoin Scripts, Bitcoin Transactions Revisited, Scripts, Full Nodes vs. SPVs, Full Nodes, SPVs, Bitcoin Wallets.
UNIT - 5
How Ethereum Works: From Bitcoin to Ethereum, Ethereum as a Next-Gen Blockchain, Design Philosophy of Ethereum, Enter the Ethereum Blockchain, Ethereum Blockchain, Ethereum

Accounts, Trie Usage, Merkle Patricia Tree, RLP Encoding, Ethereum Transaction and Message Structure, Ethereum State Transaction Function, Gas and Transaction Cost, Ethereum Smart Contracts, Contract Creation, Ethereum Virtual Machine and Code Execution, Ethereum Ecosystem, Swarm, Whisper, DApp, Development Components.

Text Books:

1. Beginning Block chain: A beginners guide to build Block chain solution, Bikramaditya Singhal, Gautam Dhameja, Priyansu sekhar panda, Apress.
2. BlockChain by Example, Development guide for creating decentralized applications using Bitcoin, Etereum and Hyperledger, Bellaj Badr. Richard Horrocks & Xun(Brion) Wu. Packt.

Reference Books:

1. Blockchain for Business with Hyperledger Fabric, Nakul Shah,Enterprice Blockchain implementation for business using Hyperledger, BPB Publications
2. Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Author- Imran Bashir, Packt Publishing Ltd, Second Edition, ISBN 978-1- 78712-544-5, 2017

MOOCs:

1. Introduction to BlockChain Technology and applications - NPTEL Course https://nptel.ac.in/courses/106104220
2. Block Chain and its applications – NPTEL Course https://onlinecourses.nptel.ac.in/noc22_cs44/preview

COURSE OUTCOMES (COs)

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

CO1	Apply the knowledge of structure and key components of Block chain technology towards creating a transparent and secure block chain system.
CO2	Analyze the requirements based on applications to write smart contract/chain code.
CO3	Conduct Experiments for a given real time problems and obtain block chain based solution model for the problem.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Artificial Intelligence**				
Course Code	**23IS5PEAIS**	**Credits**	**3**	**L-T-P**	**2-1-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**4**	**Total Lecture Hours**	**25**		

UNIT - 1
Introduction: What is AI? **Intelligent Agents:** How agent should act, Structure of Intelligent Agents, Environments. **Problem Solving:** Formulating Problems, Example Problems. **Uniformed-Search Strategies:** Breadth-First Search, Uniform Cost Search, Depth-First Search, Depth Limited Search, Iterative Deepening Search.
UNIT – 2
Heuristic Search Strategies: Generate-and-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis.
UNIT - 3
Knowledge Representation: Propositional Logic – Syntax and Semantics, Using Propositional Logic, First-Order Logic – Syntax and Semantics, Using First-Order Logic. **Representing Knowledge using Rules:** Procedural Versus Declarative Knowledge, Forward Versus Backward Reasoning.
UNIT - 4
Learning: Introduction, Learning as Choosing the Best Representation, Case-Based Reasoning, Learning as Refining the Hypothesis Space, Learning Under Uncertainty (Introductory Part), Explanation-Based Learning.
UNIT - 5
Uncertain Knowledge & Reasoning: Acting under Uncertainty, Basic Probability Notation, The Axioms of Probability, Bayes' Rule and its Use, Where do Probabilities come from?, Representing Knowledge in an Uncertain Domain, The Semantics of Belief Networks.

Text Book:
1. Artificial Intelligence - A Modern Approach, Stuart Russell and Peter Norvig, Third Edition, Pearson, 2014. 2. Computational Intelligence: A Logical Approach - David Poole, Alan Mackworth, Randy Goebel, Oxford University Press.
Reference Books:
1. Artificial Intelligence, Elaine Rich, Kevin Knight and Shivashankar B Nair, Third Edition, McGraw-Hill Education, 2015. 2. Artificial Intelligence: Structures and Strategies for Complex Problem Solving - G. Luger, Fourth Edition, Pearson Education.
e- Books:
1. http://www.e-booksdirectory.com/details.php?ebook=9845 2. http://www.e-booksdirectory.com/details.php?ebook=5643
MOOCs:
1. https://www.edx.org/course/artificial-intelligence-uc-berkeleyx-cs188-1x 2. https://www.udacity.com/course/intro-to-artificial-intelligence--cs271 3. https://www.class-central.com/subject/ai

COURSE OUTCOMES (COs)

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

CO1	Understand the concept of agents, environments, search strategies, reasoning, logic and probabilities.
CO2	Solve problems using uninformed and informed search strategies.
CO3	Represent procedural and declarative knowledge by applying agent-based rules.
CO4	Provide logic-based analysis for question and answering techniques.
CO5	Formulate probabilities for handling uncertain knowledge.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Advanced Data Structures and Algorithms**				
Course Code	**23IS5PEADS**	**Credits**	**3**	**L-T-P**	**2-1-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**4**	**Total Lecture Hours**	**25**		

UNIT - 1
Balanced Search Trees: B-Trees, Skip lists. **Tree structures for Set of Intervals:** Interval trees and Segment trees.
UNIT – 2
Data Structures for String: Tries, Suffix trees. **Heaps:** Leftist Heap, Binomial heaps.
UNIT - 3
Dynamic Programming: Matrix-chain multiplication, Longest common subsequence, Optimal Binary Search Trees. **Greedy Algorithms**: An Activity selection problem, Huffman codes.
UNIT - 4
String-Matching Algorithms: Rabin - Karp algorithm, String matching with finite automata, Knuth-Morris-Pratt algorithm.
UNIT - 5
Graph Algorithms: Bellman - Ford Algorithm, Flow networks and Ford-Fulkerson method. **Number -Theoretic Algorithms**: GCD, The Chinese remainder theorem.
Text Books:
1. Advanced Data Structures, Peter Brass, First Edition, Cambridge university Press, 2008. 2. Introduction to Algorithms, T. H Cormen, C. E. Leiserson and R. L. Rivest, 3rd Edition, Prentice Hall India, 2009.

Reference Books:
1. Data Structures and Algorithms Analysis in C++, Mark Allen Weiss, 4th Edition, Pearson, 2014. 2. Data Structures Using C and C++, Yedidyah, Augenstein, Tannenbaum, 2nd Edition, Pearson Education, 2003.
e-Books:
1. Data Structures and Algorithms by John Bullinaria. https://www.cs.bham.ac.uk/~jxb/DSA/dsa.pdf 2. Algorithms by Jeff Erickson, https://jeffe.cs.illinois.edu/teaching/algorithms/book/Algorithms-JeffE.pdf.
MOOCs:
1. https://www.coursera.org/specializations/data-structures-algorithms 2. https://ocw.mit.edu/courses/6-851-advanced-data-structures-spring-2012/

COURSE OUTCOMES (COs)

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

CO1	Apply principles of advanced Data Structures and Algorithm design techniques for solving complex problems.
CO2	Analyze and develop operations on advanced non-linear data structures.
CO3	Analyze different algorithms and its suitability to solve complex problems.
CO4	Design solutions to computing problems using appropriate data structures and algorithm design techniques.
CO5	Demonstrate and present algorithms design skill.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Advanced Python Programming**				
Course Code	**23IS5PWAPP**	**Credits**	**2**	**L-T-P**	**0-0-2**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**4**	**Total Lecture Hours**	**48**		

About the Course: The students should develop projects using advanced concepts of Python. The course will be executed in two cycles and project work. During Cycle 1, the students would be able to uses the basic concepts of Python, Files & Database concepts. In Cycle 2, Numpy & Pandas concepts will be used to develop the projects. In the Project work phase, student will design and develop complete end to end project based on requirements and design considerations.

Cycle 1:

Basic Concepts: Data Structures- lists, tuples, sets, and dictionaries. Condition Statements, Iterative statements, Regular expressions, OOP concepts: Classes and Objects, Encapsulation, Inheritance, Polymorphism, Decorators, Exception Handling

Files - File Operations, Files and Streams, creating a File, reading from a File, Iterating Through Files, Seeking, Serialization

Databases: How to Use a Database, working with a Database, Using SQL to Query a Database, Python and SQLite, creating an SQLite DB, Pulling Data from a DB, SQLite Database Files.

Cycle 2:

NumPy: The Basics of NumPy Arrays, Computation on NumPy Arrays: Universal Functions, Aggregations: Min, Max, and Everything In Between, Computation on Arrays: Broadcasting, Comparisons, Masks, and Boolean Logic, Fancy Indexing, Sorting Arrays.

Pandas: Loading your first data set, Looking at columns, rows, and cells, Creating your own data, The Series, The DataFrame, **:** Operating on Data in Pandas, Handling Missing Data, Combining Datasets: Concat and Append, Merge and Join, Aggregation and Grouping.

Case studies on Data Analysis, Data Visualization.

Text Books:

1. **Learning to Program using Python** by Cody Jackson, Second Edition, 2014.
2. **Pandas for Everyone: Python Data Analysis** by Daniel Y. Chen, First Edition, Pearson, 2018.
3. **Python Data Science Handbook** by Jake VanderPlas, O'Reilly, 2017
4. **PYTHON FOR DATA ANALYSIS by** Wes McKinney, O'Reilly, 2022

Reference Books:

1. **Programming Python**, Mark Lutz, O'Reilly Media, Edition 2010.
2. **MySQL for Python,** Albert Lukaszewski, 2010.
3. **Hands-On Data Analysis with Pandas** by Stefanie Molin, Packt, 2019.

e-Books:
1. http://www.onlineprogrammingbooks.com/learning-program-using-python/ 2. https://www.pdfdrive.com/python-for-data-analysis-data-wrangling-with-pandas-numpy-and-ipython-e158189564.html
MOOCs:
1. https://www.coursera.org/learn/python 2. https://www.coursera.org/learn/data-analysis-with-python#about

COURSE OUTCOMES (COs)

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

CO1	Understand the usage of files, databases and data analysis tools like NumPy, Pandas.
CO2	Apply the programming constructs, operations and data analysis tools on a chosen data set.
CO3	Analyse data in Python using multidimensional array in NumPy, apply data frames in Pandas.
CO4	Design solutions in teams for real time societal issues with an aim to import, clean, enrich, transform and output the analysis of large dataset.
CO5	Conduct experiments using modern Python tools.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Environmental Studies**				
Course Code	**23IS5HSEVS**	**Credits**	**1**	**L-T-P**	**1-0-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**1**	**Total Lecture Hours**	**15**		

UNIT - 1

Introduction to Environment

1. Definition, about the Earth, Earth's Structure I.e. Atmosphere and its parts, Hydrosphere, Lithosphere and Biosphere.
2. Ecology & Ecosystem, Balanced ecosystem, types of Ecosystem.

UNIT – 2

Human Activities on Environment

1. Human activities - Food, Shelter, Economic and Social Security.
2. Effects of Human activities on Environment: a. Agriculture, b. Housing, c. Industries, d. Mining and transportation activities.
3. Environmental Impact Assessment (EI A) 4. Sustainable development.

UNIT - 3

Natural Resources

1. Definition, Renewable and Non-Renewable sources.
2. Major Natural Resources are-
    - Water resources, its availability, quality, water borne & water in duced diseases,
    - Mineral resources, classification, uses in various Industries as by products.
    - Forest resources – causes & consequences of deforestation, various afforestation programs.
3. Conventional and Non-conventional energy resources-
    - Hydroelectric, Wind power, Solar, Biogas, geothermal energy.
        - Fossil fuel based energy resources – Coal, Oil & Gas, Nuclear power
        - Hydrogen as an alternate future sources of energy.

UNIT - 4

Environmental pollution

Introduction, following are few types of pollutions to study-

- Water pollution - definition, types, sources, effects and control of water pollution.
- Land pollution - definition, types, sources, effects, Solid waste management.
- Noise pollution - definition, sources, effects & control of noise pollution.
- Air pollution- definition, sources, effects & control of air pollution.

UNIT - 5

Current Environmental Issues& Importance

- Population growth, effects & Control, Climatic changes,
- Global warming, Acid rain, Ozone layer depletion and its effects.
- Environmental protection– initiatives by Government and non–Govt. Organizations (NGO's), Role of Legal aspects.
- Environmental Education, Women education.

Text Books:

1. Environmental studies, Dr. Geetha Balakrishna, Sun star publication, Revised Edition
2. Ecology, Subramanyam, Tata McGraw Hill Publication
3. Environmental studies, Dr. J.P. Sharma, Fourth edition
4. Environmental studies, Smriti Srivastav, Kataria & Sons

Reference Books:

1. Environmental studies, BennyJoseph.
2. Environmental studies, Dr. D.L. Manjunath.

e-Books:

1. NPTEL (Open Sources/ power point and visuals)
2. Ecological studies/ IITR/ Open Sources
3. Ministry of Environment and forest & wildlife.

MOOCs:

1. Introduction to Sustainability, https://www.coursera.org/learn/sustainability

COURSE OUTCOMES (COs)

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

CO1	Discuss the components and impacts of human activities on environment.
CO2	Apply the environmental concepts for conservation and protection of natural resources.
CO3	Identify and establish relationship between social, economic and ethical values from environmental perspectives.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	Research Methodology				
Course Code	23IS5AERML	Credits	2	L-T-P	2-0-0
CIE	50	SEE	50		
Contact Hours/ Week	02	Total Lecture Hours	25		

UNIT - 1
Research Methodology: An Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research. **Defining the Research Problem:** What is a Research Problem? Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration, Conclusion Chapter 1 & 2 (TB1)
UNIT – 2
Reviewing the literature: The place of the literature review in research, Bringing clarity and focus to your research problem, Improving your research methodology, Broadening your knowledge base in your research area, Enabling you to contextualize your findings, How to review the literature, Searching for the existing literature, Reviewing the selected literature. **Formulating a research problem:** The research problem, The importance of formulating a research problem, Sources of research problems, Considerations in selecting a research problem, Steps in formulating a research problem, The formulation of research objectives. Chapter 3 & 4(TB2)
UNIT - 3
Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Conclusion. **Sampling Design:** Census and Sample Survey, Implications of a Sample Design, Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of Sample Designs, How to Select a Random Sample? Random Sample from an Infinite Universe, Complex Random Sampling Designs, Conclusion Chapter 3 & 4(TB1)
UNIT - 4
Selecting a method of data collection: Differences in the methods of data collection in quantitative and qualitative research, Major approaches to information gathering, collecting data using primary sources, Methods of data collection in qualitative research, collecting data using secondary sources **Considering ethical issues in data collection** Ethics: the concept, Stakeholders in research, Ethical issues to consider concerning research participant, Ethical issues to consider relating to the researcher, Ethical issues regarding the sponsoring organization. Chapter 9 & 14(TB2)

UNIT - 5
Interpretation and Report Writing: Meaning of Interpretation, Why Interpretation? Technique of Interpretation: Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusion Chapter - 14(TB1)
Text Books:
1. Research methodology - Methods and Techniques, C.R Kothari, New Age International Publishers, 5th Edition, 2023. 2. Research methodology- a step by step guide for beginners, Ranjith Kumar, SAGE, 4th Edition, 2023.
Reference Book:
1. Research and publication ethics, Santhosh kumar yadav, Springer, 2023.
e-Books:
1. http://ndl.ethernet.edu.et/bitstream/123456789/79439/5/Research%20Methodology%20-%20Methods%20and%20Techniques%202004.pdf 2. https://rauterberg.employee.id.tue.nl/lecturenotes/DBB150/references/Kumar-2011%20Research%20Methodology-ed3.pdf
MOOCs:
1. Research Methodology By Prof. Edamana Prasad, Prof. Prathap Haridoss | IIT Madras, https://onlinecourses.nptel.ac.in/noc23_ge36/preview

COURSE OUTCOMES (COs)

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

CO1	Understanding various kinds of research objectives of doing research, research design and sampling.
CO2	Apply research approaches and techniques in the appropriate manner for managerial decisions.
CO3	Understanding the techniques for writing research report and presentations.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Bioinformatics**				
Course Code	**23IS6BSBIO**	**Credits**	**1**	**L-T-P**	**0-1-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**2**	**Total Lecture Hours**	**24**		

UNIT - 1

Introduction to Biopython and Unit Sequencing: **Biopython: Chapters 1 to 5**

Setting Up the Environment and Introduction to Biopython, Install Biopython, Explore the Biopython documentation and tutorial, Write a simple Python script to print "Hello, Biopython!", Sequence Objects, Create sequence objects using Seq, Perform basic sequence manipulations (slicing, concatenation), Transcription and translation of sequences, Reading Sequence Files, Read sequence data from FASTA and GenBank files, Extract sequences and annotations, Writing Sequence Files, Write sequence data to FASTA and GenBank files, Convert between different file formats

UNIT - 2

Sequence annotations, alignments and Database Access, Biopython: Chapters 4 to 9

Sequence Annotation Objects, Explore SeqRecord objects, Add and manipulate annotations (features, IDs, descriptions), Accessing Online Databases, Use Entrez to fetch data from NCBI Retrieve nucleotide and protein sequences, Parse XML data from Entrez, Pairwise Sequence Alignment, Perform pairwise sequence alignment using Bio.pairwise2, Score and visualize alignments, Multiple Sequence Alignment, Use Clustalw or MUSCLE for multiple sequence alignments, Analyze and visualize the alignment results

UNIT - 3

Phylogenetics and Population Genetics, Biopython: Chapters 7 to 8

Constructing Phylogenetic Trees, Use alignment data to construct phylogenetic trees, Visualize phylogenetic trees using Phylo, Population Genetics Analysis, Simulate population genetics data using Bio.PopGen, Analyze genetic variation and structure in populations

UNIT - 4

Protein Structures and Pipeline, Biopython: Chapters 10 and 11

Working with Protein Structures, Fetch protein structure data from PDB, Visualize protein structures using Bio.PDB, Perform basic structure manipulations, Building a Bioinformatics Pipeline, Combine multiple Biopython modules to build a complete bioinformatics pipeline, Perform a real-world biological data analysis.

UNIT - 5
Final Project, Biopython: Chapters 1 to 11 Project 1: Comparative Genomics and Phylogenetic Analysis, Analyze evolutionary relationships between related species, Perform multiple sequence alignment and construct a phylogenetic tree, Project 2: Protein Structure Analysis and Functional Prediction, Analyze the structure of a protein and predict its functional sites, Compare with related proteins to understand its biological role
Text Book:
1. Introduction to Bioinformatics by Arthur M Lesk, University of Cambridge, Oxford University Press Inc., 2002.
Reference Books:
1. Brain-Computer Interfacing, An Introduction, Rajesh P N Rao, Cambridge University Press, 2013. 2. DNA Computing: New Computing Paradigms Rozenberg, Grzegorz, Paun, Gheorghe, Saloma, Arto, Springer Nature, 2013. 3. An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, 1998. 4. Computational Biology: Genomes, Networks, Evolution, Manolis Kellis, MIT Press 2016 Computational Genomics with R, Altuna Akalin, Chapman and Hall/CRC, 2020.
e- Books:
3. Biopython Tutorial and Cookbook, January 10, 2024 (Biopython 1.83), https://biopython.org/DIST/docs/tutorial/Tutorial.html 4. Documentation, https://biopython.org/wiki/Documentation
MOOCs:
1. Bioinformatics Specialization, https://www.coursera.org/specializations/bioinformatics#courses

COURSE OUTCOMES (COs)

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

CO1	Implement the biological concepts using Bio python tool.
CO2	Analyze the evolutionary relationships between related species , structure of a protein and predict its functional sites.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Computer Networks - 2**				
Course Code	**23IS6PCCN2**	**Credits**	**4**	**L-T-P**	**3-0-1**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**5**	**Total Lecture Hours**	**40**		

UNIT - 1

The Transport Layer: Services provided to the upper layers, Transport service primitives, Elements of transport protocols: Addressing, Connection establishment, Connection release, Error control and flow control, Introduction to UDP, Remote procedure call, The Internet Transport Protocols: TCP - protocol, segment header, Connection establishment, connection release, Sliding window, Congestion control.

UNIT - 2

Application layer –I

Socket Programming: Client-Server Model of Interaction, The Client-Server Model, A Trivial Example: UDP Echo Server, Time and Date Service, Sequential and Concurrent Servers, Server Complexity, Broadcasting Requests, Client-Server Alternatives and Extensions.

The Socket API: Introduction, Versions of The Socket API, The UNIX I/O Paradigm and Network I/O, Adding Network I/O to UNIX, The Socket Abstraction and Socket Operations, Obtaining and Setting Socket Options, How A Server Accepts TCP Connections, Servers That Handle Multiple Services, Obtaining and Setting the Host Name, Library Functions Related to Sockets, An Example Client, An Example Server.

UNIT - 3

Application layer-II.

The Domain Name System (DNS), Introduction, Names For Computers, Flat Namespace, Hierarchical Names, Delegation Of Authority For Names, Subset Authority, Internet Domain Names, Top-Level Domains Name Syntax And Type, Mapping Domain Names To Addresses, Domain Name Resolution, Efficient Translation, Caching: The Key To Efficiency, Domain Name System Message Format, Compressed Name Format , Abbreviation Of Domain Names, Inverse Mappings, Pointer Queries, Object Types And Resource Record Contents, Obtaining Authority For A Subdomain, Server Operation And Replication, Dynamic DNS Update And Notification, DNS Security Extensions (DNSSEC), Multicast DNS And Service Discovery.

Electronic Mail (SMTP, POP, IMAP, MIME), Electronic Mail, Mailbox Names and Aliases, Alias Expansion and Mail Forwarding, TCP/IP Standards for Electronic Mail Service, Simple Mail Transfer Protocol (SMTP), Mail Retrieval and Mailbox Manipulation Protocols, The MIME Extensions for Non-ASCII Data, MIME Multipart Messages.

UNIT - 4

Voice And Video Over IP (RTP, RSVP, QoS), Introduction, Digitizing And Encoding, Audio And Video Transmission And Reproduction, Jitter And Playback Delay, Real-time Transport Protocol (RTP) ,Streams, Mixing, And Multicasting, RTP Encapsulation , RTP Control Protocol (RTCP), RTCP Operation, IP Telephony And Signaling, Quality Of Service Controversy, QoS, Utilization, And Capacity, Emergency Services And Pre-emption, IntServ And Resource Reservation, DiffServ And Per-Hop Behavior, Traffic Scheduling, Traffic Policing And Shaping.

UNIT - 5

Network Management (SNMP): Introduction, The Level of Management Protocols, Architectural Model, Protocol Framework, Examples of MIB Variables, The Structure of Management Information, Formal Definitions Using ASN.1, Structure and Representation of MIB Object Names, MIB Changes and Additions for IPv6, Simple Network Management Protocol, SNMP Message Format, An Example Encoded SNMP Message.

Text Books:

1. Computer Networks, Andrew S Tannenbaum and David J Wetherall, Pearson, 5th Edition,2014
2. Internetworking with TCP/IP: Principles, Protocols, and Architecture Douglas E. Commer Prentice Hall Edition 6th Edition, 2014.

Reference Books:

1. Computer Networks: An Open Source Approach, Ying-Dar Liu, Ren-Hung Hwang, Fred Baker, McGraw-Hill, 2011.
2. Unix Network Programming, W. Richard Stevens, Bill Fenner and Andrew Rudoff, Volumes 1 and 2, Third Edition, Addison-Wesley Professional, 2003.
3. Pocket Guide to TCP/IP Socket Programming in C, Michael Donahoo, Ken Calvert, Morgan Kaufmann Series in Networking, 2000.
4. Data Communication and Networking, Behrouz A. Forouzan, McGraw-Hill.

e- Books:
1. https://resources.saylor.org/wwwresources/archived/site/wpcontent/uploads/2012/02/Computer-Networking-Principles-Bonaventure-1-30-31-OTC1.pdf 2. http://intronetworks.cs.luc.edu/current2/ComputerNetworks.pdf
MOOCs:
1. Computer Networks, https://www.nptelvideos.in/2012/11/computer-networks.html 2. Introduction to TCP/IP, https://www.coursera.org/learn/tcpip

COURSE OUTCOMES (COs)

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

CO1	Understand the working principle of Transport and Application layers along with related protocols and Concepts of Network management protocols.
CO2	Apply the knowledge of various Client-Server Models, protocol Software, network communication approaches in building client-server applications and TCP/IP socket programs.
CO3	Analyse the functionalities of various Application Layer Protocol like HTTP (Hypertext Transfer Protocol), Domain Name System (DNS), Electronic Mail (SMTP, POP, IMAP, MIME Voice And Video Over IP and Simple Network Management Protocol.
CO4	Design solutions for real time applications by executing client server programs using advanced library for different services of Application Layer Protocols.
CO5	Conduct Experiments on various protocols of Application and Transport Layer.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Cloud Computing**				
Course Code	**23IS6PCCLC**	**Credits**	**4**	**L-T-P**	**3-0-1**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**5**	**Total Lecture Hours**	**40**		

UNIT - 1
Introduction: Cloud Computing in a Nutshell, Roots of Cloud Computing, Layers and Types of Clouds, Desired Features of a Cloud, Cloud Infrastructure Management Features, Infrastructure as a Service Providers Features, Platform as a Service Providers Features, Challenges and Risks. **Migrating into a Cloud:** Broad Approaches to Migrating into the Cloud, The Seven-Step Model of Migration into a Cloud.
UNIT – 2
Virtual Machines Provisioning and Migration Services: Virtual Machines Provisioning and Manageability, Virtual Machine Migration Services, **Virtualization Structures/Tools and Mechanisms. Cloud Application Design**, Introduction, Design Considerations for Cloud Applications, Reference architecture for cloud applications, Cloud Application Design Methodologies.
UNIT - 3
Microservice: Traditional Monolithic Applications, Monolithic Applications in A Data Center, The Microservices Approach, The Advantages of Microservices, The Potential Disadvantages of Microservices, Microservices Granularity, Communication Protocols Used for Microservices, Communication Among Microservices. **Cloud Security and Privacy:** Cloud-Specific Security Problems, Security in A Traditional Infrastructure, Why Traditional Methods Do Not Suffice for The Cloud, The Zero Trust Security Model, Identity Management, Privileged Access Management (PAM), AI Technologies and Their Effect On Security, Protecting Remote Access, Privacy in A Cloud Environment, Back Doors, Side Channels, And Other Concerns, Cloud Providers as Partners for Security and Privacy.
UNIT - 4
Introduction to Multi-Cloud: Understanding multi-cloud concepts, setting out a real strategy for multi-cloud, Starting the Multi-Cloud Journey, understanding cloud vocabulary, Planning assessments, executing technology mapping and governance, Planning transition and transformation, exploring options for transformation, Keeping the infrastructure consistent.

UNIT - 5

Edge Computing and IoT: The Latency Disadvantage of Cloud, Situations Where Latency matters, Industries that Need Low Latency, Moving Computing to The Edge, Extending Edge Computing to A Fog Hierarchy, Caching at Multiple Levels of a Hierarchy, An Automotive Example, Edge Computing and IoT, Communication for IoT, Decentralization Once Again.

Text Books:

1. Cloud Computing-Principles and paradigm, Rajkumar Buyya, James Borberg, Andrzej Goscinski, 2016.
2. The Cloud Computing Book, Douglas E. Comer, 2021
3. Cloud computing, A Hands On Approach, Arshdeep Bahga, Vijay Madisetti, 2016.
4. Multicloud Strategy for cloud architects, Jeroen Mulder, 2023,

Reference Books:

1. Cloud Computing - Theory and Practice, Dan C. Marinesco, 2013 Elsevier Inc.
2. Distributed and Cloud Computing from Parallel Processing to Internet of Things, Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, Elsevier, 2012.

e- Books:

1. Handbook of Cloud Computing, Borko Furht · Armando Escalante, https://studytm.files.wordpress.com/2014/03/hand-book-of-cloud-computing.pdf
2. Cloud Computing, Sandeep Bhowmik https://industri.fatek.unpatti.ac.id/wp-content/uploads/2019/03/210-Cloud-Computing-Sandeep-Bhowmik-Edisi-1-2017.pdf.
3. Advanced Computing,**12th International Conference, IACC 2022, Hyderabad, India, December 16–17, 2022, Revised Selected Papers, Part I** https://link.springer.com/book/10.1007/978-3-031-35641-4?sap-outbound-id=49D2A8ED71CC9B963E96364A35D838ABD0AF666A.

MOOCs:
1. Google Cloud Computing Foundation Course. https://swayam.gov.in/nd1_noc20_cs55/preview 2. Cloud Computing. https://www.coursera.org/browse/information-technology/cloud-computing

COURSE OUTCOMES (COs)

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

CO1	Understand cloud-paradigms, security, privacy, challenges and risks in cloud computing.
CO2	Apply the different computing principles using cloud environments.
CO3	Analyse the importance of virtualization, microservice architectures, edge and IOT in the usage of cloud computing.
CO4	Develop applications on cloud environments.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	Mobile Application Development				
Course Code	23IS6PCMAD	Credits	2	L-T-P	0-0-2
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	4	Total Lecture Hours	48		

I. Cycle -1

1. Programs based on Android Components, Intents and Layouts.
    - Overview of Android Architecture, Android Activity Life Cycle, Android Manifest. File.
    - Android Widgets : UI development in Android, Working with Button, TextView, EditText, AutoCompleteTextView, DatePicker, TimePicker, Toast, CustomToast, ToggleButton, Checkbox, Custom Checkbox, RadioButton, DynamicRadioButton, CustomRadioButton, AlertDialog, ProgressBar.
    - Layout Manager: Linear Layouts, Relative Layouts, Coordinator Layouts.
    - RecyclerView, Spinner, Drawing custom shapes on Canvas.
    - Explicit and Implicit Intents.
    - Progams based on Android Animation.

2. Programs based on:
    - Android Menu: Options Menu, Context Menu, Popup Menu.
    - Android Fragments.
    - Android Services.

II. Cycle-2

1. Programs based on Android Shared Preferences primitives.
2. Programs based on Room library to store and fetch the data from the database.
3. Networking with Android using HTTP/Retrofit/Volley.

III. Projects on App Development.

Text Books:

1. Android Programming with Kotlin for Beginners, John Horton, 2019.
2. Android Programming for Beginners,John Horton, Third Edition,2021.

Reference Books:

1. Pro Android 5, Dave MacLean, Satya Komatineni and Grant Allen, Apress, 2015.

2. The Android Developer's Cookbook: Building Applications with the Android SDK, James Steele, Nelson to, Addison-Wesley Professional, 2010

e-Books:

1. Android Application Development, tutorials point https://www.tutorialspoint.com//android/android_tutorial.pdf
2. Android Studio 4.0 Development Essentials – Java Edition, Neil Smyth https://www.techotopia.com/pdf_previews/AndroidStudio40EssentialsPreview.pdf

MOOCs:

1. Android App Development https://www.coursera.org/learn/aadcapstone.
2. Android Development https://www.udemy.com/course/learn-android-application-development-y/
3. The Complete Android N Developer Course https://www.udemy.com/course/complete-android-n-developer-course/

COURSE OUTCOMES (COs)

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

CO1	Comprehend the basics of Android development framework and its functionalities.
CO2	Apply the knowledge of android user interfaces, menus, fragments and service for a given problem.
CO3	Analyze packages, project libraries and services to obtain a framework for solving problems in development of mobile applications.
CO4	Implement the code patterns with android concepts, common controls, mapping packages, GUI interactive interfaces, shared preferences primitives, database, integration and networking to arrive at valid conclusions.
CO5	Design Mobile Apps to provide solutions for real world problems in a team.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Object-Oriented Modeling and Design Patterns**				
Course Code	**23IS6PCOMD**	**Credits**	**2**	**L-T-P**	**2-0-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**2**	**Total Lecture Hours**	**25**		

UNIT - 1
Modeling Concepts: Modeling as Design Technique: Modeling; abstraction; the three models. Class Modeling: Object and class concepts; Link and associations concepts; Generalization and inheritance; A sample class model.
UNIT - 2
Advanced Class Modeling: Advanced object and class concepts; Association ends; N-ary associations; Aggregation; Abstract classes, Meta Data, Derived Data, Packages.
UNIT - 3
State Modeling: Events, States, Transitions and Conditions; State diagrams; State diagram behavior.
UNIT - 4
Advanced State Modeling: Nested state diagrams; Nested states; Concurrency, Relation of class and state models.
UNIT - 5
Interaction Modeling: Use case models; Sequence models; Activity models. Advanced interaction modeling: Use case relationships; Procedural sequence models, Special Constructs for Activity Models **Design Patterns**: What is a pattern and what makes a pattern? Pattern categories; Relationships between patterns; Pattern description
Text Book:
1. Object–Oriented Modelling and Design with UML by Michael Blaha and James Rumbaugh, 2nd edition, **2018** 2. Pattern-Oriented Software Architecture: A System of Patterns by Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, Michael Stal, Volume 1, John Wiley and Sons, 2008.
Reference Books:
1. Object-Oriented Software Engineering-Using UML, Patterns, and Java™, Bernd Bruegge & Allen H. Dutoit, 3rd Edition, **2010**
e- Books:

1. Object Oriented Systems Development, Ali Bahrami. https://edutechlearners.com/download/books/OOSE/OOAD.pdf 2. Object Oriented Systems Development , https://friendkvvk.wordpress.com/wp-content/uploads/2015/08/friendkvvk-ooad.pdf
MOOCs:
1. Object-Oriented Analysis and Design https://nptel.ac.in/courses/106105153/

COURSE OUTCOMES (COs)

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

CO1	Understand and apply the knowledge of Class, State & Interaction Modeling using Unified Modeling Language to solve a given problem.
CO2	Analyse system conception for a domain using UML models
CO3	Design UML models to solve given problem using Patterns

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Social Network Analysis**				
Course Code	**23IS6PESNA**	**Credits**	**3**	**L-T-P**	**2-0-1**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**4**	**Total Lecture Hours**	**40**		

UNIT - 1
Graphs and Matrices: Why Graphs? Graphs, Digraphs, Bipartites, Multigraphs, Hypergraphs. Introduction to networks/IGRAPH using python for construction and visualization purpose.
UNIT - 2
Strong and Weak Ties: Triadic Closure, The Strength of Weak Ties, Tie Strength and Network Structure in Large-Scale Data, Tie Strength, Social Media, and Passive Engagement, Closure, Structural Holes, and Social Capital. **Networks in Their Surrounding Contexts**: Homophily, Mechanisms Underlying Homophily: Selection and Social Influence, Affiliation.
UNIT - 3
Positive and Negative Relationships: Structural Balance, Characterizing the Structure of Balanced Networks. **Centrality measures and databases**: Explore degree centrality, closeness centrality, betweenness centrality, eigen vector centrality. Explore SNAP databases for different types of networks.
UNIT - 4
Link Analysis and Web Search: Searching the Web: The Problem of Ranking, Link Analysis using Hubs and Authorities, PageRank. **Cascading Behavior in Networks**: Diffusion in Networks, Modelling Diffusion through a Network, Cascades and Clusters, Diffusion, Thresholds, and the Role of Weak Ties.

UNIT - 5

The Small-World Phenomenon: Six Degrees of Separation, Structure and Randomness, Decentralized Search, Modelling the Process of Decentralized Search, Core-Periphery Structures and Difficulties in Decentralized Search.

Structure of the Web: The World Wide Web, Information Networks, Hypertext, and Associative Memory, The Web as a Directed Graph

Text Book:

1. Social Network Analysis: Methods and Applications, Stanley Wasserman, Katherine Faust, Cambridge University Press, 2012 (Unit 1)
2. Networks, Crowds, and Markets: Reasoning about a Highly Connected World: David Easley, Jon Kleinberg.

Reference Books:

1. Social Network Analysis by John Scott, 3rd edition, SAGE publications Ltd, 2012.
2. Understanding-Social-Networks-Theories-Concepts-and findings by Harles Kadushin, Oxford university press, 2012.
3. Social and Economic Networks – Matthew O Jackson.

e- Books:

1. Social Network Analysis theory and applications. https://www.archiv.politaktiv.org/documents/10157/29141/SocNet_TheoryApp.pdf
2. Introduction to Social Network methods. https://www.analytictech.com/networks.pdf

MOOCs:

1. Applied Social Network Analysis in Python, https://www.coursera.org/learn/python-social-network-analysis#syllabus
2. Social and Economic Networks: Models and Analysis, https://www.coursera.org/learn/social-economic-networks#syllabus
3. Social Networks, https://nptel.ac.in/content/syllabus_pdf/106106169.pdf

COURSE OUTCOMES (COs)

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

CO1	Comprehended the basic knowledge of social network analysis, graphs, cliques, structural equivalence, positional analysis and data collection.
CO2	Apply graphs and matrices to represent social networks.
CO3	Analyze the usage of graphs, matrices and subgroups in social networks.
CO4	Communicate effectively in a team and investigate on the topics related to Social Network Analysis.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Big Data Analytics**				
Course Code	**23IS6PEBDA**	**Credits**	**3**	**L-T-P**	**2-0-1**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**4**	**Total Lecture Hours**	**40**		

UNIT - 1

Introduction to Big Data: Types of Digital Data- Classification of Digital Data Structured Data, Semi-Structured Data and Unstructured Data, Characteristics of Data, Evolution of Big Data, Definition of Big Data, Challenges with Big Data, what is Big Data? Why Big Data? Traditional Business Intelligence Versus Big Data, Big Data framework.

Big Data Analytics – What is Big Data Analytics? Classification of Analytics, Top Challenges Facing Big Data. Introduction to Hadoop – Introducing Hadoop, Why Hadoop? Why not RDBMS? RDBMS versus Hadoop, Distributed Computing Challenges, History of Hadoop, Hadoop Overview, Installation of Hadoop Use Case of Hadoop.

UNIT - 2

Hadoop Distributed File System: Processing Data with Hadoop, Managing Resources and Applications with Hadoop YARN (Yet another Resource Negotiator),

Introduction to MAPREDUCE Programming: Introduction, Mapper, reducer, Combiner, Partitioner, Searching, Sorting, Compression.

UNIT - 3

Cassandra – Apache Cassandra - An Introduction, Features of Cassandra, CQL Data types, CQLSH, Keyspaces, CRUD (Create, Read, Update and Delete) Operations, Collections, using a Counter, Time to Live (TTL), Alter Commands, Import and Export, Querying System Tables, Practice Examples.

Hive – What is Hive? Hive Architecture, Hive Data Types, Hive File Format, Hive Query Language (HQL), SerDe, User-defined Function(UDF).

UNIT - 4

Spark – Installing Spark, An Example, Spark Applications, Jobs, Stages, and Tasks, A Scala Standalone Application, A Java Example, A Python Example, Resilient Distributed Datasets Creation, Transformations and Actions, Persistence, Serialization , Anatomy of a Spark Job Run, Job Submission, Task Scheduling. Big Data integration, analytics and visualization using Lumify, Data Wrapper.

Sqoop: Introduction, Installation, Import and Export.

UNIT – 5

Data Ingestion Tools: Apache Zookeeper: What is Apache Zookeeper? Introduction to Apache Zookeeper, Why do we need Zookeeper in Hadoop? How ZooKeeper in Hadoop Works? Reads and writes in Zookeeper.

Apache Flume - Introduction, Architecture, Dataflow, Features and Limitations, Applications.

Text Books:

1. Big data and Analytics, Seema Acharya,Subhashini Chellappan, Wiley publications, 2014.
2. Big Data Analytics with R and Hadoop, Vignesh Prajapati, -Packt Publishing 2013.
3. https://mapr.com/ebook/getting-started-with-apache-sparkv2/assets/Spark2018eBook.pdf
4. Learning Sqoop, https://riptutorial.com/Download/sqoop.pdf
5. https://3.droppdf.com/files/qgktT/apache-sqoop-cookbook.pdf

Reference Books:

1. Hadoop: The Definitive Guide, Tom White, Fourth Edition, O'Reilly, 2015.
2. Hrushikesha Mohanty, Prachet Bhuyan, Deepak Chenthati Editors Big Data a Premier Springer Volume 11.
3. Using Flume: Flexible, Scalable, and Reliable Data Streaming by Hari Shreedharan.

e- Books:

1. Arvind Sathi, “Big Data Analytics: Disruptive Technologies for Changing the Game”,1st Edition, IBM Corporation, 2012
https://www.studocu.com/in/document/shivaji-university/computer-science/big-data-analytics-disruptive-technologies-for-changing-the-game-arvind-sathi-z-lib/30791655

MOOCs:

1. Introduction to Big Data Analytics
https://www.coursera.org/courses?query=introduction%20to%20big%20data%20analytics
2. Big Data, https://www.edx.org/learn/big-data.
3. Data Analytics with Python, https://swayam.gov.in/nd1_noc20_cs46/

COURSE OUTCOMES (COs)

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

CO1	Understand the concepts of Hadoop, HDFS, Map Reduce, YARN, Hadoop I/O, Cassandra, Hive, Sqoop, Spark, Apache Zookeeper, Apache Flume and operations for analytics of big data.
CO2	Apply the knowledge of Hadoop distributed file system, Cassandra, Hive, Sqoop, Spark, Apache Zookeeper, Apache Flume for solving real time problems
CO3	Identify the appropriate concepts of big data to solve a given usecase.
CO4	Design solutions for applications using appropriate big data concepts.
CO5	Conduct experiments using modern big data tools like Hadoop, Cassandra, Hive, Sqoop, Spark to solve given problems.
CO6	Communicate effectively in a team and investigate on the topics related to big data.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Deep Learning**				
Course Code	**23IS6PEDLG**	**Credits**	**3**	**L-T-P**	**2-0-1**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**4**	**Total Lecture Hours**	**40**		

UNIT - 1
Introduction to Artificial Neural Networks- Biological Neurons, Logical Computations with Neurons, The Perceptron, Multi-Layer Perceptron (MLP) and Backpropagation, Implementing MLP's with keras, Fine Tuning Neural Network Hyper Parameters.
UNIT - 2
Training Deep Neural Networks- Vanishing/Exploding Gradients, Reusing Pre-Trained Layers Avoiding Overfitting Through Regularization.
UNIT - 3
Custom Models and Training with TensorFlow - A Quick Tour of TensorFlow, Using TensorFlow like NumPy, Customizing Models and Training Algorithms, TensorFlow Functions and Graphs.
UNIT - 4
Deep Computer Vision Using Convolutional Neural Networks - Architecture of Visual Cortex, Convolutional Layer, Pooling Layer, CNN Architectures, AlexNet, GoogLeNet, Using Pre-trained Models from Keras, Classification and Localization, Object Detection, Fully Convolutional Networks.
UNIT - 5
Processing Sequences Using RNNs and CNNs - Recurrent Neurons and Layers , Training RNNs, Forecasting a Time Series, Baseline Metrics , Implementing a Simple RNN , Handling Long Sequences- Tackling the Short-Term Memory Problem, LSTM Cell.

Text Books:
1. Hands-On Machine Learning with Scikit-Learn, Keras and Tensor Flow: Concepts, Tools and Techniques to Build Intelligent Systems, Aurelien Geron, Second Edition, September 2019.
Reference Books:
1. Python Machine Learning- Third Edition by Sebastian Raschka and Vahid Mirjalili.
e- Books:
1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition [Book] (oreilly.com)
MOOCs:
1. IBM: Deep Learning with TensorFlow, https://www.edx.org/course/deep-learning-with-tensorflow 2. Deep Learning https://www.deeplearning.ai/tensorflow-in-practice/

COURSE OUTCOMES (COs)

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

CO1	Comprehend the fundamentals of deep learning algorithms.
CO2	A ply specific deep learning algorithms to obtain solutions for appropriate problems.
CO3	Identify and analyse deep learning techniques suitable for training the models using TensorFlow and keras.
CO4	Conduct various experiments to demonstrate techniques using Deep neural networks, Convolutional neural networks, Recurrent neural networks so on.
CO5	Usage of modern tools for implementing deep learning algorithms using Python.
CO6	Communicate effectively in a team and investigate on the topics related to deep learning algorithms.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Service Oriented Architecture**				
Course Code	**23IS6PESOA**	**Credits**	**3**	**L-T-P**	**2-0-1**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**4**	**Total Lecture Hours**	**40**		

UNIT - 1

Introduction to Service-Oriented Architecture:

Overview of Service-Oriented Architecture

- Idea of a Service, Key Characteristics, Historical Context, AI-Driven Services

Principles and Concepts of SOA

- Service Loose Coupling, Service Reusability, Service Abstraction, AI Considerations

Evolution and History of SOA

- Early Web Services, Emergence of SOA Standards, Transition to Microservices & Containerization, DevOps and MLOps, Role of Cloud Providers & AI Services:

Benefits and Challenges of SOA

- Business Agility, Interoperability, Challenges in Implementation, AI Integration Challenges

Contemporary Trends in SOA

- Microservices Architecture, Cloud Computing and SOA
- Serverless Computing and SOA, AI/ML in the Service Ecosystem

UNIT - 2

SOA Design and Modeling

Service Design Principles and Patterns

- Service Cohesion, Service Coupling, Client-Server architecture, Service IP and **DNS Service**

Connection and Data Management

- Proxy, GraphQL, RESTAPI, SQL, NoSQL, Idempotency

Designing for Scalability and Resilience

- Load Balancing, Sharding, Partitioning, Fault Tolerance, Circuit Breaker Pattern,

UNIT - 3

SOA Implementation Technologies

Web Services Standards

- Simple Object Access Protocol (SOAP), Representational State Transfer (REST)
- GraphQL, gRPC

Microservices Architecture and its Relationship with SOA

- Decentralized Data Management, Independent Deployment, MLOps & Microservices:
- Infrastructure Automation, Automated Model Deployment

Containerization and Orchestration

- Docker Container, Kubernetes Orchestration, Specialized AI/ML Orchestration, Service Mesh Technologies, Observing AI Microservices

Event-Driven Architecture (EDA) and SOA

- Event-Driven Messaging Systems, Pub/Sub patterns, Streaming Pipelines for AI

API Management and Governance

- API Design Principles, AI-Specific API Considerations
- Rate Limiting and Quotas, AI Endpoint Limits

UNIT – 4

Security and Governance in SOA:

Security Considerations in SOA

- Understanding Threat Models, Common Security Risks in SOA Threats in AI-Driven Services
- Security Design Patterns, Zero Trust for distributed microservices (including AI endpoints)

API Security Best Practices

- Securing RESTful APIs, Web Service Security Standards (WS-Security)
- Securing AI Inference APIs

JSON-based Security

- SAML Assertions and Assertions Consumers, Modern Alternatives with JWT/OAuth 2.0 vs. SAML usage in microservices and AI service endpoints

UNIT - 5

SOA Emerging Trends

Serverless Computing and its Impact on SOA

- Function-as-a-Service (FaaS), Event-Driven Architectures, AI Use Cases in Serverless
- Operational Characteristics, Observability in AI-Driven Serverless

Artificial Intelligence (AI) and Machine Learning (ML) in SOA

- Intelligent Agents, Predictive Analytics, Natural Language Processing (NLP), AI Orchestration and Workflow

Edge Computing and SOA Integration, Edge Gateway Architectures, Low-Latency Data Processing. Offline Capabilities, AI Workloads at the Edge

Text Book:

1. Service-Oriented Architecture: Concepts, Technology and Design by Thomas Erl, 2005
2. Building Micro services by Sam Newman, 2nd Edition
3. Microservices Patterns: With examples in Java by Chris Richardson, 2018
4. SOA Security by Ramarao Kanneganti and Prasad Chodavarapu, Manning; First Edition

Reference Books:

1. SOA Using Java™ Web Services by Mark D. Hansen, Prentice Hall , 2007
2. SOA Design Pattern by Thomas Erl (The Prentice Hall Service-Oriented Computing Series from Thomas Erl) 1st Edition
3. Web service contract Design & Versioning for SOA by Thomas Erl PHI, 2008
4. SOA with .NET by Rajbalasubhramaniam Prentice Hall

e- Books:

1. https://www.arcitura.com/wp-content/uploads/2017/09/Erl_SOABook2_Ch07-2.pdf

MOOCs:

2. Service Oriented Architecture: https://www.coursera.org/learn/service-oriented-architecture

COURSE OUTCOMES (COs)

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

CO1	Acquire Knowledge of service oriented computing paradigm, its evolution and the emergence of web services.
CO2	Identify service descriptions suitable for implementing arrange of message exchange patterns.
CO3	Describe and explain quality of service aspects of web service provision, and show how these can be applied to Existing services to add value to them.
CO4	Develop a Web Service and Comms using modern tool on a given problem.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Web Technologies**				
Course Code	**23IS6OEWTS**	**Credits**	**3**	**L-T-P**	**3-0-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**3**	**Total Lecture Hours**	**40**		

UNIT - 1

XHTML: Evolution of HTML and XHTML, Basic syntax, Standard XHTML document structure, Basic Text Markup, Images, Hypertext links, Lists, Tables, Forms

Cascading Style sheet: Introduction, Levels of Style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, the Box Model, Background images

Unit2 **8 Hours**

JavaScript: Overview of JavaScript, Object orientation and JavaScript, General syntactic characteristics, Primitives, Operations and Expressions, Screen Output and Keyboard Input, Control statements, Object creation and modification, arrays, functions, constructor, pattern matching regular expressions.

JavaScript and XHTML Documents: JavaScript Execution Environment, The Document Object Model, Element Access in JavaScript, Events and Event Handling, Handling Events from Body Elements, Handling Events from Button elements, Handling Events from Text box and Password elements

UNIT - 3

Dynamic documents with JavaScript: Introduction to dynamic documents, positioning elements, moving elements, element visibility, changing colors and fonts, dynamic content, stacking elements, locating mouse cursor, reacting to a mouse click.

XML: Introduction to XML, Syntax, XML Document structure
Document type Definitions: Declaring Elements, Declaring Attributes, Declaring Entities, A Sample DTD, Internal and External DTDs, Namespaces
XML schemas: Schema Fundamentals, Defining a schema, Defining a Schema Instance, An overview of Data types, Simple types, complex types, Validating instances of Schemas Displaying raw XML documents, Displaying raw XML documents with CSS

Unit4 **8 Hours**

NodeJS: Introduction to Node JS

Using Events, Listeners, Timers and Callbacks in Node.js: Understanding the Node.js Event model, Adding work to the event queue, Implementing Callbacks

Accessing the File system from Node.js: Synchronous Versus Asynchronous File System calls, Opening and Closing files, Writing files, Reading files, Other file system tasks

Unit5	8 Hours

MongoDB:
Understanding NoSQL and MongoDB: Understanding MongoDB, MongoDB Data Types

Manipulating MongoDB Documents from Node.js: Understanding Database Change options, Understanding Database Update operators, Adding documents to a Collection, Getting Documents from a Collection, Updating Documents in a Collection, Automically modifying Documents in a Collection, Saving Documents in a Collection, Upserting Documenting in Collection, Deleting Documents from a Collection, Removing a Single Document from a Collection

Text Book:

1. Robert W. Sebesta, Programming the World Wide Web, 7th Edition, Pearson Education, 2013.
2. Brad Dayley, Brendan Dayley, Caleb Dayle: Node.JS, MongoDB and Angular Web Development: The Definitive guide to using the MEAN stack to build web applications, Pearson Educatin; Second Edition, 2018.

Reference Books:

1. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel., Internet & World Wide Web How to Program,5/e , Pearson Education , 2018.
2. M. Srinivasan, Web Technology: Theory and Practive, Pearson India, 2012.

e- Books:

1. https://books,goalkicker.com/NodeJSBook/
2. (web.tech 1st book) Web Technologies - A Computer Science Perspective.pdf (seu1.org)

MOOCs:

1. https://www.mooc-list.com/course/web-development-udacity?static=true
2. https://www.mooc-list.com/course/javascript-basics-udacity?static=true
3. https://www.mooc-list.com/course/intro-html-and-css-udacity?static=true

COURSE OUTCOMES (COs)

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

CO1	Acquire and apply knowledge of scripting, markup language to build web pages using HTML, CSS and JavaScript.
CO2	Identify appropriate web elements to prepare dynamic web pages.
CO3	Design user's specific markup language.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Data Structures and Algorithms**				
Course Code	**23IS6OEDSA**	**Credits**	**3**	**L-T-P**	**3-0-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**3**	**Total Lecture Hours**	**40**		

UNIT - 1

Introduction to Data Structures: Definition and its classification, Dynamic Memory Allocation
Linked List: Definition, Operations on Singly linked list, Types of linked list, Applications of Linked list.

UNIT – 2

Stacks: Definition, Stack Operations, Infix to Postfix, Evaluation of postfix
Recursion: Factorial, Fibonacci
Queues: Definition, Queue operations, Types of queues

UNIT - 3

Binary Search Trees: Definition, Traversals, Insertion, Deletion, Applications
Fundamentals of Algorithm Analysis: Framework for Analysis of algorithm efficiency, Asymptotic Notations, Mathematical Analysis of Non recursive algorithms and Recursive algorithms.

UNIT - 4

Brute Force: Bubble Sort and Selection Sort
Divide and Conquer: Merge sort, Quicksort
Decrease and conquer: Depth First Search (DFS), Breadth First Search (BFS)

UNIT - 5

Transform and Conquer: Heaps and Heap sort
Dynamic Programming: Floyd's Algorithm, Knapsack Problem
Space and Time Trade-offs: Hashing

Text Books:

1. Data Structures using C and C++ by Yedidyah, Augenstein, Tannenbaum, 2nd Edition, Pearson Education, 2015.
2. Introduction to the design and analysis of algorithms by Anany Levitin, third Edition, Pearson Education, 2017.

Reference Books:

1. Introduction to Algorithms, Cormen T.H, Leiserson C. E, Rivest rd R.L, Stein C, 3 Edition, PHI 2010.
2. Data Structures and Algorithm Analysis in C++, by Mark Allen rd Weiss, 3 Edition, Pearson Education, 2007.

e-Books:
1. https://faculty.washington.edu/jstraub/dsa/Master_2_7a.pdf 2. https://www2.cs.duke.edu/courses/fall08/cps230/Book.pdf
MOOCs:
1. https://www.coursera.org/specializations/data-structuresalgorithms 2. https://www.coursera.org/learn/algorithms-part1

COURSE OUTCOMES (COs)

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

CO1	Apply principles of Data Structures and Algorithm design techniques for solving problems.
CO2	Analyse and develop operations on linear and non-linear data structures and time complexity of different algorithms.
CO3	Develop solutions to computing problems using appropriate data structures and algorithm design techniques.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Cryptography And Network Security**				
Course Code	**23IS6OECNS**	**Credits**	**3**	**L-T-P**	**3-0-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**3**	**Total Lecture Hours**	**40**		

UNIT - 1

Introduction: Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for Network Security.

Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques – Caesar Cipher, Monoalphabetic Ciphers, Play fair Cipher, Hill Cipher, Polyalphabetic Ciphers, One-Time Pad, Transposition Techniques.

UNIT - 2

Block Ciphers: Traditional Block Cipher Structure – Stream Ciphers and Block Ciphers, Motivation for the Feistel Cipher Structure, The Feistel Cipher, Block Cipher Design Principles, The Simplified Data Encryption Standard (S-DES) – S-DES Encryption, S-DES Decryption, S-DES Key Generation.

Stream Ciphers: Stream Ciphers, RC4 – Initialization of S, Stream Generation, Strength of RC4.

UNIT - 3

Public-Key Cryptosystems: Principles of Public-Key Cryptosystems – Public-Key Cryptosystems, Applications for Public-Key Cryptosystems, Requirements for Public-Key Cryptosystems, Public-Key Cryptanalysis, The RSA Algorithm – Description of the Algorithm, Computational Aspects, The Security of RSA, Diffie-Hellman Key Exchange – The Algorithm, Key Exchange Protocols, Man-in-the-Middle Attack.

Cryptographic Hash Functions: Secure Hash Algorithm (SHA) – SHA-512 Logic

UNIT - 4

Key Management and Distribution

Symmetric key distribution using Symmetric encryption, A key distribution scenario, Hierarchical key control, session key lifetime, a transparent key control scheme, Decentralized key control, controlling key usage, Symmetric key distribution using asymmetric encryption, simple secret key distribution, secret key distribution with confidentiality and authentication, A hybrid scheme, distribution of public keys, public announcement of public keys, publicly available directory, public key authority, public keys certificates.

UNIT - 5

Digital Signatures

Digital Signatures – Properties, Attacks and Forgeries, Digital Signature Requirements, Direct Digital Signature, SCHNORR Digital Signature Scheme, NIST Digital Signature Algorithm

Transport-Level Security

Transport Layer Security – Architecture, Record Protocol, Change Cipher Spec Protocol, Alert Protocol, Handshake Protocol, Cryptographic Computations, Heartbeat Protocol, SSL/TLS Attacks, HTTPS – Connection Initiation, Connection Closure.

Text Book:

1. Cryptography and Network Security – Principles and Practice by William Stallings, Person, 7th Edition, 2017.

Reference Books:

1. Network Security Essentials Applications and Standards, William Stallings, Pearson, 4th Edition, 2012.
2. Network Security Private Communication in a Public world, Charlie Kaufman, Radia Perlman and Mike Speciner, 2nd Edition, PHI, 2013.
3. Network Security and Management, Brijendra Singh, 3rd Edition, PHI, 2013.

e- Books:

1. Cryptography and Network Security-Principles and Practice, William Stallings. https://dl.hiva-network.com/Library/security/Cryptography-and-network-securityprinciples- and-practice.pdf
2. Network Security. https://imcs.dvfu.ru/lib.int/docs/Networks/Security/Network%20Security%20Foundations.pdf

MOOCs:

1. Network Security, https://www.mooc-list.com/course/network-security-wma
2. Cryptography 1, https://www.coursera.org/learn/crypto
3. Applied Cryptography, https://www.coursera.org/specializations/applied-crypto

COURSE OUTCOMES (COs)

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

CO1	Understand the basic concepts of classical encryption techniques, block ciphers, stream ciphers, cryptographic functions, key management.
CO2	Apply the knowledge of classical encryption techniques to solve cryptographic problems, public key cryptosystems, hash functions and key distribution techniques
CO3	Analyze the structure of various block ciphers, stream ciphers, transport level security, and digital signatures.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	Robotic Process Automation Design And Development				
Course Code	23IS6OERPA	Credits	3	L-T-P	3-0-0
CIE	50	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	3	Total Lecture Hours	40		

UNIT - 1
Introduction: What is Robotic Process Automation? **Scope and Techniques of Automation:** What should be automated?, What can be automated?, Techniques of automation. **Robotic Process Automation:** What can RPA do?, Benefits of RPA, Components of RPA, RPA platforms, The future of Automation. **Record and Play:** About UiPath, Downloading and Installing UiPath Studio, UiPath Stack, Learning UiPath Studio, Task Recorder, Emptying trash in Gmail, Emptying Recycle Bin.
UNIT - 2
Sequence, Flowchart and Control Flow: Sequencing the Workflow, Activities, Control flow, various types of loops, and decision making, how to use a sequence, how to use a flowchart, step by step example using sequence and control flow. **Data Manipulation:** Variables and scope, Collections, Arguments-purpose and use, Data table usage with examples, Clipboard management, File operation with step-by-step example. CSV/Excel to data table and vice versa examples.
UNIT - 3
Taking control of the controls: Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls-mouse and keyboard activities, working with UiExplorer, Handling events, Revisit recorder, Screen scraping, When to use OCR?, Types of OCR available, How to use OCR?, Avoiding typical failure points. **Tame that Application with Plugins:** Mail plugin, PDF plugin, web integration, Excel and Word plugins, Credential management.
UNIT - 4
Handling User Events and Assistant Bots: What are assistant bots?, Monitoring system event triggers, Monitoring image and element triggers, Launching an assistant bot on a keyboard event.

Exception Handling, Debugging, and Logging Exception handling: Common exceptions and ways to handle them, Logging and taking screenshots, Debugging techniques, Collecting crash dumps, Error reporting.

UNIT - 5

Managing and Maintaining the Code: Project Organization, Nesting workflows, Reusability of workflows, Commenting techniques, State Machine, When to use Flowcharts?, State Machines or sequences, Using config files and examples of a config file.
Deploying and Maintaining the Bot: Publishing using publish utility, Overview of Orchestration Server, Using Orchestration Server to control bots, Using Orchestration Server to deploy bots.

Text Books:

1. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing Release Date: March 2018 ISBN: 9781788470940

Reference Books:

1. Tom Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems,2020, ISBN-13 (electronic): 978-1-4842-5729-6, Publisher: A Press.
2. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, "Introduction to Robotic Process Automation: A Primer", Institute of Robotic Process Automation.

e- Books:

1. https://www.uipath.com/rpa/robotic-process-automation.
2. https://www.packtpub.com/product/learning-robotic-process-automation/9781788470940.

MOOCs:

1. https://www.uipath.com/learning/video-tutorials.
2. https://www.guru99.com/uipath-tutorial.html.

COURSE OUTCOMES (COs)

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

CO1	To understand the basic concepts of RPA.
CO2	Analyze the usage of appropriate Robotic Process Automation technique for a given application.
CO3	Design and implement techniques of Robotic Process Automation for the given application.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Project work -1**				
Course Code	**23IS6PWPW1**	**Credits**	**2**	**L-T-P**	**0-0-2**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours / Week	**4**				

About the Course: Students must form a team of minimum two or maximum three members and enroll for Capstone Project-1. Each team must develop the Capstone Project proposal on a question or problem of their choice by carrying out a detailed literature Survey under the guidance of a faculty mentor, and secure approval of the proposal from a faculty mentor and the Capstone Project instructor.

During phase I, the project student team will initially identify a potential engineering problem either from industry/research/societal perspective in the niche technology. A detailed literature survey, requirements identification, requirements elicitation, high level and low level designs has to be carried out for the identified problem. The students also have to prepare a project report.

A team should comprise a minimum of two and maximum of three members.

- Internship projects are not allowed.
- Simple database related projects are not allowed.

Scheme of Evaluation

The Capstone Project-1 CIE is evaluated in two phases based on the rubrics.

Review-1: will be evaluated based on the following parameters: Preliminary study, Literature survey, problem formulation, Motivation and Objectives.

Review-2: will be evaluated based on the following parameters: Requirements Identification and Elicitation, High level and Low level designs, documentation and presentation. Change of title is permitted during review-2 only upon panel recommendations

Panel	
Review 1	Guide
Review 2	Guide + UG Project Coordinator + Industry Person

The rubrics for Review 1 and Review 2 will be framed by the internal committee composed of HOD, UG NBA Coordinator, UG Project Coordinator, One Professor, One Associate Professor and One Assistant Professor.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Full Stack Development**				
Course Code	**23IS6AEFSD**	**Credits**	**1**	**L-T-P**	**0-0-1**
CIE	**50**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**2**	**Total Lecture Hours**	**25**		

Working with in-demand Full Stack Development skills like HTML, CSS, JavaScript, React.js, NodeJS etc. It is designed to give an essence of Front-end, Middleware, Backend and Testing with web developer technologies applying on real time projects.

- Building expertise in developing Front End Application using HTML,CSS,JavaScript along with jQuery and AngularJS framework or with the latest framework and technologies such as NodeJS, .
- Exploring MVC architecture and implementing responsive web applications which will scale well across PC, Tablet and Mobile.
- Creating Databases and Users, Inserting, Retrieving and Updating Data into the Databases.
- Setting up a connection and Querying the Databases.
- Deploying and hosting web applications.
- Securing web applications.

Projects

Students should develop a full-fledged interactive web application by using the latest web

Text Books:

1. “Full Stack Web Development” The Comprehensive Guide, 740 pages by Philip Ackermann, ISBN 978-1-4932-2437.

COURSE OUTCOMES (COs)

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

CO1	To understand the basic concepts of Front and back end tools.
CO2	Analyze the usage of appropriate constructs to design the web pages.
CO3	Design and development of solutions for real time problems.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Green Computing**				
Course Code	**23IS7PCGCT**	**Credits**	**2**	**L-T-P**	**2-0-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**2**	**Total Lecture Hours**	**25**		

UNIT - 1

Green IT Overview: Introduction, Environmental Concerns and Sustainable Development, Environmental Impacts of IT, Green I, Holistic Approach to Greening IT, Greening IT, Applying IT for Enhancing Environmental Sustainability, Green IT Standards and Eco-Labelling of IT, Enterprise Green IT Strategy, Green Washing, Green IT: Burden or Opportunity? Green Devices and Hardware: Introduction, Life Cycle of a Device or Hardware, Reuse, Recycle and Dispose.

UNIT - 2

Green Software: Introduction, Processor Power States, Energy-Saving Software Techniques, Evaluating and Measuring Software Impact to Platform Power.

Sustainable Software Development: Introduction, Current Practices, Sustainable Software, Software Sustainability Attributes, Software Sustainability Metrics, Sustainable Software Methodology, Defining Actions.

UNIT - 3

Green Data Centres: Data Centres and Associated Energy Challenges, Data Centre IT Infrastructure, Data Centre Facility Infrastructure: Implications for Energy Efficiency, IT Infrastructure Management, Green Data Centre Metrics.

UNIT - 4

Green Networks and Communications: Introduction, Objectives of Green Network Protocols, Green Network Protocols and Standards

Enterprise Green IT Strategy: Introduction, Approaching Green IT Strategies, Business Drivers of Green IT Strategy, Business Dimensions for Green IT Transformation, Organizational Considerations in a Green IT Strategy, steps in Developing a Green IT Strategy, Metrics and Measurements in Green Strategies.

UNIT - 5

Sustainable Information Systems and Green Metrics: Introduction, Multilevel Sustainable Information, Sustainability Hierarchy Models, Product Level Information, Individual Level

Information, Functional Level Information, Organizational Level Information, Measuring the Maturity of Sustainable ICT.
Text Book:
1. Harnessing Green IT: Principles and Practices, San Murugesan, G. R. Gangadharan, Wiley & IEEE, 2012.
Reference Books:
1. Green Computing: Tools and Techniques for Saving Energy, Money, and Resources Bud E.Smith CRC Press. 2. Green Communications: Principles, Concepts and Practice- Samdanis et al, J. Wiley.
e- Books:
1. https://tinyurl.com/yb5tutng. 2. http://dsc.soic.indiana.edu/publications/11-greenit-bookch.pdf.
MOOCs:
1. https://www.athabascau.ca/syllabi/comp/comp635.php 2. https://www.apus.edu/schedule-classes/schedule/course/issc387

COURSE OUTCOMES (COs)

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

CO1	Create awareness about Green Software, Sustainable Software Development and Enterprise Green IT Strategy in the IT working environment leading to green computing.
CO2	Apply the various methodologies to measure the sustainable performance of software projects
CO3	Analyse sustainability challenges associated with data center and strategies to mitigate energy consumption.
CO4	Analyse information requirements and methods utilized at multilevel sustainable information.
CO5	Apply the green IT approaches and methods to engage in the changing world of IT.
CO6	Propose solutions for various case studies in Green Computing.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**PROJECT MANAGEMENT, ENTREPRENEURSHIP**				
Course Code	**23IS7PCPME**	**Credits**	**2**	**L-T-P**	**2-0-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**2**	**Total Lecture Hours**	**25**		

UNIT - 1
Definitions of Project and Project Management, Issues and Problems in Project Management, Project Life Cycle - Initiation / Conceptualisation Phase, Planning Phase, Implementation / Execution Phase, Closure / Termination Phase.
UNIT – 2
Project Feasibility Studies – Pre-Feasibility and Feasibility Studies, Preparation of Detailed Project Report, Technical Appraisal, Economic/Commercial/Financial Appraisal including Capital Budgeting Process, Social Cost Benefit Analysis. Project Planning – Importance of Project Planning, Steps of Project Planning, Project Scope, Work Breakdown Structure (WBS) and Organisation Breakdown Structure (OBS), Phased Project Planning.
UNIT - 3
Project Scheduling and Costing – Gantt Chart, CPM and PERT Analysis, Identification of the Critical Path and its Significance, Calculation of Floats and Slacks, Crashing, Time Cost Trade-off Analysis, Project Cost Reduction Methods. Project Monitoring and Control – Role of Project Manager, MIS in Project Monitoring, Project Audit.
UNIT - 4
Introduction: Meaning and Concept of Entrepreneurship, Innovation and Entrepreneurship, Contributions of Entrepreneurs to the Society, Risk-Opportunities Perspective and Mitigation of Risks. Entrepreneurship – An Innovation: Challenges of Innovation, Steps of Innovation Management, Idea Management System, Divergent v/s Convergent Thinking, Qualities of a Prospective Entrepreneur.
UNIT - 5
Idea Incubation: Factors Determining Competitive Advantage, Market Segment, Industry and Competitor Analysis (Market Structure, Market Size, Growth Potential), Demand-supply Analysis. Entrepreneurial Motivation: Design Thinking - Driven Innovation, TRIZ (Theory of Inventive Problem Solving)

Text Books:

1. Entrepreneurship and Project Management by Dr. S. N. Banerjee, Thakur Publications Pvt. Ltd
2. Entrepreneurship Development - S. S. Khanka, S. Chand & Co. New Delhi.
3. Gray, Clifford F., Larson, Eric W., and Desai, Gautam V. Project Management: The Managerial Process. McGraw Hill Education.

Reference Books:

1. Vasanta Desai: Entrepreneurial development, and Management, 13th edition, Himalaya pub., Harper Collins, edition- Paperback.
2. UNIDO: Guidelines for Project Evaluation, United Nations, reprinted,1993..
3. Manual for the preparation of Industrial Feasibility Studies, United Nations 1995.
4. Manual for Evaluation of Industrial Projects, United Nations, reprinted on 1993..

COURSE OUTCOMES (COs)

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

CO1	Comprehend the concepts and principles of project management systems, nature and functions of entrepreneur, legal and financial conditions for starting a business venture.
CO2	Analyse essential skills in project planning, scheduling, costing, risk analysis, performance evaluation, and innovation management to successfully develop and execute entrepreneurial ventures.
CO3	Apply key entrepreneurial concepts, creativity, and strategic planning to develop business ideas, analyze the entrepreneurial process, and evaluate project management techniques using case studies.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Cyber Security and Cyber Law**				
Course Code	**23IS7PCCSL**	**Credits**	**2**	**L-T-P**	**2-0-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**2**	**Total Lecture Hours**	**25**		

UNIT - 1
Cyber Security Engineering: Lifecycle Assurance of Systems and Software -Introduction, Lifecycle Assurance, Principles for Software Assurance, Addressing Lifecycle Assurance, Case Studies.
UNIT – 2
Cyber Crimes - Introduction to Cybercrime : Introduction, cybercrime : Definition and origins of the word, cybercrime and information security, cyber criminals, Classification of cybercrimes, The legal perspectives, cybercrime : An indian perspective. cybercrime, A Global perspective on cybercrimes, cybercrime era: survival mantra for the netizens, Case studies.
UNIT - 3
Machine Learning approaches for Cyber Security analytics - Tools and Techniques : Machine Learning and Cybersecurity-Introduction,Spam Detection, Phishing Page Detection, Malware Detection, DoS and DDoS Attack Detection, Anomaly Detection, Biometric Recognition, Software Vulnerabilities .
UNIT - 4
Cyber Law - An Introduction, Definition of Cyber Law, Why cyberlaw in India. **Preliminary & Digital Signature -** Objectives, Section 1,2,3 **Electronic Governance -** Section 4, 5,6,7,8 **Attribution, Acknowledgement and Despatch of Electronic Records -** Section 11 **Classification of offences detailed under IT Act, 2000 -** Section 65,66,67,68,69,70,71,72
UNIT - 5
Data Privacy and Protection : Obligations of Data Fiduciary - Grounds for processing personal data, Certain legitimate uses, General obligations of Data Fiduciary, Processing of personal data of children, Additional obligations of Significant Data Fiduciary. Rights and Duties of Data Principal -

Right to access information about personal data , Right to correction and erasure of personal data, Right of grievance redressal. , Right to nominate, Duties of Data Principal, SPECIAL PROVISIONS - Processing of personal data outside India, Exemptions.

Text Books:

1. Cyber Security Engineering- A Practical Approach for Systems and Software Assurance by Nancy R. Mead, Carol C. Woody, Addison Wesley. Unit 1 (chapter 1)
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. - Unit 2 (chapter 1)
3. Machine Learning Approaches in Cyber Security Analytics by Tony Thomas, Athira P. Vijayaraghavan and Sabu Emmanuel – Unit 3
4. Cyber Law by Pavan Duggal Unit -4 (Chapter 1, 3,4)
5. Digital Personal Data Protection Act 2023.pdf (meity.gov.in)-- Unit -5 (chapter 2,3,4,9)

Reference Books:

1. Security in the Digital Age : Social Media Security Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform.
2. Data Privacy Principles and Practice by Natraj Venkataraman and Ashwin Shiram, CRC Press.

e-Books:

1. Introduction to Cyber Security (uou.ac.in)
2. Cybersecurity Law by Jeff Kosseff (z-lib.org).pdf (unidel.edu.ng)

e-Resources

1. IT Act 2000: Objectives, Features, Amendments, Sections, Offences and Penalties (cleartax.in)
2. Cyber Security Tutorial (geeksforgeeks.org)
3. Cyber law – it act 2000,it act 2008 | PPT (slideshare.net)
4. Information Technology Act, 2000 - iPleaders
5. IT Act,2000 - Law | PPT (slideshare.net)
6. Cyber-Security-Books/README.md at master · manjunath5496/Cyber-Security-Books · GitHub
7. Microsoft Word - 1F Duggal (bvuict.in)

MOOCs:

1. Cybersecurity for Everyone | Coursera
2. Foundations of Cybersecurity | Coursera
3. Introduction to Cybersecurity Fundamentals | Coursera
4. Introduction to Cybersecurity Tools & Cyberattacks | Coursera

COURSE OUTCOMES (COs)

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

CO1	Comprehend the concepts of Cyber Security, Cyber Law, Data privacy, Tools & Techniques.
CO2	Analyze various approaches for Cyber crime attack using security tools and techniques for feasible solutions
CO3	Apply and evaluate cyber law for cybercrime and cybersecurity issues.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**INDIAN KNOWLEDGE SYSTEMS (Theory) (Common to All UG Programs)**				
Course Code	**25MA7HSIKL**	**Credits**	1	**L-T-P**	**1-0-0**
CIE	**50 Marks**	**SEE**	**50 Marks (50% Weightage)**		
Contact Hours/ Week	**1**	**Total Lecture Hours**	**15**		

Unit-1
Introduction to Indian Knowledge Systems (IKS): Overview, Vedic Corpus, Philosophy, Character scope and importance, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge vs. western knowledge.
Unit – 2
Traditional Knowledge in Humanities and Sciences: Linguistics, Number and measurements-Mathematics, Chemistry, Physics, Art, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology.
Unit -3
Traditional Knowledge in Professional domain: Town planning and architecture-Construction, Health, wellness and Psychology-Medicine, Agriculture, Governance and public administration, United Nations Sustainable development goals.

Reference Books	
1	**Introduction to Indian Knowledge System- concepts and applications**, B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N, 2022, PHI Learning Private Ltd, ISBN-978-93-91818-21-0
	Traditional Knowledge System in India, Amit Jha, 2009, Atlantic Publishers and Distributors (P) Ltd., ISBN-13: 978-8126912230,
2	**Knowledge Traditions and Practices of India**, Kapil Kapoor, Avadesh Kumar Singh, Vol. 1, 2005, DK Print World (P) Ltd., ISBN 81-246-0334,
	Suggested Web Links:
1.	**https://www.youtube.com/watch?v=LZP1StpYEPM**
2.	**http://nptel.ac.in/courses/121106003/**
3.	http://www.iitkgp.ac.in/department/KS;jsessionid=C5042785F727F6EB46CBF432D7683B63 (Centre of Excellence for Indian Knowledge System, IIT Kharagpur)
4.	https://www.wipo.int/pressroom/en/briefs/tk_ip.html
5.	https://unctad.org/system/files/official-document/ditcted10_en.pdf
6.	http://nbaindia.org/uploaded/docs/traditionalknowledge_190707.pdf
7.	https://unfoundation.org/what-we-do/issues/sustainable-development-goals/?gclid=EAIaIQobChMInp-Jtb_p8gIVTeN3Ch27LAmPEAAYASAAEgIm1vD_BwE

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ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50% (CIE)**	**50%(SEE)**
QUIZZES		
Quiz-I Quiz-II	Each quiz is evaluated for 05 marks adding up to **10 Marks.**	*****
THEORY COURSE - (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I Test – II	Each test will be conducted for 25 Marks adding upto 50 marks. Final test marks will be reduced to **20 Marks**	*****
EXPERIENTIAL LEARNING	**20**	*****
Case Study-based Teaching-Learning	--	*****
Sector wise study & consolidation (viz., Engg. Semiconductor Design, Healthcare & Pharmaceutical, FMCG, Automobile, Aerospace and IT/ ITeS)	--	
Video based seminar (4-5 minutes per student)	--	
Maximum Marks for the Theory	---	**50 Marks**
Practical	--	--
Total Marks for the Course	**50**	**50**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Provide an overview of the concept of the Indian Knowledge System and its importance.
CO2:	Appreciate the need and importance of protecting traditional knowledge.
CO3:	Recognize the relevance of Traditional knowledge in different domains.
CO4:	Establish the significance of Indian Knowledge systems in the contemporary world.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	-	-	-	-	3	-	-	-	1
CO2	-	-	-	-	-	2	-	-	-	-	-	-
CO3	-	-	2	2	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	3	2	-	-	-	-	-

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**DEVOPS**				
Course Code	**23IS7PEDVS**	**Credits**	**2**	**L-T-P**	**0-1-2**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**4**	**Total Lecture Hours**	**48**		

About the Course: The students will learn the fundamentals of DevOps framework. The course would include two lab cycles and a project work.

During Cycle 1, students would be able to build CI/CD pipeline using Git and Jenkins.

In cycle 2, students will be exposed to containerization with Docker and Kubernetes. They will also be able to use Grafana to setup a monitoring solution for an application.

In the project phase, student teams will work to build an application and deploy the same to an environment using DevOps tools.

Reference Books:

1. Accelerate: The Science of Lean Software and DevOps, Nicole Forsgren, Jez Humble, and Gene Kim, IT Revolution, 2018
2. The DevOps Handbook, Gene Kim, Jez Humble, Patrick Debois, and John Willis, IT Revolution, 2016
3. The DevOps 2.0 toolkit: Automating the Continuous Deployment Pipeline with Containerized Microservices, Viktor Farcic, 2016
4. Cloud Native DevOps with Kubernetes, John Arundel and Justin Domingus, O'Reilly, 2019

MOOCs:

1. https://www.edx.org/professional-certificate/linuxfoundationx-introduction-to-devops- practices-and-tools
2. https://www.coursera.org/learn/version-control-with-git
3. https://www.coursera.org/learn/continuous-integration
4. https://www.coursera.org/learn/kubernetes-deployment

COURSE OTCOMES (CO's)

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

CO1	Understand the concepts of DevOps , Docker Containerization, Micro service Architecture, CI/CD pipeline, Version control with Git,workflows of Git, Jenkins	
CO2	To get acquainted with containerization with Docker and Kubernetes and apply the same for various applications	PO1
CO3	To build applications using Git and Jenkins tools. Use of Grafana tool to setup a monitoring solution for an application.	PO3, PO5
CO4	To deploy an application to an environment using DevOps tools.	PO2, PO3, PO5, PO12

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Internet Of Things**				
Course Code	**23IS7PEIOT**	**Credits**	3	**L-T-P**	0-1-2
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	4	**Total Lecture Hours**	52		

UNIT – 1
Introduction to Internet of Things: Introduction: Definition and Characteristics of IoT, Physical Design of IoT: Things in IoT, IoT Protocols, Logical Design of IoT: IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication protocols, Communication Protocols, Embedded Systems, IoT Levels and Deployment Templates. IoT Applications: Introduction, Home Automation, Smart Metering/Advanced Metering Infrastructure-Health/Body Area Networks, City Automation, Smart Cards, Tracking, Surveillance system, Environment, Energy, Retail, Logistics, Agriculture, Industry and Health care and Lifestyle.
UNIT – 2
Prototyping IoT Objects Using Microprocessor/Microcontroller Working principles of sensors and actuators – Setting up the board - Programming for IOT – Reading from Sensors, Communication: Connecting microcontroller with mobile devices – communication through Bluetooth, Wi-Fi, Ethernet, Zigbee, RFID, NFC.Case Study and IoT Application Development: IoT applications in home- infrastructures- security-Industries- IoT electronic equipment.. Use of Big Data and Visualization in IoT-Industry 4.0 concepts - Sensors and sensor Node –Interfacing using Raspberry Pi/Arduino- Web Enabled Constrained Devices.
UNIT – 3
Writing Code: building a program and deploying to a device, writing to Actuators, Blinking Led, Reading from Sensors, Light Switch, Voltage Reader, Device as HTTP Client, HTTP, Push Versus Pull Pachube, Netduino,
UNIT – 4
Sending HTTP Requests—The Simple Way, Sending HTTP Requests— The Efficient Way HTTP: Device as HTTP Server, Relaying Messages to and from the Netduino, Request Handlers, Web Html, Handling Sensor Requests, Handling Actuator Requests Going Parallel: Multithreading, Parallel Blinker, prototyping online components, using an API, from prototypes to reality, business models, ethics, privacy, disrupting control, Crowdsourcing.
UNIT – 5
Edge Computing: Introduction, Key benefits of edge for IOT, Unique Requirements of Edge for the IoT,EdgeUse Cases for IoT Edge,Security.

Text Books :
1. Adrian McEwen and Hakim Cassimally, ―Designing the Internet of Things‖, John Wiley & Sons, 2013. 2. Cuno Pfister, ―Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud‖, Maker Media, 2011. 3. Arshdeep Bahga, Vijay Madisetti, "Internet of Things (A Hands-On-Approach)", VPT,2014.
Reference Books :
1. Internet of Things from Versa Technology
e-Books : 1. https://www.iotforall.com/free-intro-ebook-on-the-internet-of-things/
MOOCs: 1. https://www.coursera.org/specializations/internet-of-things **2.** https://nptel.ac.in/courses/106/105/106105166/

COURSE OUTCOMES (COs)

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

CO1	Understand characteristics such as design, communication model, prototyping and enabling technologies required to develop application of IOT.	
CO2	Apply in-depth knowledge of Internet of Things in Identifying the appropriate sensors and actuators with microcontrollers and porting the data to cloud, web site for given applications.	PO1
CO3	Identify the appropriate sensors and actuators to solve a given use-case.	PO2
CO4	Conduct experiments using modern tools like Arduino boards and sensors, actuators, and related softwares to solve given problems.	PO5
CO5	Design and develop IOT applications for solving real world problems.	PO3
CO6	Communicate effectively in a team and investigate on the topics related to IOT.	PO9, PO10

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Mobile Computing And 5g Technologies**				
Course Code	**23IS7PEM5G**	**Credits**	3	**L-T-P**	0-1-2
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	4	**Total Lecture Hours**	**48**		

UNIT – 1
Basics of Mobile Computing: Introduction to Mobile Computing, Seeding of 1G, Digitization with 2G, Mobile Internet with 3G, Faster Mobile Networks with 4G, Cellular Network. Cellular Call Handoffs, Circuit Switched and Packet Switched Networks.
UNIT – 2
5G Basics and Features: Rationale of 5G, 5G Metrics, Typical Mobile Architecture, 5G New Radio -Millimeter Waves, Beamforming, Multiple Access, Antenna ,MIMO and Massive MIMO, Benefits of MIMO.
UNIT – 3
5G Deployment Architecture: SA and NSA, 5G Core Architecture - Service Based Architecture, Point-to-Point Interface, O-RAN, C-RAN, v-RAN. 5G Core Elements - Access and Mobility Function, Session Management Function, User Plan Function, Network Repository Function, Unified Data Management Function, AUSF, EIR, Policy Control Function, Identifiers in 5G, Call Flows.
UNIT – 4
5G Technology Enablers Basics: Data Centers, Virtualization, Microservices, Cloud Native, Containers, Dockers, Orchestration, Automation, SDN, Infrastructure as Code, Dockers.
UNIT – 5
Security in 5G: Security Attacks, Software Architecture, Application Performance, Interconnecting with 5G.
Text Books :
1. Wireless and Mobile Network Architectures, by Yi-Bing Lin, Imrich Chlamtac,WILEYINDIA Edition. 2. 5G Mobile and Wireless Communications Technology, Edited By Afif Osseiran,Ericsson Jose F. Monserrat, Patrick Marsch , Nokia . 3. Fundamentals of 5G Mobile Networks, Edited by: Jonathan Rodriguez. 4. An Introduction to 5G Wireless Networks: Technology, Concepts and Use-Cases , Edited By Saro Velrajan.
Reference Books :
1. Key Technologies for 5G Wireless Systems,Edited by Vincent.W.Wong, Robert Schober, Derrick Wing Kwan Ng, Li-Chun Wang, 2. Mobile Computing-Technology,Applications and Service Creation byAsoke K Talukder, Hasan Ahmed, Roopa R Yavagal, 2nd Edition, 2014, Mc Graw Hill Education 3. Mobile Communications, Jochen Schiller, 2nd Edition.

MOOCs:

1. https://www.coursera.org/lecture/smart-device-mobile-emerging-technologies/4-6-5g-technology-5ud4z
2. https://www.coursera.org/lecture/smart-device-mobile-emerging-technologies/4-7-5g-architecture-6KzD8
3. https://swayam.gov.in/nd1_noc20_ee61/preview

Lab Work:

- 5G Network / Core Simulation
  - Python-Based
    - https://github.com/rodrigo-tinini/5GPy
    - https://pypi.org/project/sim2net/
  - R-based 5G Infra Generator
    - https://github.com/MartinPJorge/mec-generator/tree/5g-infra-gen
    - Study above R-based simulator and convert it into a Python-based simulator.
- NFV Services
  - Demonstrate DNS/DHCP/IDS Services using Faucet
    - Install OpenSwitch http://www.openvswitch.org/
    - Use Faucet https://docs.faucet.nz/en/latest/intro.html
    - NFV Services Tutorial using Faucet https://docs.faucet.nz/en/latest/tutorials/nfv_services.html#
- REST APIs and Principles
  - 5G API Use Case-1: Establish Packet Data Unit
  - 5G API Use Case-2: Access Subscriber Information
- Reference
  - https://github.com/calee0219/awesome-5g
  - https://github.com/cerob/slicesim

COURSE OUTCOMES (COs)

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

CO1	Understand the basic concepts of Mobile computing and Cellular Network and basics of 5G.
CO2	Interpret the various use cases and requirements of 5G and, Annotating the various architectures, 5G functional architecture, 5G New Radio, Spectrum bandwidth and Security attacks.
CO3	Illustrate the various strategies used in the implementation of 5G functionalities using 5G Technology Enablers
CO4	Simulate wireless communication network by using modern tools and provide the analysis for the obtained results to arrive at substantial conclusions by communicating effectively as a member of diverse team.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Data visualization and reporting**				
Course Code	**23IS7PEDVR**	**Credits**	**03**	**L-T-P**	**0-1-2**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**03**	**Total Lecture Hours**	**40**		

The students should work with given dataset and create effective visualizations. The course will be executed in two cycles and a project work.

Cycle 1:

The students would be able to implement the key visualization techniques using Python tools like Matplotlib, Seaborn etc.

1. Matplotlib
    1. Different types of plots: Line, Bar, Horizontal bar, Scatter plot, Stacked bar, Box plot etc.
    2. Subplots,
    3. Legends and annotations
    4. Pie chart, Histograms, Fill between

2. Seaborn
    a. Relational plot
    b. Distributed plot
    c. Categorical plot

Cycle 2:

Students will be exposed to industry-standard software tools like Tableau, Google Data Studio etc. to create compelling and interactive visualization of various types of data.

1. Tableau basics, Joins, Filtering, sorting, groups, sets, measure names and values, Table calculations, Charts, Story etc.

Text Books:

1. Data Analysis and Visualization Using Python: Analyze Data to Create Visualizations for BI Systems, Embarak, D. O, Germany: Apress, 2018
2. Pro Tableau: A Step by Step Guide, Seema Acharya, Subhashini Chellappan, Apress, 2016

Reference Books:

1. Python Data Visualization Cookbook, Igor Milovanović , Dimitry Foures , Giuseppe Vettigli, 2nd Edition 2015
2. Practical Tableau, Ryan Sleeper, O'Reilly, 1st Edition,2018

e- Books:

1. Data Visualization with Python and JavaScript, Kyran Dale, O'Reilly,2016 https://github.com/jllovet/dataviz-with-py-and-js
2. Jumpstart Tableau: A Step-by-Step Guide to Better Data Visualization, Arshad Khan, Apress, 2016

https://link.springer.com/book/10.1007/978-1-4842-1934-8
MOOCs:
1. https://www.coursera.org/learn/python-for-data-visualization **2. https://www.udacity.com/course/data-visualization-in-tableau--ud1006** **3. https://www.coursera.org/professional-certificates/ibm-data-science**

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to.

CO1	Design and create effective data visualizations using Python.
CO2	Apply data transformations such as Joins, filtering, sorting, aggregation etc., for visualization using industry-standard software tools.
CO3	Identify opportunities for application of data visualization in various domains and communicate the results for documentation and interpretation

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Introduction to Cyber Security**				
Course Code	**23IS7OEICS**	**Credits**	**03**	**L-T-P**	**3-0-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**03**	**Total Lecture Hours**	**40**		

UNIT – 1
Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals?, Classifications of Cybercrimes, Cybercrimes: An Indian Perspective, Hacking and the Indian Laws, A Global Perspective on Cybercrimes. Textbook 1: Chapter 1 (1.1 to 1.5, 1.7-1.9)
UNIT – 2
Cyber Offenses: How Criminals Plan Them Introduction, How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector. Textbook 1: Chapter 2 (2.1 to 2.7)
UNIT – 3
Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key Loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, Attacks on Wireless Networks. Textbook 1: Chapter 4 (4.1 to 4.9, 4.12)
UNIT – 4
Phishing and Identity Theft: Introduction, Phishing: Methods of Phishing, Phishing Techniques, Spear Phishing, Types of Phishing Scams, Phishing Toolkits and Spy Phishing, Phishing Countermeasures, Identity Theft (ID Theft): Personally Identifiable Information, Types of Identity Theft, Techniques of ID Theft, Countermeasures, How to Efface your Online Identity. Textbook 1: Chapter 5 (5.1. to 5.3)
UNIT – 5
Understanding Computer Forensics: Introduction, Historical Background of Cyberforensics, Digital Forensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidence, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics. Textbook 1: Chapter 7 (7.1. to 7.5, 7.7 to 7.9)

Text Book:
1. Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt. Ltd., 2015.
Reference Books:
1. Surya Prakash Tripathi, Ritendra Goyal, and Praveen Kumar Shukla, "Introduction to Information Security and Cyber Laws", Dreamtech Press, 2015. 2. James Graham, Ryan Olson, and Rick Howard, "Cyber Security Essentials", CRC Press, 2010.
e-Books:
1. https://www.simplilearn.com/introduction-to-cyber-security-beginners-guide-pdf 2. https://www.simplilearn.com/enterprise-cyber-security-framework-guide-pdf
MOOCs:
1. https://www.mooc-list.com/course/digital-safety-and-security-coursera 2. https://www.mooc-list.com/course/introduction-cybersecurity-foundations-coursera

COURSE OUTCOMES (COs)

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

CO1	Identify and describe different types of cybercrime, including hacking, identity theft, phishing, malware, and cyberstalking.	-
CO2	Identify various cyber offenses and crimes committed by cybercriminals, including hacking, data breaches, and online fraud.	PO2
CO3	Gain a comprehensive understanding of computer forensics, including the collection, analysis, and preservation of digital evidence for legal purposes.	PO1
CO4	Examine the different tools and methods used in cybercrime, such as malware, social engineering, and encryption.	PO1
CO5	Evaluate the risks and consequences of phishing and identity theft, and explore preventive measures to protect personal and financial information.	PO2

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	Artificial Intelligence				
Course Code	23IS7OEAIS	Credits	3	L-T-P	3-0-0
CIE	50	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	3	Total Lecture Hours	40		

UNIT – 1
Introduction: What is AI? **Intelligent Agents:** How agent should act, Structure of Intelligent Agents, Environments. **Problem Solving:** Formulating Problems, Example Problems. **Uniformed-Search Strategies:** Breadth-First Search, Uniform Cost Search, Depth-First Search, Depth Limited Search, Iterative Deepening Search.
UNIT – 2
Heuristic Search Strategies: Generate-and-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis.
UNIT – 3
Knowledge Representation: Propositional Logic – Syntax and Semantics, Using Propositional Logic, First-Order Logic – Syntax and Semantics, Using First-Order Logic. **Representing Knowledge using Rules:** Procedural Versus Declarative Knowledge, Forward Versus Backward Reasoning.
UNIT – 4
Uncertain Knowledge & Reasoning: Acting under Uncertainty, Basic Probability Notation, The Axioms of Probability, Bayes' Rule and its Use, Where do Probabilities come from?, Representing Knowledge in an Uncertain Domain, The Semantics of Belief Networks.
UNIT – 5
Introduction to Expert Systems: Definition, Features of an Expert System, Organization, Characteristics, Prospector, Knowledge Representation in Expert Systems, Expert System Tools – MYCIN, EMYCIN.

Text Book:

1. Artificial Intelligence - A Modern Approach, Stuart Russell and Peter Norvig, Third Edition, Pearson, 2014.

Reference Books:
1. Artificial Intelligence, Elaine Rich, Kevin Knight and Shivashankar B Nair, Third Edition, McGraw-Hill Education, 2015. 2. Introduction to Artificial Intelligence and Expert Systems, Dan W Patterson, Pearson, 2015.
e-Books:
1. http://www.e-booksdirectory.com/details.php?ebook=9845 2. http://www.e-booksdirectory.com/details.php?ebook=5643
MOOCs:
1. https://www.edx.org/course/artificial-intelligence-uc-berkeleyx-cs188-1x 2. https://www.udacity.com/course/intro-to-artificial-intelligence--cs271 3. https://www.class-central.com/subject/ai

COURSE OUTCOMES (COs)

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

CO1	Understand the concept of agents, environments, search strategies, reasoning, logic and probabilities.
CO2	Solve problems using uninformed and informed search strategies.
CO3	Represent procedural and declarative knowledge by applying agent-based rules.
CO4	Provide logic-based analysis for question and answering techniques.
CO5	Formulate probabilities for handling uncertain knowledge.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Project work -2**				
Course Code	**23IS7PWPW2**	**Credits**	**2**	**L-T-P**	**0-0-7**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours / Week	**16**				

The project student team will be continuing the identified engineering problem and design solutions carried out during Capstone Project-1. A detailed implementation, Modules Integration and Testing has to be carried out. Students also have to prepare a detailed project report.

The outcome of the capstone project can be either published in a reputed conference/journal of Scopus/Web of science indexed based on the strength of the work carried out. If the outcome of the project is a combination of software and hardware it is recommended to apply for patent. The students should be encouraged to submit their work in project competitions/Ideathon either national or international forums.

A team should comprise a minimum of two and maximum of three members.

- Internship projects are not allowed.
- Simple database related projects are not allowed.

The Head of the Department shall form a review committee for project work.
There shall be three reviews during the semester for evaluating the CIE.

Review-1: Shall be reviewed by the panel consisting of three internal faculty members (One Professor, One Associate or One Senior Assistant Professor and Respective Project Guide). At the time of Project Work Review 2, the students should be able to satisfy the below outcomes:

Sl. No.	Parameters	Marks (Max)
PR1.1	Technology Stack	5
PR1.2	Implementation	15
Total		20

Review-2: Shall be reviewed by the panel consisting of three internal faculty members (One Professor, One Associate or One Senior Assistant Professor

Sl. No.	Parameters	Marks (Max)
PR2.1	Module Integration and Testing	5
PR2.2	Analysis of Experimental results	5
PR2.3	Presentation and Report Writing	15
PR2.4	Project outcome (Research Paper/Patent/Competition)	5

Total	30

Panel Review
The Panel review committee should include:
1. Senior faculty Member
2. Respective Guides of the students
3. Industry Person or Alumni who is working in Industry with minimum experience of 5 years.

Parameters for Evaluation of Panel Review towards Best-Project Identification:

Sl. No.	Parameters	Marks (Max)
3.1	Originality and Novelty of the project	5
3.2	Industry relevant Modern tools Identification and Usage	10
3.3	Team Work	5
3.4	Presentation and Report Writing	10
3.5	Contribution to Society/Institute/Industry	5
3.6	Research component in the project	5
3.7	Viva-voce	10
Total		50

- The student shall make a presentation on the progress made by him /her before the committee for every week and to be presented to theirrespectiveguidesforReview-1andReview-2.
- The student shall present the Complete Project to the Panel members for PanelReview.
- The total marks obtained in the three reviews shall be reduced for 50 marks.
- The project report shall be submitted as per the approved guidelines.
- The Viva-voce external examinations shall carry 50 marks.
- Marks are awarded to each student of the project group based on theindividualperformanceinthe viva-voce external examination.
- If a candidate fails to submit the project report on or before the specified deadline, he/she is deemed to have failed in the Project Work and shall re-enroll for the same in a subsequent semester.

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<table>
<tr><th colspan="3">CIE Marks Distribution</th><th>SEE Marks Distribution</th></tr>
<tr><td>Review I</td><td>Review II</td><td>Review III (Panel Review)</td><td rowspan="3">• Identification of Problem and Detailed Analysis:10marks
• Demonstration and Technical Skills:15 marks
• Project Report Writing and Presentation:15 marks
• Team Work:5 marks
• Plagiarism:5 marks</td></tr>
<tr><td>20 Marks</td><td>30 marks</td><td>50 marks</td></tr>
<tr><td colspan="2">Total: 50 marks</td><td>Total: 50 marks</td></tr>
<tr><td colspan="3">Average of both: 50 marks</td><td>Total: 50 marks</td></tr>
</table>

COURSE OUTCOMES (COs)

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

CO1	Identify Industry relevant Modern tools relevant to identified engineering domain.
CO2	Synthesize and Implement feasible solution/s for the identified problem

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	Robotic Process Automation Design and Development				
Course Code	23IS8PERPA	Credits	3	L-T-P	3-0-0
CIE	50	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	3	Total Lecture Hours	40		

UNIT – 1
Introduction: What is Robotic Process Automation? **Scope and Techniques of Automation:** What should be automated?, What can be automated?, Techniques of automation. **Robotic Process Automation:** What can RPA do?, Benefits of RPA, Components of RPA, RPA platforms, The future of Automation. **Record and Play:** About UiPath, Downloading and Installing UiPath Studio, UiPath Stack, Learning UiPath Studio, Task Recorder, Emptying trash in Gmail, Emptying Recycle Bin.
UNIT – 2
Sequence, Flowchart and Control Flow: Sequencing the Workflow, Activities, Control flow, various types of loops, and decision making, how to use a sequence, how to use a flowchart, step by step example using sequence and control flow. **Data Manipulation:** Variables and scope, Collections, Arguments-purpose and use, Data table usage with examples, Clipboard management, File operation with step-by-step example. CSV/Excel to data table and vice versa examples.
UNIT – 3
Taking control of the controls: Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls-mouse and keyboard activities, working with UiExplorer, Handling events, Revisit recorder, Screen scraping, When to use OCR?, Types of OCR available, How to use OCR?, Avoiding typical failure points. **Tame that Application with Plugins:** Mail plugin, PDF plugin, web integration, Excel and Word plugins, Credential management.
UNIT – 4
Handling User Events and Assistant Bots: What are assistant bots?, Monitoring system event triggers, Monitoring image and element triggers, Launching an assistant bot on a keyboard event. **Exception Handling, Debugging, and Logging Exception handling:** Common exceptions and ways to handle them, Logging and taking screenshots, Debugging techniques, Collecting crash dumps, Error reporting.

UNIT – 5
Managing and Maintaining the Code: Project Organization, Nesting workflows, Reusability of workflows, Commenting techniques, State Machine, When to use Flowcharts?, State Machines or sequences, Using config files and examples of a config file. **Deploying and Maintaining the Bot:** Publishing using publish utility, Overview of Orchestration Server, Using Orchestration Server to control bots, Using Orchestration Server to deploy bots.

Text Book:
1. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing Release Date: March 2018 ISBN: 9781788470940
Reference Books:
1. Tom Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems,2020, ISBN-13 (electronic): 978-1-4842-5729-6, Publisher: A Press. 2. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation.
e-Books:
1. https://www.uipath.com/rpa/robotic-process-automation 2. https://www.packtpub.com/product/learning-robotic-process-automation/9781788470940
MOOCs:
1. https://www.uipath.com/learning/video-tutorials 2. https://www.guru99.com/uipath-tutorial.html

COURSE OUTCOMES (COs)

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

CO1	To understand the basic concepts of RPA.
CO2	Analyze the usage of appropriate Robotic Process Automation technique for a given application.
CO3	Design and implement techniques of Robotic Process Automation for the given application.

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Data Science for Software Engineering**				
Course Code	**23IS8PEDSE**	**Credits**	**3**	**L-T-P**	**3-0-0**
CIE	**50**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**3**	**Total Lecture Hours**	**40**		

UNIT - 1
Foundations of Data Science in Software Engineering: Introduction to software analytics, Seven principles of inductive software engineering, Overview of data sources in SE, Role of data scientists in development teams
UNIT - 2
Data Quality, Bias, and Ethics: Bias in SE data (sampling, labeling, survivorship), Cleaning noisy software data, Reproducibility and validation of studies, Ethics in mining software data
UNIT - 3
Mining and Analyzing SE Data: Mining data from repositories (Git, Jira, logs), Code and process metrics, Visualization and trend analysis, Practical frameworks for MSR
UNIT - 4
Predictive Modeling in Software Engineering: Introduction to defect prediction and effort estimation, Model selection, validation, and deployment, Real-world case studies (Microsoft, IBM), Avoiding modeling pitfalls
UNIT - 5
Advanced Topics and Capstone Project: Analytics for cloud and large-scale systems, Developer productivity and social analytics, Sharing models and reproducible research, Capstone project: analysis of real-world SE data
Text Books:
1. Text Book 1 (Format: Perspectives on Data Science for Software Engineering, Tim Menzies, Laurie Williams, and Thomas Zimmermann, Morgan Kaufmann (an imprint of Elsevier), Edition, 2016)
Reference Books:
1. Mining Software Repositories by Ayşe Başar Bener, Thomas Zimmermann, and Christian Bird (2023), Springer, ISBN: 9783031295095
e- Books:
1. e-Book 1 **(Format: Title, Author, Link)**
MOOCs:
1. Data Science for Software Engineering (Coursera - University of California, San Diego) **2.** Mining Software Repositories (Coursera - University of California, Irvine) **3.** Introduction to Data Science (Coursera - IBM)

COURSE OUTCOMES (COs)

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

CO1	Apply data science principles to software engineering practices
CO2	Analyze and address issues related to data quality, bias, and ethics in SE data
CO3	Extract meaningful insights from software repositories using mining techniques
CO4	Develop and evaluate predictive models for software metrics and performance

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Digital Forensics**			
Course Code	**23IS8PEDFS**	**Credits**	**L-T-P**	**3-0-0**
CIE	**50**	**SEE**	**50**	
Contact Hours/ Week	**3**	**Total Lecture Hours**	**40**	

UNIT – 1`
Computer Forensics Fundamentals: What is Computer Forensics ?, Use of Computer Forensics in Law Enforecement, Computer Forensics Assistance to Human Resources /Employment Proceedings, Computer Forensics Services, Benefits of professional Forensics Methodology, Steps taken by Computer Forensics Specialists. Types of Computer Forensics Technology: - Types of Business Computer Forensic Technology. Types of Military Computer Forensic Technology, Types of Law Enforcement- Computer Forensic Technology, Types of Business Computer Forensic Technology. Computer Forensics Evidence and capture: Data Recovery Defined-Data Back-up and Recovery-The Role of Back -up in Data Recovery-The Data -Recovery Solution.
UNIT – 2
Evidence Collection and Data Seizure: Why Collect Evidence? Collection Options Obstacles-Types of Evidence-The Rules of Evidence-Volatile Evidence-General Procedure-Collection and Archiving-Methods of Collections-Art Facts-Collection Steps -Controlling Contamination: The chain of custody. Duplication and Preservation of Digital Evidence: Preserving the Digital Crime Scene-Computer Evidence Processing Steps-Legal Aspects of collecting and Preserving Computer Forensic Evidence. Computer image Verification and Authentication: Special needs of Evidential Authentication - Practical Consideration-Practical Implementation.
UNIT – 3
Computer forensic analysis and validation: Determining what data to collect and analyse, validating forensic data, addressing data-hiding techniques, performing remote acquisitions Network Forensics: Network forensic overview, performing live acquisitions, developing standard procedures for network forensics, using network tools, examining the honey net project. Processing crime at incident scenes: Identifying digital evidence, collecting evidence in private-sector incident scenes, processing law enforcement crime scenes, preparing for a search, securing a computer incident or crime scene, seizing digital evidence at the scene, storing digital evidence, obtaining a digital hash, reviewing a case.
UNIT – 4
Current Computer Forensic Tools: evaluating computer forensic tool needs, computer forensic software tools, computer forensic hardware tools, validating and testing forensic software. E-mail investigations: Exploring the role of email in investigations, exploring the role of client and server in email, investigating email crimes and violations, understanding email servers, using specialized email forensic tools. Cell phone and mobile device forensics: Understanding mobile device forensic, understanding acquisition procedures for cell phones and mobile devices.

UNIT - 5

Working with windows and dos systems: understanding file systems, exploring Microsoft file structures examining NTFS disks, understanding whole disk encryption, windows registry, Microsoft start-up tasks, MS Dos start-up tasks, virtual machines

Text Books:

1. Computer Forensics, Computer Crime Investigation by John R,Vacca, Firewall Media, New Delhi. January 2015
2. Computer Forensics and Investigations by Nelson, Phillips Enfinger, Steuart, CENGAGE Learning.

Reference Books:

1. Real Digital Forensics by Keith j.Jones, Richard Bejitlich,Curtis W.Rose ,AddisonWesley Pearson Education
2. Forensic Compiling,A Tractitioneris Guide by Tony Sammes and Brain Jenkinson,Springer International edition.

e- Books:

1. Guide-to-computer-forensics-and-investigations-5th-Edition Christopher Steuart , Bill Nelson , Amelia Phillips **https://pdfdrive.com.co/wp-content/pdfh/guide-to-computer-forensics-and-investigations-5th-Edition-ebook.pdf**
2. Incident Response & Computer Forensics Jason T. Luttgens , Matthew Pepe , Kevin Mandia https://cdn.preterhuman.net/texts/law/forensics/Incident%20Response%20and%20Computer%20Forensics%202nd%20ed.%20-%20C.%20Prosise,%20K.%20Mandia%20(2003)%20WW.pdf
3. Digital Forensics Dr.Jeetendra Pande Dr. Ajay Prasad https://uou.ac.in/sites/default/files/slm/MIT(CS)-202.pdf

MOOCs:

1. **Swayam :https://onlinecourses.swayam2.ac.in/cec20_lb06/preview**
2. **Coursera : https://www.coursera.org/learn/ibm-penetration-testing-threat-hunting-cryptography**

COURSE OUTCOMES (COs)

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

CO1	To understand the concepts of Computer Forensics, Evidence Collection and Data Seizure, Computer Forensic Tools and forensic validation.	
CO2	To apply the knowledge gathered from Computer forensics to recover important evidence for identifying computer crime	PO1
CO3	To analyse the digital evidence to reconstruct the crime scene	PO2
CO4	To conduct investigations on collected evidences and data using forensic tools.	PO4,PO5

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Generative AI for Beginners**				
Course Code	**23IS8PEGAI**	**Credits**	**3**	**L-T-P**	**3-0-0**
CIE	**50 Marks**	**SEE**	**100 Marks(50% Weightage)**		
Contact Hours/ Week	**3**	**Total Lecture Hours**	**40**		

UNIT – 1: Introduction to Generative AI and Deep Learning Foundations
Introduction to Generative AI: Definition, Key Concepts, and Applications, Discriminative vs. Generative Models. Neural Networks Primer: Neurons, Layers, Activation Functions, Latent Space and Representation Learning. Overview of Generative Models: VAEs, GANs, Autoregressive Models, Use Cases, Setting Up the Environment, Basic Neural Network for Data Reconstruction.
UNIT – 2: Variational Autoencoders (VAEs)
Autoencoders: Structure, Loss Functions, Limitations, Variational Inference: KL Divergence, Gaussian Assumptions, Reparameterization Trick in VAEs. Latent Space Navigation: Sampling, Interpolation, Visualization. Applications of VAEs: Denoising, Anomaly Detection, Image Generation, Implementing a VAE in Keras, Comparing AEs and VAEs.
UNIT – 3: Generative Adversarial Networks (GANs)
GAN Architecture: Generator, Discriminator, Adversarial Loss, Training GANs: Minimax Game, Instability Issues, Mode Collapse. Deep Convolutional GANs (DCGANs): Architecture, Enhancements, GAN Evaluation Metrics: Inception Score, FID. Conditional GANs: Adding Labels to Generation, Implementing a Simple GAN using Keras, Visualizing Generated Images over Epochs, Debugging and Improving GAN Training.
UNIT – 4: Advanced GAN Variants and Practical Use Cases
CycleGAN: Image-to-Image Translation without Paired Data, Pix2Pix: Supervised Image Translation, StyleGAN: High-Quality Image Generation (Overview). Text-to-Image Generation: Introduction to DALL·E and Stable Diffusion, Applications in Industry: Face Generation, Style Transfer, Art, Fashion, Ethical Considerations: Deepfakes, Misinformation, AI Bias.
UNIT – 5: Future Directions of Generative AI
Text Generation Models: RNNs, LSTMs, and Transformers. Introduction to GPT-2/GPT-3: Autoregressive Language Models, Generating Text with HuggingFace Transformers. Future Directions: Large Language Models (LLMs), Prompt Engineering, Diffusion Models, Career Paths and Research Opportunities in Generative AI.

Text Book:

1. Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play by David Foster, 2nd Edition, O'Reilly Media, 2019.

Reference Books:

1. Deep Learning with Python, François Chollet, Manning Publications, Second Edition, 2021.
2. Natural Language Processing with Transformers, Lewis Tunstall, Leandro von Werra, Thomas Wolf, O'Reilly Media, 2022.

e-Books:

1. https://www.e-booksdirectory.com/details.php?ebook=11739 — Deep Learning by Ian Goodfellow et al. (Free online version of foundational text)
2. https://www.e-booksdirectory.com/details.php?ebook=12558 — Neural Networks and Deep Learning by Michael Nielsen (Introductory resource)

MOOCs:

1. https://www.deeplearning.ai/courses/generative-ai-with-llms/ — Generative AI with Large Language Models (DeepLearning.AI)
2. https://huggingface.co/learn/nlp-course — NLP Course with Transformers (Hugging Face)
3. https://platform.openai.com/docs — Official OpenAI API Documentation
4. https://magenta.tensorflow.org/ — Google Magenta for AI-Generated Music & Art

COURSE OUTCOMES (COs)

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

CO1	Understand the fundamentals of Generative AI.
CO2	Apply variational autoencoders (VAEs) for tasks such as data reconstruction, denoising, and anomaly detection, and analyze latent space representations.
CO3	Develop and train basic and conditional Generative Adversarial Networks (GANs), advanced GAN architectures like CycleGAN, Pix2Pix, and StyleGAN.
CO4	Evaluate generative models for text and multimodal outputs using modern architectures like Transformers, GPT-2/3, and diffusion models.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Python for Data Analysis**			
Course Code	**23IS8OEPDA**	**Credits**	**L-T-P**	**3-0-0**
CIE	**50 Marks**	**SEE**	**100 Marks(50% Weightage)**	
Contact Hours/ Week	**3**	**Total Lecture Hours**	**40**	

UNIT - 1
Introduction to NumPy and Vectorized Computation: Introduction to NumPy: ndarray, array creation, Data types, type conversion,Indexing, slicing, boolean and fancy indexing,Transposing and reshaping arrays, Vectorized operations and broadcasting, Universal functions, mathematical/statistical methods,Sorting, unique values, set logic, File I/O with NumPy, Linear algebra operations, Random number generation and random walks.
UNIT - 2
Pandas – Data Structures and Functionality: Introduction to Series, DataFrame, and Index objects, Reindexing, dropping, selection, filtering, Arithmetic and data alignment, Function application and mapping, Sorting and ranking, Descriptive statistics, correlation, covariance, Handling duplicate labels,Value counts and membership testing.
UNIT - 3
Data Loading, Storage, and Cleaning: Data Input/Output: **Reading/writing text files (CSV, TSV), JSON, XML, HTML, Reading Excel, HDF5,Interacting with Web APIs and Databases,** Data Cleaning and Preparation-Handling missing data**: dropna, fillna,Data transformation: mapping, replacing, renaming, Removing duplicates, binning, Detecting/filtering outliers,Dummy variables, string manipulation, Categorical data and conversions**
UNIT - 4
Data Wrangling and Reshaping-Hierarchical indexing and multi-level labels, Combining datasets: merge, join, concat, Merging on index vs. columns, Overlapping data and fill methods, Reshaping with stack, unstack, melt, pivot, Pivoting long to wide and vice versa, Case examples and best practices
UNIT-5
Visualization, Grouping, and Time Series: **Plotting and Visualization, Matplotlib API: figures, subplots, customization, Plotting with pandas and seaborn: line, bar, hist, scatter, Saving plots, formatting styles, Facet grids and categorical plots** **Group Operations:** groupby: grouping strategies,Aggregation, transformation, and filtering, Applying custom functions, pivot tables, cross-tabulation, **Time Series:**Date and time types, conversion, indexing, Resampling, frequency conversion, Moving windows, time zone handling, Periods and arithmetic.
Text Books:
Wes McKinney, Python for Data Analysis, O'Reilly Media (2nd Edition)
Reference Books:

- Jake VanderPlas – Python Data Science Handbook
- Joel Grus – Data Science from Scratch

e- Books:

- Hands-On Data Analysis with Pandas – Stefanie Molin
- Effective Pandas – Matt Harrison

MOOCs:

- Python Data Analysis (Coursera – University of Michigan)- Introduction to Data Science in Python | Coursera
- Data Science with Python (edX – IBM)

COURSE OUTCOMES (COs)

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

CO1	Understand and apply NumPy and pandas for efficient data representation and manipulation.
CO2	Perform data loading, cleaning, and preparation using pandas and associated libraries.
CO3	Analyze and visualize datasets through data wrangling and plotting techniques.
CO4	Evaluate time series data and grouped operations for advanced data analysis.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Software Engineering**			
Course Code	**23IS8OESTG**	**Credits**	**L-T-P**	**3-0-0**
CIE	**50 Marks**	**SEE**	**100 Marks(50% Weightage)**	
Contact Hours/ Week	**3**	**Total Lecture Hours**	**40**	

UNIT - 1
OVERVIEW: Introduction: Professional software development, Software engineering ethics. Case Studies- An insulin pump control system, MHC-PMS (Mental Health Care-Patient Management System), wilderness weather station **Software processes:** Software process models, Process activities, Coping with change.
UNIT - 2
Agile Software Development: Agile methods, Plan-driven and agile development, Extreme programming: Testing in XP, Pair programming, Agile project management, Scaling agile methods.
UNIT - 3
Requirements engineering: Functional and non-functional requirements, The software requirements document, Requirements specification, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management.
UNIT - 4
Architectural design: Architectural design decisions, Architectural views, Architectural patterns: Layered architecture, Repository architecture, Client–server architecture, Pipe and filter architecture, Application architectures: Transaction processing systems, Information systems, Language processing systems **Software testing :** Development testing , Test-driven development
UNIT-5
Project management: Risk management: Risk identification, Risk analysis, Risk planning, Risk monitoring. Managing people: Motivating people, Teamwork: Selecting group members, Group organization, Group communications. **Project Planning**: Software pricing, Plan-driven development, Project scheduling, Agile planning, Estimation techniques
Text Books:
1. Software Engineering by Ian Somerville, 9th edition, Pearson Education, 2007
Reference Books:

1. Software Engineering: A Practitioners Approach by Rogers S Pressman, 7th edition, MCGrawHill, 2007
2. Software Engineering theory and Practice by shari Lawrence Pfleeger, Joanne m Atlec, 3rd edition, Pearson Education, 2006.
3. Software Engineering Principles and Practice by Waman.S. Jawadekar, Tata McGrawhill,2004.

e- Books:

1. https://www.ece.rutgers.edu/~marsic/books/SE/book-SE_marsic. pdf
2. https://friendkvvk.files.wordpress.com/2015/08/friendkvvk-ooad.pdf

MOOCs:

1 https://www.edx.org/learn/software-engineering
2 https://www.coursera.org/courses?query=software%20
3 https://www.coursera.org/courses?query=software%20engineering

COURSE OUTCOMES (COs)

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

CO1	Understand the software engineering process, ethics, process models, requirement specification, project management and planning.
CO2	Apply the concept of agile software engineering in software development.
CO3	Analyze various architectural patterns used in different types of application system.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**Internship**				
Course Code	**23IS8SRINT**	**Credits**		**L-T-P**	**0-0-6**
CIE	**50**	**SEE**	**50**		
Contact Hours/ Week	**12**				

The Technical internship must be carried out for at least four months and it must be based on hands-on skills related to Information Science technology

The student should be evaluated for the Summer/Winter Internship done with any company or research lab for four months during 8th Semester. The students must make a presentation on the scheduled dates and this will be evaluated by the internal committee based on the rubrics for 25 Marks. The students must submit an internship report and it will be evaluated for 25 marks by the internal committee based on the rubrics. Total internal assessment for the Internship would be 25+25=50 Marks. SEE will be conducted for 50 Marks The final marks would be CIE+SEE (50+50) = 100 Marks.

COURSE OUTCOMES (COs)

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

CO1	Understand the vital aspects perceived from domain knowledge from industry perspective which helps in problem analysis.
CO2	Apply the required design principles/constraints to achieve solutions
CO3	Develop/attain conclusions using modern engineering tools.
CO4	Communicate effectively as an individual/diverse team through presentation and documentation.