SYLLABUS

(With effect from 2023 -24)

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕ ವರ್ಷ2023-24)

Bachelor Degree
In
Computer Science &Engineering

V & VI Semester

Out Come Based Education
With
Choice Based Credit System

[National Education Policy Scheme]

P.E.S. College of Engineering, Mandya - 571 401, Karnataka

[An Autonomous Institution affiliated to VTU, Belagavi,
Grant – in – Aid Institution (Government of Karnataka),
Accredited by NBA (All UG Programs), NAAC and Approved by AICTE, New Delhi]

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ
ಮಂಡ್ಯ–571 401, ಕರ್ನಾಟಕ
(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

Ph : 08232- 220043, Fax : 08232 – 222075,Web : www.pescemandya.org

VISION

"PESCE shall be a leading institution imparting quality Engineering and Management education developing creative and socially responsible professionals."

MISSION

- *Provide state of the art infrastructure, motivate the faculty to be proficient in their field of specialization and adopt best teaching-learning practices.*
- *Impart engineering and managerial skills through competent and committed faculty using outcome based educational curriculum.*
- *Inculcate professional ethics, leadership qualities and entrepreneurial skills to meet the societal needs.*
- *Promote research, product development and industry-institution interaction.*

QUALITY POLICY

Highly committed in providing quality, concurrent technical education and continuously striving to meet expectations of stake holders.

CORE VALUES

***P**rofessionalism*
***E**mpathy*
***S**ynergy*
***C**ommitment*
***E**thics*

Department of Computer Science and Engineering

The Vision of the department is:

"The Department of Computer Science and Engineering shall create professionally competent and socially responsible engineers capable of working in global environment.*"*

The mission of the department is:

DM1: Enforce best practices in teaching-learning, with dedicated faculty and supportive infrastructure to impart the knowledge in emerging technologies.
{Required to create professionally competent engineers}

DM2: Improve Industry-Institute relationship for mutual benefit.
{Required to create professionally competent engineers}

DM3: Inculcate ethical values, communication and entrepreneurial skills.
{Required to create professionally competent and socially responsible engineers}

DM4: Sensitize social, legal, environmental and cultural diversity issues through professional training and balanced curriculum.
{Required to create engineers capable of working in global environment}

Program Educational Objectives (PEO's)

Graduates of the program shall

- Have Successful computer professional career in IT industry and related areas
- Pursue higher education in engineering or management with the focus on intensive research and developmental activities.
- Develop their career as entrepreneurs in a Responsible, Professional and ethical manner to serve the society

The National Board of Accreditation (NBA) has defined twelve Program Outcomes for Under Graduate (UG) engineering programs as listed below.

Program Outcomes (PO's)

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problem.
2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **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 public health and safety, and cultural, societal, and environmental considerations.
4. **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.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.
6. **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.
7. **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.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with the 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.
11. **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.
12. **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.

The Under Graduate (UG) of B.E Computer Science & Engineering Program has defined **Program Specific Outcomes (PSO**) which are listed below.

PSO-1: Ability to apply problem solving skills in developing solutions through fundamentals of Computer Science and Engineering.

PSO-2: Ability to apply Analytical Skills in the field of Data Processing Systems.

PSO-3: Ability to design and develop applications through Software Engineering methodologies and Networking Principles.

	Bachelor of Engineering (V –Semester)										
Sl. No.	**Course Code**	**Course Title**	**Teaching Department**	**Hrs / Week**				**Credits**	**Examination Marks**		
				L	**T***	**P**	**PJ**		**CIE**	**SEE**	**Total**
1	P21CS501	Software Engineering and Management	CS	3	-	-	-	3	50	50	100
2	P21CS502	Computer Networks	CS	3	-	-	-	3	50	50	100
3	P21CS503X	Professional Core - 1 (Elective)	CS	3	-	-	-	3	50	50	100
4	P21CS504	Operating System (Integrated)	CS	3	-	2	-	4	50	50	100
5	P21CSO505X	Open Elective – I	CS	3	-	-	-	3	50	50	100
6	P21CSL506	Computer Networks Laboratory	CS	-	-	2	-	1	50	50	100
7	P21INT507	Internship - II	XX	-	-	-	-	2	-	100	100
8	P21HSMC508	Employability Enhancement Skills – V	HSMC	1	-	-	-	1	50	50	100
9.	P21UHV509	Social Connect and Responsibility	XX	1	-	-	-	1	100	-	100
	Total							**21**			

Professional Elective Course – I (P21XX503X)	
Course Code	**Course Title**
P21CS5031	System Software and Compiler Design
P21CS5032	Computer graphics and visualization
P21CS5033	Cloud Computing Platform
P21CS5034	Artificial Intelligence

Open Elective – I(P21XXO505X)	
Course Code	**Course Title**
P21CSO5051	Fundamentals of Data Structures
P21CSO5052	Introduction to Python Programming
P21CSO5053	Fundamentals of AI
P21CSO5054	Data Base Management System

	Bachelor of Engineering (VI –Semester)										
Sl. No.	**Course Code**	**Course Title**	**Teaching Department**	**Hrs / Week**				**Credits**	**Examination Marks**		
				L	**T***	**P**	**PJ**		**CIE**	**SEE**	**Total**
1	P21CS601	Data Analytics	CS	3	-	-	-	3	50	50	100
2	P21CS602X	Professional Core Course (Elective) - II	CS	3	-	-	-	3	50	50	100
3	P21CS603X	Professional Core Course (Elective) - III	CS	3	-	-	-	3	50	50	100
4	P21CS604	Computer Architecture (Integrated)	CS	3	-	2	-	4	50	50	100
5	P21CSO605X	Open Elective – II	CS	3	-	-	-	3	50	50	100
6	P21CSL606	Data Analytics Lab	CS	-	-	2	-	1	50	50	100
7	P21CSMP607	Mini – Project	CS	-	-	2	2	2	50	50	100
8	P21HSMC608	Employability Enhancement Skills - VI	HSMC	1	-	-	-	1	50	50	100
9.	P21UHV609	Universal Human Values and Professional Ethics	XX	1	-	-	-	1	50	50	100
	Total							**21**			

Professional Elective Course – II(P21XX602X)	
Course Code	**Course Title**
P21CS6021	Fundamentals of Block chain
P21CS6022	Network Management
P21CS6023	Service Oriented Architecture
P21CS6024	Software Testing

Professional Elective Course – III(P21XX603X)	
Course Code	**Course Title**
P21CS6031	Soft Computing
P21CS6032	Fundamentals of Devop's
P21CS6033	UNIX System programming
P21CS6034	Pervasive Computing

Open Elective-II (P21XXO605X)	
Course Code	**Course Title**
P21CSO6051	Introduction to WEB Programming
P21CSO6052	Design and Analysis of Algorithms
P21CSO6053	Fundamentals of Data Mining
P21CSO6054	Fundamentals of Machine Learning

Software Engineering and Management [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	**P21CS501**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. Introduction to Software Engineering.
2. Describe the process of Agile Software Engineering, the technologies used for Software Engineering, and configuration management of Software Engineering.
3. Apply Object oriented Design decisions, Patterns and Software testing.
4. Understand Software Project management and Configure management.
5. Explain Earned Value Management (EVM) and its basics.

UNIT – I	OVERVIEW	8 Hours

OVERVIEW: Introduction to Software Engineering, Introduction, Professional software development.

Software processes: Software process models, Process activities, coping with change, The Rational Unified Process.

Self-study component:	Software Engineering Ethics

UNIT – II	Agile and Lean Software development	8 Hours

Agile software development: Agile methods, Plan driven and agile development, Extreme programming, Agile project management, Scaling agile methods.

Lean Software Development (LSD): Eliminating the waste, Fast Delivery, Amplify Learning, Builds Quality, Respect Teamwork, Delay the commitment, optimizing the whole system, Difference between Lean Development Model and Agile Development Model.

Self-study component:	EVO function specification using planguage

UNIT – III	Design and Implementation	8 Hours

Design and Implementation: Object-oriented design using the UML Design patterns, Implementation issues, Open source development.

Software testing: Development testing, Test-driven development, Release testing, User testing.

Self-study component:	Control styles in design

UNIT – IV	Project and Configuration Management	8 Hours

Software Project Management (SPM): Conflict Management, Risk Management, Requirement Management, Managing people, Teamwork.

Configuration management: Change management, Version management System building ,Release management

Self-study component:	Software measurements and Metrics

UNIT – V	Earned Value Management(EVM)	8 Hours

Earned Value Management (EVM): Benefits of EVM, Planned Value (PV), Actual Costs (AC), Earned Value (EV). Variance Analysis, Performance Indexes.

Fundamentals of Earned Value Management: Organization and Scope of Project, Planning, Scheduling, and Budgeting, Accounting for Actual Costs, Analyzing and Reporting on Project Performance, Revisions and Data Maintenance, Find the Best EVM Solution for Your Projects.

Self-study component:	Different Earned value formulas

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Explore** the various types of software process models	Remember	L1
CO2	**Elaborate** the importance of software development.	Understanding	L2
CO3	**Asses** the significance of software engineering design and development	Understanding	L2
CO4	**Derive** different Software project management methods	Applying	L3
CO5	**Solve various** Earned Value Management techniques	Applying	L3

Text Book(s):

1. **Software Engineering** – Ian Somerville, 10th Edition, *©2016* | ***Pearson*** .
2. **Earned value Project Management by** Quentin W. Fleming PhD MSc and Joel M. Koppelman, fourth Edition 2010, PMI

Reference Book(s):

1. Agile and Iterative Development by Craieg Larman 2003
2. **Software Engineering: A Practitioners Approach -** Roger S. Pressman, 7th Edition,
3. McGraw-Hill, 2007.
4. **Software Engineering Theory and Practice -** Shari Lawrence Pfleeger, Joanne M.
5. Atlee, 3rd Edition, Pearson Education, 2006.
6. **Software Engineering Principles and Practice –** Waman S Jawadekar, Tata McGraw Hill, 2004
7. **Software Engineering** – Pankaj Jalote, Tata McGraw Hill

CO-PO Mapping

Semester : V		Course code : P21CS501					Title : Software Engineering and Management									
CO	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO01**	**PSO02**	**PSO03**
1	**Explore** the various types of software process models	3	2						2	2				1		2
2	**Elaborate** the importance of software development	3	2	2	1	2			1	3	3	1	1	1		3
3	**Asses** the significance of software engineering design and development			3	2	2			1	2	2	1		1		3
4	**Derive** different Software project management methods	1	1	1	2	2				2	2	3	2			3
5	**Solve various** Earned Value Management techniques	1	1	1	2	2				2	2	3	2			3

Computer Networks

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P21CS502**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Understand the fundamentals concepts of computer networks.
- Familiarize with the standard models for the layered approach to set the communication between machines in a network using protocols of the various layers.
- Get prepare for advanced courses in computer networking.

UNIT – I	**INTRODUCTION AND PHYSICAL LAYER**	**8 Hours**
Data communication—Networks — Network Types — Protocol Layering — TCP/IP Protocol suite — OSI Model — Physical Layer: Signals: analog signals, digital signals—Signal impairment—Multiplexing—Transmission media : guided		
Self-study component:	Transmission media : unguided	

UNIT – II	**DATA-LINK LAYER & MEDIA ACCESS**	**8 Hours**
Introduction — Data-Link Control—Media Access Control —Layer Addressing —Ethernet—Cellular telephony—Satellite Network.		
Self-study component:	Connecting devices	

UNIT – III	**NETWORK LAYER**	**8 Hours**
Network Layer Services — Packet switching —Internet protocol version 4: IP addressing, main and auxiliary protocol, options, ICMPv4 — Next GenerationIP (IPV6): IPV6 addressing , IPV6 protocol — Transition from IPv4 to IPv6—Routing algorithms: —Unicasting routing protocols: RIP,OSPF—Multicasting Protocol: PIM— IGMP		
Self-study component:	BGP4, Multicasting protocol: DVMRP, MOSPF	

UNIT – IV	**TRANSPORT LAYER**	**8 Hours**
Transport Layer services— Transport Layer Protocols — User Datagram Protocol — Transmission Control Protocol: TCP services, TCP features, Segment, TCP connection, Windows in TCP, Flow control, Error control ,TCP congestion control— SCTP: Services and features, packet format.		
Self-study component:	Transport layer services: Connectionless and connection oriented protocols	

UNIT – V	**APPLICATION LAYER**	**8 Hours**
Introduction—Client /Server Paradigm—Standard Applications: World Wide Web and HTTP, FTP, Electronic Mail, Domain Naming Services—Socket interface programming		
Self-study component:	Network management: Introduction	

Course Outcomes: On completion of this course, students are able to:			
COs		**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Understand** the basic taxonomy and terminology of computer networks.	Knowledge	L1
CO2	**Comprehend** services, basic protocols of various layers and how they can be used to assist in network design.	Understand	L2
CO3	**Articulate** various techniques involved in data transmission with examples.	Apply	L3
Text Book(s): Behrouz A. Forouzan "Data Communications and Networking with TCP/IP protocol suite" 6th Edition Published by McGraw Hill LLC, 2022.			
Reference Book(s): - Computer networks ,Andrew S. Tanenbaum, David J. Wetherall. -- 5th ed, Pearson Education, Inc, 2011.			
Web and Video link(s): ➢ **https://www.youtube.com/watch?v=bR3l1L1oCb0&list=PL9P1J9q3_9fNXTTpJ1TM0gJDdjM9HBGxN** ➢ **https://www.youtube.com/watch?v=VwN91x5i25g&list=PLBlnK6fEyqRgMCUAG0XRw78UA8qnv6jEx**			
E-Books/Resources: **https://drive.google.com/file/d/1BXjlY59ka2gYkxGLVPnSmH8Ew0IBqBLi/view?usp=drive_link**			

CO	Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	**Understand** the basic taxonomy and terminology of computer networks.	2											1	2		1
CO2	**Comprehend** basic protocols of various layers and how they can be used to assist in network design and implementation.	2	2	2	3								1	2		1
CO3	**Articulate** various techniques involved in data transmission with examples.	2	2	3	2								1	1		1

OPERATING SYSTEMS (INTEGRATED)
[As per Choice Based Credit System(CBCS) &OBE Scheme]
SEMESTER –V

Course Code:	**P21CS504**	**Credits:**	**04**
Teaching Hours /Week(L:T:P):	**3:0:2**	**CIE Marks:**	**50**
Total Theory Teaching Hours:	**40**	**SEE Marks:**	**50**
Total Laboratory Hours:	**24**		

Course Learning Objectives: This course will enable the students to:

- Understand the basic functionalities of Operating System, Process and Threads.
- Analyze the usage of different Process and Disk scheduling
- Understand the implementation of memory management and virtual memory.
- Analyze the structure and organization of the file system

UNIT – I	**8 Hours**

Introduction to operating systems, System structures: What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations.

Operating System Structures: Operating System Services, System calls; Types of system calls; System programs; Operating System structure

Process Management:

Process: Process concept; Process scheduling; Operations on processes; Inter process communication.

Self-study component:	Operating System Debugging; Operating System generation.
Practical topics:(4Hours)	1. Write a program to read data from the standard input device and write it on the screen(using read()/write() system calls) 2. Write a program to print 10 characters starting from the 10th character from a file(lseek () system call) 3. Write a program to implement IPC using shared memory

UNIT – II	**8 Hours**

Threads: Overview; Multithreading models; Thread Libraries; Threading issues

Process Synchronization: Background, The critical section problem; Peterson's solution; Semaphores; Classical problems of synchronization; Monitors.

Self-study component:	Implicit threading, Synchronization hardware, mutex locks
Practical Topics:(6 Hours)	1. Implement the Producer & consumer Problem (Semaphore) 2. Implement the solution to dining philosopher's problem using monitors.

UNIT – III	**8 Hours**

CPU Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms; Multiple-processor scheduling;

Deadlocks: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection.

Self-study component:	Thread scheduling, Recovery from deadlock
Practical Topics:(4Hours)	1. Implement the FCFS CPU Scheduling Algorithms 2. Implement Bankers Algorithm for Deadlock Avoidance

UNIT – IV	**8 Hours**

Memory Management:
Main Memory: Background, Swapping; Contiguous Memory allocation; Segmentation; Paging;
Virtual Memory: Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing.

Self-study component:	Structure of page table, I/O Interlock and Page Locking
Practical Topics: (6Hours)	1. Implement the following Memory Allocation Methods for fixed partition a) First Fit b) Worst Fit 2.Implement the following Page Replacement Algorithms a) FIFO b) LRU

UNIT – V	**8 Hours**

Storage Management:
Mass storage structures: Overview of mass storage structure, Disk structure; Disk scheduling;
File System Interface: File concept; Access methods; Directory structure
File System Implementation: File system structure; Directory implementation; Allocation methods;

Self-study component:	Disk Attachment , RAID structure, File system implementation;
Practical Topics: (4Hours)	1.Implement the following Disk Scheduling Algorithms: a) SSTF Scheduling b) SCAN Scheduling 2.Implement the following File Allocation Strategies a) Sequential b) Indexed

Course Outcomes: On completion of this course, students are able to:

CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Understand** the structure of an operating system and various concepts related to it.	Understand	L1
CO2	**Demonstrate** various operating system operations.	Apply	L3
CO3	**Apply** suitable techniques for management to different resources.	Apply	L3
CO4	**Implement** various algorithm related to operating system concepts.	Apply	L3

Text Book(s):

1. Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin, Greg Gagne ,9th Edition, Wiley-India-2013

Reference Book(s):

1. Operating Systems: A Concept Based Approach – D.M Dhamdhere, 2nd Edition, Tata McGraw- Hill, 2017.
2. Operating systems internals and design principles 7th edition, , PHI, 2012

Web and Video links:

1. https://nesoacademy.org/cs/03-operating-system
2. https://archive.nptel.ac.in/courses/106/105/106105214/

CO-PO Mapping

CO's	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**Understand** the structure of an operating system and various concepts related to it.	**2**												**2**		
CO2	**Demonstrate** various operating system operations.	**2**	**2**	**3**		**2**								**2**		
CO3	**Apply** suitable techniques for management of different resources.	**2**	**2**	**1**		**2**								**2**		
CO4	**Implement** various algorithm related to operating system concepts.	**2**	**2**		**2**	**2**								**2**		

SYSTEM SOFTWARE AND COMPILERS

(Professional Effective from the academic year 2023 -2024)

SEMESTER – V

Course Code:	**P21CS5031**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Learn basics of System Software and compilers.
- Familiarize with the approaches of lexical, syntax and syntax directed translations.
- Describe the front-end and back-end phases of compiler and their importance to students

UNIT – I	**8 Hours**

INTRODUCTION TO SYSTEM SOFTWARE: Assemblers: Elements of Assembly Language programming, A Simple Assembly Scheme and Pass Structure of Assemblers. Linkers and Loaders: Relocation, Linking and Loading Concepts.

Language processors, The structure of a Compiler, Impacts on Compilers **LEXICAL ANALYSIS**: The Role of Lexical Analyzer, Lexical Analysis Versus Parsing, Tokens, Patterns, and Lexemes, Attributes for Tokens, Lexical Errors, Input Buffering, Buffer Pairs, Sentinels, Specification of Tokens, Strings and Languages, Operations on Languages, Regular Expressions.

Self-study component:	Compiler tools and applications of the compilers

UNIT – II	**8 Hours**

LEXICAL ANALYSIS: Recognition of Tokens, Transition Diagrams, Architecture of a Transition-Diagram-Based Lexical Analyzer.

SYNTAX ANALYSIS : The role of parser, Representative Grammars, syntax error handling, error recovery strategies, Writing a grammar, lexical versus syntactic analysis, Eliminating ambiguity, Elimination of left-recursion, Left-factoring.

Self-study component:	Recognition of Reserved Words and Identifiers, Completion of the Running Example,

UNIT – III	**8 Hours**

TOP-DOWN PARSING : Introduction, Recursive-Descent Parsing, FIRST and FOLLOW, LL(1) grammars , Constructing a predictive parsing table , Non recursive Predictive Parsing, Error Recovery in Predictive Parsing: Panic mode Error Recovery.

Self-study component:	Phrase level Error Recovery

UNIT – IV	**8 Hours**

BOTTOM-UP PARSING : Reductions, Handle Pruning, Shift-reduce parsing and conflicts during Shift-reduce parsing, Introduction to LR Parsing: Simple LR, Need of LR parsers, Items and LR(0) automaton, Closure of Item Sets, The Function GOTO, LR(0) automaton for the expression grammar, The LR-Parsing Algorithm, Constructing SLR-parsing tables, LALR parsers.

Self-study component:	CLR parsers

UNIT – V	**8 Hours**

SYNTAX-DIRECTED TRANSLATION: Syntax directed definitions, Inherited and synthesized attributes, evaluating an SDD at the nodes of the parse tree.

INTERMEDIATE-CODE GENERATION: Three-address code – Addresses and instructions, Quadruples and Triples.

Self-study component:	S-attributed and L-attributed SDTs, Code optimization techniques,code generation

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Ability** to learn the basics of system software and phases of compiler	Remember	L1
CO2	**Ability** to learn the concepts of lexical and syntax analysis	Understanding	L2
CO3	**Construct** appropriate parsers using top-down and bottom-up parsing in syntax analysis	Apply	L3
CO4	**Apply** different syntax directed translation schemes with appropriate intermediate code and code generation techniques	Apply	L3

Text Book(s):

1. Compilers- Principles, Techniques and Tools, Alfred V Aho, Monica S.Lam, Ravi Sethi, Jeffrey D Ullman, Pearson Education, 2nd Edition 2007.
2. System Programming and Operating Systems, D M Dhamdhere , Mcgraw Hill. 2nd Revised Edition.

Reference Book(s):

1. Compiler Construction Principles & Practice, Kenneth C Louden, Thomson Education, 1997.
2. Modern Compiler Implementation in C, Andrew W Appel, First Edition, Cambridge University Press, 2010

CO-PO Mapping

Semester: V		Course code : P21CS5031					Title : SYSTEM SOFTWARE AND COMPILERS								
CO	**Statement**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS 01**	**PS O2**
CO1	Ability to learn the basics of system software and phases of compiler	3	3	2	2	1								3	2
CO2	Ability to learn the concepts of lexical and syntax analysis	3	3	3	3	1								3	3
CO3	Construct appropriate parsers using top-down and bottom-up parsing in syntax analysis	3	3	3	3	1								3	3
CO4	Apply different syntax directed translation schemes with appropriate intermediate code and code generation techniques	3	3	2	1									3	2

COMPUTER GRAPHICS AND VISUALIZATION

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P21CS5032**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Explain hardware, software and OpenGL Graphics Primitives.
- Illustrate interactive computer graphics using OpenGL.
- Design and implement algorithms for 2D graphics Primitives and attributes.
- Demonstrate Geometric transformations, viewing on both 2D and 3D objects.

UNIT – I	**Computer Graphics Hardware:**	**8 Hours**

Computer Graphics Hardware: Video Display Devices: , Raster-Scan Systems, Computer Graphics Software: Coordinate Representations, Graphics Functions, Software Standards, Introduction To OpenGL, Graphics Output Primitives: Coordinate Reference Frames, Specifying A Two Dimensional World-Coordinate Reference Frame In OpenGL, OpenGL Point Functions, OpenGL Line Functions, Opengl Curve Functions, Fill Area Primitives, OpenGL Polygon Fill Area Functions, OpenGL Vertex Arrays, OpenGL Pixel-Array Functions, Character Primitives, OpenGL Character Functions, OpenGL Display Lists, OpenGL Display-Window Reshape Function.

Self-study component:	Input Devices, Hardcopy devices, Polygon Fill Areas.

UNIT – II	**Graphics Primitives and Attributes**	**8 Hours**

Attributes of Graphics Primitives: OpenGL State Variables, Color and Gray Scale, OpenGL Color Functions, Point Attributes, OpenGL Point-Attribute Functions, Line Attributes, OpenGL Line-Attribute Functions, Curve Attributes, Fill Area Attributes, OpenGL Fill-Area Attribute Functions, Open-GL Antialiasing Functions, OpenGL Query Functions.

Implementation Algorithms for Graphics Primitives and Attributes: Line Drawing Algorithms, Circle Generating Algorithms, General Scan-Line Polygon-Fill Algorithm.

Self-study component:	OpenGL Character Attribute Functions, Fill Methods for Areas with Irregular Boundaries.

UNIT – III	**Geometric Transformations**	**8 Hours**

Two Dimensional Transformations: Basic Two-Dimensional Geometric Transformations, Matrix Representations and Homogeneous Coordinates, Inverse Transformations, Two Dimensional Composite Transformations, Other Two Dimensional Transformations, Transformations Between Two Dimensional Coordinate System, OpenGL Functions for Two-Dimensional Geometric Transformations.

Three Dimensional Geometric Transformations: Three-Dimensional Translation, Three-Dimensional Rotation, Three-Dimensional Scaling, Composite Three-Dimensional Transformations, Other Three-Dimensional Transformations, Affine Transformations, OpenGL Geometric-Transformation Functions.

Self-study component:	Raster Methods for Geometric Transformations, OpenGL Raster Transformations.	
UNIT – IV	**Viewing and Clipping**	**8 Hours**
Two-Dimensional Viewing: The Two-Dimensional Viewing Pipeline, The Clipping Window, Normalization and Viewport, OpenGL Two-Dimensional Viewing Functions, Clipping Algorithms, Two-Dimensional Point Clipping, Two-Dimensional Line Clipping (Cohen-Sutherland Line Clipping and Liang-Barsky Line Clipping), Polygon Fill-Area Clipping (Sutherland- Hodgeman Polygon Clipping), Text Clipping.		
Self-study component:	Curve Clipping, Weiler-Atherson Polygon Clipping.	
UNIT – V	**3D Viewing and Illumination Models**	**8 Hours**
Three-Dimensional Viewing: Transformation from World to Viewing Coordinates, Projection Transformations, Orthogonal Projections, Perspective Projections, OpenGL Three-Dimensional Viewing Functions. **Illumination Models and Surface Rendering Methods**: Light Sources, Surface Lighting Effects, Basic Illumination Models.		
Self-study component:	Transparent Surfaces, OpenGL Illumination and Surface Rendering Functions.	

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Explain graphics hardware, OpenGL Graphics primitives attributes.	Understand	L1
CO2	Identify and implement algorithms for 2D graphics Primitives and attributes	Apply	L2
CO3	Evaluate various Algorithms of 2D and 3D Transformations on different type of objects	Evaluate	L3
CO4	Apply clipping and viewing techniques on different types of objects.	Apply	L3
CO5	Design interactive computer graphics programs using OpenGL.	Create	L4

Course Articulation Matrix:

CO	Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO 3
CO1	Explain graphics hardware, OpenGL Graphics primitives attributes.	1				1							1	1		
CO2	entify and implement algorithms for 2D graphics Primitives and attributes	2	2	1									1	1		
CO3	Evaluate various Algorithms of 2D and 3D Transformations on different type of objects	2	2	2									1	1		
CO4	Apply clipping and viewing techniques on different types of objects.	2	2	1									1	1		
CO5	Design interactive computer graphics programs using OpenGL.	2	2	2		2			1	1	1	1	1	1		

Text Book(s):

1. Computer Graphics with OpenGL, Donald Hearn & M Pauline Baker, Fourth Edition Pearson 2014

Reference Book(s):

1. Computer Graphics using OpenGL, FS Hill & Stephen M Kelley, 3 rd Edition, Pearson Education, 2009.
2. Interactive Computer Graphics – A Top-down Approach using Opengl, Edward Angel, 6 th Edition Pearson Education 2012.

Web and Video link(s):

1. https://www.youtube.com/watch?v=lTN7bDyHrfE
2. https://www.youtube.com/watch?v=XYWjnRV3ty8

E-Books/Resources:

1 **https://drive.google.com/drive/folders/1WJiTYewbVpfhe8G0IAw7YLR43djW8aIB?usp=drive_link**

2 **https://drive.google.com/file/d/1zMCWWFN9bxtl0mXjRw_o1v-dqjwcv282/view?usp=drive_link**

Cloud Computing Platform

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P21CS5033**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

The student will be able to :

CLO 1.Identify the architecture, infrastructure and delivery models of cloud computing

CLO 2.Compare and contrast different cloud services.

CLO 3.Apply suitable virtualization concept.

CLO 4.Apply Cloud automation and management tools to build your own cloud application in Google Cloud Platform.

UNIT – I	**Introduction to Cloud Infrastructure**	**8 Hours**

Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Major Challenges Faced by Cloud Computing, Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, User experience and software licensing.

Self-study component:	Comparative analysis on Services provided by AWS AND GCP

UNIT – II	**Cloud Computing: Application Paradigms and Concepts**	**8 Hours**

Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model, A case study: The Grep The Web application. Cloud Resource Virtualization-Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and Para virtualization, Hardware support for virtualization.

Self-study component:	Virtualization in AWS and Microsoft Azure

UNIT – III	**Resource Management and Scheduling**	**8 Hours**

Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling Map Reduce applications subject to deadlines, Resource management and dynamic scaling.

Self-study component:	Application of map reduce in AWS and Microsoft Azure

UNIT – IV	**Google Cloud Platform and Services**	**8 Hours**

Types of Cloud Services, Cloud Computing vs. Data Center Computing. Computing Components of Google Cloud Platform, Storage Components of Google Cloud Platform, Networking Components of Google Cloud Platform, Additional Components of Google Cloud Platform. How GCP Organizes Projects and Accounts, Roles and Identities, Billing, Enabling APIs.

Self-study component:	Projects and Accounts, Roles and Identities, Billing, Enabling APIs in AWS and Microsoft Azure

UNIT – V	**Computation in Google Cloud**	**8 Hours**

Compute Engine, App Engine, Kubernetes Engine, Cloud Functions, Creating and Configuring Virtual Machines with the console, Creating and Configuring Virtual Machines with Cloud SDK, Basic Virtual Machine Management, Guidelines for planning, Deploying and Managing Virtual Machines, Managing Single Virtual Machine Instances, Introduction to Instance Groups, Guidelines for Managing Virtual Machine.

Self-study component:	Execution of Kubernetes Engine in AWS and Microsoft Azure

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Explain** the basic cloud computing concepts and distinguish between the various cloud infrastructures.	Understanding	L2
CO2	**Explain** application paradigm and concept	Understanding	L2
CO3	**Apply** different types of virtualization and Resource Management techniques that can be used in designing cloud applications.	Applying	L3
CO4	**Explain** google platform and services.	Understanding	L2
CO5	**Apply** Google Cloud Platform using Qwiklabs to build cloud applications.	Applying	L3

Text Book(s):

1. Dan C Marinescu: Cloud Computing Theory and Practice, 2nd edition. Elsevier(MK) 2013.
2. Dan Sullivan: Official Google Cloud Certified Associate Cloud Engineer Study Guide, 1st edition, SYBEX, 2019

Reference Book(s):

1. John W Rittinghouse, James F Ransome:Cloud Computing Implementation, Management and Security, CRC Press 2013.

Web and Video link(s):

- AWS https://www.youtube.com/watch?v=k1RI5locZE4
- GCP https://www.youtube.com/watch?v=m6ozQnqit50
- Aneka https://www.youtube.com/watch?v=8FeysgQLwIo

E-Books/Resources:

- https://aws.amazon.com/executive-insights/content/data-security-as-business-accelerator/
- https://cloud.google.com/resources/future-of-cloud-computing-ebook

CO-PO Mapping

COURSE ARTICULATION MATRIX [Cloud Computing Platform]															
CO's	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PSO 3**
Explain the basic cloud computing concepts	**1**												1		
Explain application paradigm and concept	**1**	**2**											1		
Apply different types of virtualization and Resource Management techniques that can be used in designing cloud applications.	**1**	**2**	**1**										1		
Explain google platform and services	**1**	**2**											1		
Apply Google Cloud Platform using Qwiklabs to build cloud applications.	**1**	**2**	**1**										1		

Artificial intelligence [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER - V			
Course Code:	**P21CS5034**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives:

- Gain a historical perspective of AI and its foundations.
- Become familiar with basic principles of AI toward problem solving.
- Get to know approaches of inference, perception, Uncertain Knowledge and Reasoning

UNIT – I	**8 Hours**
Introduction - The Foundations of Artificial Intelligence, The History of Artificial Intelligence. Intelligent Agents - Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents.	
Self-study component:	AI - State of the Art
UNIT – II	**8 Hours**
Solving Problems by Searching - Problem-Solving Agents, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions	
Self-study component:	Problem-solving agents - Example problems
UNIT – III	**8 Hours**
Beyond Classical Search - Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces, Searching with Nondeterministic Actions, Searching with Partial Observations, Online Search Agents and Unknown Environments.	
Self-study component:	Learning in online search.
UNIT – IV	**8 Hours**
Adversarial Search – Games, Optimal Decisions in Games, Alpha–Beta Pruning, Imperfect Real-Time Decisions, Stochastic Games, Partially Observable Games. **Logical Agents** - Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic: A Very Simple Logic, Propositional Theorem Proving.	
Self-study component:	State-of-the-Art Game Programs.
UNIT – V	**8 Hours**
First-Order Logic - Representation, Syntax and Semantics of First-Order Logic, Using First-Order Logic. **Inference in First-Order Logic** - Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution.	
Self-study component:	Knowledge Engineering in First-Order Logic

COs	**Course Outcomes** with ***Action verb*** for the Course topics	**Bloom's Level**	**Level Indicator**
CO1	**Apply** knowledge of agent architecture, searching and reasoning techniques for different applications.	Apply	L3
CO2	**Analyse** Searching and Inferencing Techniques.	Analyse	L3
CO3	**Develop** knowledge base sentences using propositional logic and first order logic	Develop	L3

Text Book(s): 1. Stuart J. Russell and Peter Norvig , Artificial Intelligence, 3rd Edition, Pearson,2015
Reference Book(s): 1. Elaine Rich, Kevin Knight, Artificial Intelligence, 3rd edition, Tata McGraw Hill,2013 2. George F Lugar, Artificial Intelligence Structure and strategies for complex, Pearson Education, 5th Edition, 2011
Web and Video link(s): 1. https://www.kdnuggets.com/2019/11/10-free-must-read-books-ai.html 2. https://www.udacity.com/course/knowledge-based-ai-cognitive-systems--ud409 3. https://nptel.ac.in/courses/106/105/106105077/

CO-PO Mapping

CO's	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**Apply** knowledge of agent architecture, searching and reasoning techniques for different applications.	3													2	
CO2	**Analyse** Searching and Inferencing Techniques.		3												2	
CO3	**Develop** knowledge base sentences using propositional logic and first order logic			3											2	

Fundamentals of Data Structures [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	**P21CSO5051**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students :

- To become familiar with the concept of pointers and its usage in data structure.
- To study and understand the representation and implementation of linear & non-linear data structures.
- To identify the appropriate data structure in solving real-time applications.

UNIT – I	**8 Hours**

Basic concepts: Structures, Pointers and dynamic memory allocation.
Stack: Definition and examples, Representation of stack
Applications of Stack: Converting an expression from Infix to postfix, Evaluation of Expression.
Recursion: Factorial, Fibonacci Sequence, Tower of Hanoi.

Self-study component:	Converting an expression from Infix to Prefix, Prefix to Postfix

UNIT – II	**8 Hours**

Queues: The queue and its Array representation, Linear queue, Circular Queue, Double Ended Queue, Priority Queue.

Self-study component:	Implementation of Queues using Structures.

UNIT – III	**8 Hours**

Linked Lists: Linked list, Operations on singly linked list: Insert, Delete, Display, Concatenate, Search, Merge Sort.

Self-study component:	Reverse the linked list

UNIT – IV	**8 Hours**

Circular lists and its basic operations: Insert, Delete and Display.
Doubly linked lists and its basic operations: Insert, Delete and Display.
Applications of linked lists: Addition of long positive integers using circular list.

Self-study component:	Evaluation of a polynomial

UNIT – V	**8 Hours**

Trees: Introduction, Representation of trees, Binary Tree, Properties of Binary Trees, Binary tree representation- Binary tree traversals,
Binary Search Tree (BST): Definition, Searching a BST, Inserting into BST, deletion from BST.

Self-study component:	Construction of a Binary Tree for a given Expression.

Course Outcomes: On completion of this course, students are able to:			
CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Apply** the concepts of pointers in data structures.	Apply	L2
CO2	Analyze and represent various data structures and its operations.	Analyze	L2
CO3	Design algorithms using different data structures like List, Stack, Queue and Trees.	Design	L3
CO4	Develop programs with suitable data structure based on the requirements of the real- time applications.	Develop	L3

Text Book(s):

1. Fundamentals of Data Structures in C Horowitz, Sahni, Anderson Freed Second Universities Press 2008
2. Data Structures using C Aaron M. Tenenbaum, Yedidyah Langsam, Moshe J. Augenstein Fifth Pearson education 2007

Reference Book(s):

1. Data structures and program design in C Robert L. Kruse, Clovis L. Tondo, Bruce P. Leung Second Prentice Hal 1997.
2. Data Structure using C A.M Padma Reddy Thirteenth edition Sri Nandi 2013.

Web and Video link(s):

1. Data Structures and algorithms offered by NPTEL: https://nptel.ac.in/courses/106102064/

E-Books/Resources:

1. https://www.academia.edu/28758384/

CP-PO Mapping

CO's	Statements	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	Apply the concepts of pointers in data structures.	**2**											
CO2	Analyze and represent various data structures and its operations.	**2**	**2**										
CO3	Design algorithms using different data structures like List, Stack, Queue and Trees.	**2**	**2**	**2**									
CO4	Develop programs with suitable data structure based on the requirements of the real-time applications.	**1**	**1**	**2**									**1**

Introduction to Python Programming [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	**P21CSO5052**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Learn the syntax and semantics of the Python programming language.
- Illustrate the process of structuring the data using Data Structure..
- Appraise the need for working with various documents like Excel, PDF, Word and Others.
- Implement the Object Oriented Programming concepts in Python.

UNIT – I	**8 Hours**

Python Basics: Feature of Python, Writing and Executing First Python Program, Literal Constants, Variables and Identifiers, Data Types, Input Operation, Operators and Expressions, Expressions in Python, Other Data Types.

Decision Control Statements: Introduction to Decision Control Statements, Conditional Branching Statements, Basic Loop statements, Nested Loops.

Self-study component:	Type Conversion.

UNIT – II	**8 Hours**

Functions: Function Definition, Function Call, Variable Scope, Return Statement

Strings: Introduction, Operations on strings, Strings Formatting Operator, Built in String Methods and Functions, Slice Operation, in and not in operators, Comparing Strings, Iterating String, The String Module.

Self-study component:	Recursive Functions.

UNIT – III	**8 Hours**

Lists: Access Values in Lists, Updating Values in Lists, Nested Lists, Cloning Lists, Basic List Operations, List Methods, Using List as a Stack, Using Lists as Queues, Looping Lists.

Tuples: Creating Tuples, Utility of Tuples, Accessing Values in a Tuple, Updating Tuple, Deleting Elements in Tuple, Basics of Tuple Operation.

Dictionaries: Creating a Dictionary, Accessing values, Adding and Modifying an Item in a Dictionary, Deleting Items, Sorting Items, Looping over a dictionary, Nested dictionary.

Self-study component:	Advantages of Tuple over List

UNIT – IV	**8 Hours**

Introduction to Object Oriented Programming (OOP): Generation of Programming Languages, Programming Paradigms, Features of Object Oriented Programming.

Classes and objects: Classes and Objects, Class Method and *self*-Argument, The *init* Method, Class Variables and Object Variables, *del* Method, Other Special Methods, Public and Private Data Members, Private Methods, Calling a Class Method, Built in Functions, Built in Class Attributes.

Self-study component:	Garbage Collection.

UNIT – V			8 Hours
Inheritance: Introduction, Inheriting Classes in Python, Types of Inheritance, Abstract Classes and Interfaces. **Exception Handling**: Introduction, Handling Exceptions, Multiple Except Blocks, Raising Exceptions, Handling Exception in Invoked Functions**,** The finally Block.			
Self-study component:	Built-in and User defined Exceptions.		
Course Outcomes: On completion of this course, students are able to:			
CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Demonstrate** python basics and proficiency in handling control statement.	Understand	L2
CO2	**Apply** the concepts of Data Structure for the given problem.	Apply	L3
CO3	**Develop** programs for string processing.	Apply	L3
CO4	**Implement** the concepts of Object-Oriented Programming as used in Python.	Analyze	L3

Textbook:

1. Reema Thereja , "Python programming: using problem solving approach", 1st Edition, Oxford University press, 2017.

Reference book(s):

1. Al Sweigart, "Automate the Boring Stuff with Python", 1st Edition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at https://automatetheboringstuff.com/) (Chapters 1 to 18, except 12) for lambda functions use this link: https://www.learnbyexample.org/python-lambda-function/
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015. (Available under CC-BY-NC license at http://greenteapress.com/thinkpython2/thinkpython2.pdf (Chapters 13, 15, 16, 17, 18) (Download pdf/html files from the above link

Web and Video link(s):

1. https://www.learnbyexample.org/python/
2. https://www.learnpython.org/
3. https://pythontutor.com/visualize.html#mode=edit

E-Books/Resources:

1. https://www.scribd.com/presentation/541584917/Basics-of-Python

CO-PO Mapping

CO's	Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**Demonstrate** python basics and proficiency in handling control statement.	2	2	1									
CO2	**Apply** the concepts of Data Structure for the given problem.	2	1	1									
CO3	**Develop** programs for string processing.	1	1	1									
CO4	**Implement** the concepts of Object-Oriented Programming as used in Python.	1	1										

Fundamentals of Artificial Intelligence [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	**P21CSO5053**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives:
To make the students to understand the concepts of intelligence, modeling, simulation, knowledge representation, reasoning, issues, expert and fuzzy systems.

UNIT – I	**8 Hours**
Artificial Intelligence: Definitions, Programming Methods, Techniques; Intelligent Systems; Predicate Calculus; Rule-Based Knowledge Representation; Symbolic Reasoning Under Uncertainty; Basic Knowledge Representation Issues.	
Self-study component: Artificial Intelligence Importance	

UNIT – II	**8 Hours**
Heuristic Search: Techniques for Heuristic Search; Heuristic Classification; Intelligent Agents **State Space Search:** Strategies for State Space Search; Learning.	
Self-study component: Applications of Search Techniques in Game Playing and Planning	

UNIT – III	**8 Hours**
Expert Systems: Stages in the development of an Expert Systems; Probability based Expert Systems; Expert System Tools; Applications of Expert Systems.	
Self-study component: Applications of Expert System	

UNIT – IV	**8 Hours**
Introduction to fuzzy systems: Foundation of fuzzy Systems; Linguistic Description and their Analytical Forms; Defuzzification Methods; Fuzzy logic in Control and Decision-making Applications.	
Self-study component: Fuzzy Relations, Arithmetic Operation of Fuzzy Numbers.	

UNIT – V	**8 Hours**
Introduction to Genetic Algorithms: Genetic Algorithms; Procedures of Genetic Algorithms; The working of Genetic Algorithms; Logic behind Genetic Algorithms. Swarm Intelligent Systems Ant Colony Systems; Development of Ant Colony Systems; Applications of Ant Colony Intelligence.	
Self-study component: Swarm Intelligent System – Background of Ant Intelligent Systems, Importance of the Ant Colony Paradigm.	

CO's	**Course Outcomes** with ***Action verb*** for the Course topics	**Bloom's Level Taxonomy**	**Level Indicator**
CO1	**Analyze** how Artificial Intelligence and Intelligence Systems enable capabilities that are beyond conventional technology.	`Analyze	L3
CO2	**Analyze** how heuristic state-space search algorithms are used to solve complex problems.	Analyze	L3
CO3	**Analyze** and **Design** a rule-based expert system with tools.	Analyze	L3
CO4	**Design** *fuzzy-logic* based controllers and explore their unique characteristics.	Design	L3
CO5	**Applying** genetic algorithms and an outlook on the applications of genetic algorithms.	Apply	L3

Text Book(s):

1. N.P.Padhy: Artificial Intelligence and Intelligent Systems, Oxford University Press, 2017.

Reference Book(s):

1. Efraim Turban, Jay E. Aronson, Ting-Peng Liang**:** Decision Support Systems and Intelligent Systems, VII Edition, Prentice-Hall of India.

CO-PO MAPPING

CO's	Statements	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**Analyze** how Artificial Intelligence and Intelligence Systems enable capabilities that are beyond conventional technology.		2										
CO2	**Analyze** how heuristic state-space search algorithms are used to solve complex problems.		2										
CO3	**Analyze** and **Design** a rule-based expert system with tools.		2	2									
CO4	**Design** *fuzzy-logic* based controllers and explore their unique characteristics.		1	2									
CO5	**Applying** genetic algorithms and an outlook on the applications of genetic algorithms.	2											

Data Base Management System [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	**P21CSO5054**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- To learn the basic knowledge of Database Management System and various types of data models.
- To learn the concept and syntax of ER Diagram, relational data model and relational algebra.
- To learn and write various SQL queries.
- To learn the concept of Normalization.

UNIT – I	**8 Hours**
INTRODUCTION: An example: Characteristics of Database approach; Advantages of using DBMS approach; A brief history of database applications; Data models, schemas and instances; Three-schema architecture and data independence; Database languages and interfaces; The database system environment.	
Self-study component:	Actors on the scene, workers behind the scene.
UNIT – II	**8 Hours**
ENTITY-RELATIONSHIP MODEL : Using High-Level Conceptual Data Models for Database Design; An Example Database Application; Entity Types, Entity Sets, Attributes and Keys; Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types; Refining the ER Design; ER Diagrams, Naming Conventions and Design Issues..	
Self-study component:	Relationship types of degree higher than two.
UNIT – III	**8 Hours**
RELATIONAL MODEL AND RELATIONAL ALGEBRA: Relational Model Concepts; Relational Model Constraints and Relational Database Schemas; Update Operations, Transactions and dealing with constraint violations; Unary Relational Operations: SELECT and PROJECT; Relational Algebra Operations from Set Theory; Binary Relational Operations : JOIN and DIVISION; Additional Relational Operations; Examples of Queries in Relational Algebra; Relational Database .	
Self-study component:	Rename and Division operation.
UNIT – IV	**8 Hours**
STRUCTURED QUERY LANGAUGE: SQL Data Definition and Data Types; Specifying basic constraints in SQL; Basic Retrieval Queries in SQL, INSERT, DELETE, and UPDATE Statements in SQL.	
Self-study component:	Specifying constraints as assertions and triggers.
UNIT – V	**8 Hours**
DATABASE DESIGN: 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;	
Self-study component:	Definitions of Multi valued Dependencies and Fourth Normal Form; Join Dependencies and Fifth Normal Form.

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Understand** the database concepts to create the relations by specifying various constraints.	Understand	L2
CO2	**Design** an ER diagram for given scenario.	Design	L3
CO3	**Develop** SQL commands for a given queries.	Develop	L3
CO4	**Apply** suitable normalization technique to improve database design	Apply	L3

Text Book(s):

1. Fundamentals of Database Systems – Elmasri and Navathe, 7 th Edition, Addison-Wesley, 2011

Reference Book(s):

1. **Data Base System Concepts** – Silberschatz, Korth and Sudharshan, 5th Edition, Mc-GrawHill, 2006.
2. **An Introduction to Database Systems** – C.J. Date, A. Kannan, S.Swamynatham, 8th Edition, Pearson Education, 2006.
3. **Database Management Systems** – Raghu Ramakrishnan and Johannes Gehrke, 3rd Edition, McGraw-Hill, 2003.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc22_cs91/
2. **2**. https://youtu.be/c5HAwKX-suM

E-Books/Resources:

1. https://www.ebooks-for-all.com/bookmarks/detail/Database-Management-Systems/onecat/0.html
2. https://ebooks.lpude.in/management/mba/term_3/DCAP204_MANAGING_DATABASE_DCAP402_DATABASE_MANAGEMENT_SYSTEMS.pdf

CO-PO MAPPING

CO's	Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**Understand** the database concepts to create the relations by specifying various	3	3	3	1					2		2	2
CO2	**Design** an ER diagram for given scenario.	3	2	3	1					2		2	2
CO3	**Develop** SQL commands for a given queries.	3	3	3		2				2		2	
CO4	**Apply** suitable normalization technique to improve database design	2	2	2						2		2	

Computer networks Laboratory

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P21CSL506**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**24**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Understand the fundamentals concepts of computer networks in simulation environment.
- Familiarize with the implement of the standard models to set the communication between machines in a network.

EXPERIMENTS

Part A

1. Simulate a topology with 2 LAN's each having two devices connected to switches. Switches are connected to a common router. Observe the packet flow.
2. Construct simple LAN using 3 nodes and understand working of Address Resolution Protocol (ARP).
3. Perform an experiment to understand the dynamic IP address allocation process observe the routing table at beginning and the end of simulation.
4. Construct a simple LAN by configuring static routing and observe the routing table at the beginning and at the end of simulation.
5. Simulate a topology where 3 routers are fully connected and each router connected to an end device. Observe the flow of ICMP packets from one network to other using RIP protocol.
6. Simulate a topology where 3 routers are fully connected and each router connected to an end device. Observe the flow of ICMP packets from one network to other using OSPF protocol.
7. Simulate a network for browsing and understand DNS protocol.

Part B

1. Write a program to implement error detection/ error correction using hamming code.
2. Write a program to show working of the Stop and wait protocol.
3. Implementation of CSMA/CD.
4. Write a program to implement Distance Vector Routing algorithm.
5. Write program to create a least cost tree using Link State Routing algorithm.
6. To write echo client-server application using TCP.

Course Outcomes: On completion of this course, students are able to:		**Bloom's Level**
Cos	**Course Outcomes with Action verbs for the Course topics**	
CO1	**Understand** the working of various networking components in the simulation environment.	**L1**
CO2	**Analyse** the working principle of the protocols in the TCP/IP protocol suite.	**L2**
CO3	**Implemen**t given networking scenarios and analyse the results.	**L3**

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	**Understand** the working of various networking components in the simulation environment.	1	1	1										1		1
CO 2	**Analyse** the working principle of the protocols in the TCP/IP protocol suite.	2	1	2	2	2								1		2
CO 3	**Implemen**t given networking scenarios and analyse the results.	1	2	2	2	2								1		2

Internship - II [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	**P21INT507**	**Credits:**	**02**
Teaching Hours/Week (L:T:P)	**0:0:0**	**CIE Marks:**	**-**
Total Number of Teaching Hours:	**-**	**SEE Marks:**	**100**

All the students registered to III year of BE shall have to undergo a mandatory internship of 04 weeks during the vacation of IV semesters in industrial/Govt./NGO/MSME/Rural Internship/Innovation/Entrepreneurship/AICTE Intern Shala/College Partnered Industries. A Semester End Examination (Presentation followed by Question Answer session) shall be conducted during V semester and the prescribed credit shall be included in the V semester grade card. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during subsequent Semester End Examination after satisfying the internship requirements. (The faculty coordinator or mentor has to monitor the students' internship progress and interact to guide them for the successful completion of the internship.)

Internship-II: SEE component will be the only seminar/Presentation and question answer session

Social Connect and Responsibility [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	**P21UHV509**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**1:0:0**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**25+5**	**SEE Marks:**	**--**

Course Outcomes: This course will enable the students to:

- **Identify** the needs of the community and involve them in problem solving.
- **Demonstrate** the knowledge about the culture and societal realities.
- **Develop** sense of responsibilities and bond with the local community.
- **Make use** of the Knowledge gained towards significant contributions to the local community and the society at large.
- **Develop** among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions for individual and community problems.

PART-I	

Plantation and adoption of a tree: Plantation of a tree that will be adopted for four years by a group of BE / B.Tech students. (ONE STUDENT ONE TREE) They will also make an excpert either as a documentary or a photo blog describing the plant's origin, its usage in daily life, its appearance in folklore and literature – Objectives, Visit, case study, report, outcomes.

PART-II	

Heritage walk and crafts corner: Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms - – Objectives, Visit, case study, report, outcomes.

PART-III	

Organic farming and waste management: Usefulness of organic farming, wet waste management in neighboring villages, and implementation in the campus.

PART-IV	

Water conservation: Knowing the present practices in the surrounding villages and implementation in the campus, documentary or photoblog presenting the current practices – Objectives, Visit, case study, report, outcomes.

PART-V	

Food walk: City's culinary practices, food lore, and indigenous materials of the region used in cooking – Objectives, Visit, case study, report, outcomes.

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Identify** the needs of the community and involve them in problem **solving.**	**Knowledge / Apply**	**L1 & L3**
CO2	**Demonstrate** the knowledge about the culture and societal realities.	**Understand**	**L2**
CO3	**Develop** sense of responsibilities and bond with the local community	**Apply**	**L4**
CO4	**Make use** of the Knowledge gained towards significant contributions to the local community and the society at large.	**Apply**	**L4**
CO5	**Develop** among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions for individual and community problems.	**Create**	**L6**

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Identify** the needs of the community and involve them in problem **solving.**	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
2	**Demonstrate** the knowledge about the culture and societal realities.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
3	**Develop** sense of responsibilities and bond with the local community.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
4	**Make use** of the Knowledge gained towards significant contributions to the local community and the society at large.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
5	**Develop** among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-

Guideline for Assessment Process:

Continuous Internal Evaluation (CIE) :

After completion of the social connect and responsibility course, the student shall prepare, with daily diary/ report as reference and a comprehensive report in consultation with the faculty/mentor to indicate what he has observed and learned in the social connect period.

The report shall be evaluated on the basis of the following below criteria's or other relevant criteria pertaining to the activity completed.

- Planning and scheduling the social connect.
- Information/Data collected during the social connect.
- Analysis of the information/data and report writing.
- Presentation and interaction.

CIE Rubrics for Evaluation.

Report	Video presentation	Interaction	Total
10	05	05	20

Note:

- Video presentation of **4 to 5 min** in a team to be presented and the same to be uploaded in the department YouTube channel.
- The number of students in each team can be from **4 to 5** members.
- Each activities has to be evaluated on above basis that is [20 * 5 = 100 marks] for final total marks.

Duration : A total of 25 – 30 hours engagement per semester is required for the 5th semester of the B.E./B.Tech. program. The students will be divided into groups and each group will be handled by faculty mentor.

Pedagogy – Guidelines:

Special Note: NO SEE – Semester End Exam – Completely Practical and activities based evaluation

It may differ depending on local resources available for the study as well as environment and climatic differences, location and time of execution.

Sl No	Topic	**Group size**	Location	**Activity execution**	**Reporting**	**Evaluation Of the Topic**
1.	**Plantation and adoption of a tree:**	May be individual or team	Farmers land/ parks / Villages / roadside/ community area / College campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
2.	**Heritage walk and crafts corner:**	May be individual or team	Temples / monumental places / Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
3.	**Organic farming and waste management:**	May be individual or team	Farmers land / parks / Villages visits / roadside/ community area / College campus etc…..	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
4.	**Water conservation:** & conservation techniques	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers / campus etc…..	site selection / proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
5.	**Food walk: Practices in society**	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty

Employability Enhancement Skills (EES) - V
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – V

Course Code:	**P21HSMC508**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:2:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**28**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable students to:

- Apply programming constructs of C language to solve the real-world problem.
- Explore user-defined data structures like arrays, structures and pointers in implementing solutions to problems.
- Design and Develop solutions to problems using functions.

UNIT – I	**10 Hours**

Problem solving through C -

Flow Control: If…else, for Loop, while Loop, break and continue, switch…case, goto, Control Flow Examples, Simple Programs.

Functions: Functions, User-defined Functions, Function Types, Recursion, Storage Class, Programs

Arrays: Arrays, Multi-dimensional Arrays, Arrays & Functions, Programs.

Self-Study: Variables and constants

UNIT – II	**10 Hours**

Problem solving through C -

Pointers: Pointers, Pointers & Arrays, Pointers and Functions, Memory Allocation, Array & Pointer Examples.

Strings: String Functions, String Examples, Programs.

Self-Study: Evaluation of Expression.

UNIT – III	**08 Hours**

Problem solving through C -

Structure and Union: Structure, Struct & Pointers, Struct & Function, Unions, Programs.

Programming Files: Files Input/output

Self-Study: Error handling during I/O operations.

Course Outcomes: On completion of this course, students are able to:	
CO – 1:	Apply suitable programming constructs of C language to solve the given problem.
CO – 2:	Explore user-defined data structures like arrays in implementing solutions to problems like searching and sorting.
CO – 3:	Design and Develop solutions to problems using functions.

Text Book(s):

1. The C Programming Language (2nd edition) by Brian Kernighan and Dennis Ritchie.
2. C in Depth by S K Srivastava and Deepali Srivastava.
3. Computer fundamentals and programming in c, "Reema Thareja", Oxford University, Second edition, 2017.

Reference Book(s):

1. E. Balaguruswamy, Programming in ANSI C, 7th Edition, Tata McGraw-Hill. Brian W. Kernighan and Dennis M. Ritchie, The 'C' Programming Language, Prentice Hall of India.

Web and Video link(s):

1. Problem Solving through Programming in C - https://archive.nptel.ac.in/courses/106/105/106105171/

COURSE ARTICULATION MATRIX [Employability Enhancement Skills (EES) - V**]**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	2	2	2	-	-	-	-	-	-	-	-	-
CO-2	2	2	2	-	-	-	-	-	-	-	-	-
CO-3	2	2	1	-	-	-	-	-	-	-	-	-

DATA ANALYTICS [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	**P21CS601**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40 Hours**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Apply quantitative modeling and data analysis techniques to draw conclusion regarding the dataset.
- Employ predictive modeling techniques.
- Identify, assess, and select appropriate data analytics methods and models for solving a particular real-world problem, weighing their advantages and disadvantages.

UNIT – I	**8 Hours**

Introduction to Data Science: Data Analysis Life Cycle Overview. Data analysis Discovery, Framing Problem, Developing Initial Hypothesis, Sources of Data, Process for Making Sense of Data, Data Preparation, Performing ETLT, Data Conditioning, Survey and Visualize, Common tools for Data Preparation Phase, Data Exploration and Variable Selection, Common tools for the Model Planning and Building Phase, Communicate Results, Operationalize.

Self-study component:	The KDD Process, The CRISP-DM Methodology.

UNIT – II	**8 Hours**

Descriptive Statistics: Scale Types, Descriptive Univariate Analysis, Descriptive bivariate Analysis.

Multivariate Analysis: Multivariate Frequencies, Multivariate Data Visualization, Multivariate Statistics.

Statistical Methods for Evaluation: Hypothesis Testing, Difference of Means, Wilcoxon Rank-Sum Test, Type I and Type II Errors, Power and Sample Size, ANOVA.

Self-study component:	Visualization Before Analysis, Dirty Data, Visualizing a Single Variable, Examining Multiple Variables, Data Exploration Versus Presentation.

UNIT – III	**8 Hours**

Data Quality and Pre-processing: Data Quality, Missing Values, Redundant Data, Inconsistent Data, Noisy Data Outliers, Converting to a Different Scale Type, Converting to a Different Scale, Data Transformation, Dimensionality Reduction: Attribute Aggregation: Principal Component Analysis. Attribute selection: filters, wrappers.

Self-study component:	Introduction to R, Exploratory Data Analysis.

UNIT – IV	**8 Hours**

Clustering : Distance Measures, Difference between Values of Common Attribute Types, Distance Measures for Objects with Quantitative Attributes, Distance Measures for Non-conventional Attributes, Clustering Validation, Clustering Techniques, K-means, Centroids and Distance Measures, How K-means Works, Density-based spatial clustering of applications with noise (DBSCAN).

Frequent Pattern Mining: Frequent Item sets, Setting the min_sup Threshold, Apriori – a Join-based Method, Eclat, Maximal and Closed Frequent Item sets, Association Rules.

Self-study component:	Agglomerative Hierarchical Clustering Technique, FP-Growth.

UNIT – V	8 Hours

Regression: Predictive Performance Estimation, Generalization, Model Validation, Predictive Performance Measures for Regression, Finding the Parameters of the Model, Linear Regression.

Classification : Binary Classification , Predictive Performance Measures for Classification, Distance-based Learning Algorithms ,K-nearest Neighbor Algorithms, Case-based Reasoning, Logistic Regression Algorithm, Naive Bayes Algorithm.

Self-study component:	Search-based Algorithms, Decision Tree Induction Algorithms, Decision Trees for Regression.

Course Outcomes: On completion of this course, students are able to:

CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Describe the basic tenets of Data Analysis.	Remember	L2
CO2	Utilize the statistical and computational methods to gain the knowledge on relationships between data.	Apply	L3
CO3	Apply data preprocessing methods on raw data set.	Apply	L3
CO4	Apply unsupervised and supervised learning methods to analyze the datasets.	Apply	L3

Text Book(s):

1. A General Introduction to Data Analytics, João Mendes Moreira, André C.P.L.F. de Carvalho, © 2019 John Wiley & Sons, Inc.
2. Data Science & Big Data Analytics, Discovering, Analyzing, Visualizing and Presenting Data, Published by EMC Education services, 2015.

Reference Book(s):

2. Big Data and Data Analytics by Seema Acharya & Subhashini Chellappan by Wiley India Pvt Ltd.
3. Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining by Glenn J. Myatt, 2nd Edition, Wiley, 2014.
4. Data Mining by Jiawei Han, Micheline Kamber & Jian Pei, 3rd Edition, Morgan Kaufmann, 2012.
4. Beginning R by Mark Gardner, © 2012 John Wiley & Sons, Inc.

Web and Video link(s):

1. Foundations of Data Science: https://www.edx.org/course/foundationsof-data-science
2. Data Preprocessing: https://www.youtube.com/watch?v=CaqJ65CIoMw
3. Unsupervised learning algorithms: https://www.youtube.com/watch?v=D6gtZrsYi6c
4. Supervised learning algorithms: https://www.youtube.com/watch?v=QeKshry8pWQ&pp=ygUSc3VwZXJ2aXNlZCBsZWFybmln

E-Books/Resources:

1. https://careerfoundry.com/en/blog/data-analytics/what-is-data-analytics/
2. https://www.geeksforgeeks.org/supervised-unsupervised-learning/

CO-PO Mapping

CO's	Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	Describe the basic tenets of Data Analysis.	**1**												**1**	**1**	
CO2	Utilize the statistical and computational methods to gain the knowledge on relationships between data.	**2**	**2**	**2**										**1**	**2**	
CO3	Apply data pre-processing methods on raw data set.	**2**	**2**	**2**										**1**	**2**	
CO4	Apply unsupervised and supervised learning methods to analyze the datasets.	**2**	**2**	**2**										**1**	**2**	

Fundamentals of Block chain [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	**P21CS6021**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- The students should be able to understand a broad overview of the essential concepts of blockchain technology.
- To familiarize students with Bitcoin protocol followed by the Ethereum protocol – to lay the foundation necessary for developing applications and programming.
- Students should be able to learn about different types of blockchain and consensus algorithms.

UNIT – I	**Basics of Blockchain**	**8 Hours**
Basics: The Double-Spend Problem, Byzantine Generals' Computing Problems, Public-Key Cryptography, Hashing, Distributed Systems, Distributed Consensus. Technology Stack: Blockchain, Protocol, Currency.		
Self-study component:	Methods of Hashing Techniques	
UNIT – II	**Bitcoin Blockchain**	**8 Hours**
Bitcoin Blockchain: Structure, Operations, Features, Consensus Model, Incentive Model.		
Self-study component:	Creation of Blockchain Nodes	
UNIT – III	**Ethereum Blockchain**	**8 Hours**
Ethereum Blockchain: Smart Contracts, Ethereum Structure, Operations, Consensus Model, Incentive Model.		
Self-study component:	Components of Ethereum networks	
UNIT – IV	**Tiers of Blockchain Technology**	**8 Hours**
Tiers of Blockchain Technology: Blockchain 1.0, Blockchain 2.0, Blockchain 3.0, Types of Blockchain: Public Blockchain, Private Blockchain, Semi-Private Blockchain, Side chains.		
Self-study component:	Understanding the role and responsibility of Blockchain Developers	
UNIT – V	**Types of Consensus Algorithms**	**8 Hours**
Types of Consensus Algorithms: Proof of Stake, Proof of Work, Delegated Proof of Stake, Proof Elapsed Time, Deposite-Based Consensus, Proof of Importance, Federated Consensus or Federated Byzantine Consensus, Practical Byzantine Fault Tolerance.		
Self-study component:	Blockchain Use Case: Supply Chain Management.	

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	To explain the basic notion of distributed systems.	Understanding	L2
CO2	To use the working of an immutable distributed ledger and trust model that defines blockchain.	Applying	L3
CO3	To illustrate the essential components of a blockchain platform.	Applying	L3

Text Book(s):

1.Kirankalyan Kulkarni, Essentials of Bitcoin and Blockchain, Packt Publishing.

2. Anshul Kaushik, Block Chain & Crypto Currencies, Khanna Publishing House.

3. Tiana Laurence, Blockchain for Dummies, 2nd Edition 2019, John Wiley & Sons.

4. Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks by Imran Bashir, Packt Publishing (2017).

Reference Book(s):

1.Blockchain: Blueprint for a New Economy by Melanie Swan, Shroff Publisher O'Reilly Publisher Media; 1st edition (2015).

2. Mastering Bitcoin: Programming the Open Blockchain by Andreas Antonopoulos.

Web and Video link(s):

1. https://www.coursera.org/specializations/blockchain.
2. https://nptel.ac.in/courses/106105184/
3.Introduction to Blockchain Technology and Applications, https://swayam.gov.in/nd1_noc20_cs01/preview

CO-PO Mapping

CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2				1								2	
CO2	2	2			1	1								2	
CO3	2	2			1	1								2	

Network Management

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21CS6022**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Understand the principles of network management
- Understand different standards and protocols used in managing networks
- Understanding the Automation of network management
- Understand remote monitoring of network statistics for Ethernet networks.

UNIT – I	**8 Hours**
Introduction: Common Network Problems, Challenges of Information Technology Managers, Network Management: Goals, Organization and Functions: Goal of Network Management, Network Provisioning, Network Operations and NOC. Network Management, Architecture and Organization. Network Management Perspectives, Service Management Perspectives	
Self-study component: Network Node Components	
UNIT – II	**8 Hours**
Basic Foundations: Network Management Standards, Network Management Models, Organization Model, Information Model – Management Information Trees, Managed Object Perspective. Communication Model; ASN.1-(Abstract syntax notation) Terminology, Symbols, and Conventions, Objects and Data Types, Object Names. Functional Models	
Self-study component: Object Perspectives, An Example of ASN.1 ISO 8824	
UNIT – III	**8 Hours**
SNMPv1 Network Management: Managed Network: The History of SNMP Management, Internet Organizations and standards, Internet Documents, The SNMP Model, The Organization Model, System Overview. The Information Model – Introduction, The Structure of Management Information Management Information Base(MIB)- Object group, System group, IP group and TCP group.	
Self-study component: Case Histories and Examples of Managed Network	
UNIT – IV	**8 Hours**
SNMP Communication Model – The SNMP Architecture, Administrative Model, SNMP Protocol specification, SNMP operation- PDU operations, SNMP MIB groups, Functional Models. **SNMP Management–RMON:** Remote Monitoring, RMON SMI and MIB, RMONI1- RMON1 Textual Conventions, RMON1 Groups and Functions, Relationship Between Control and Data Tables, RMON1 Common and Ethernet Groups, RMON Token Ring Extension Groups.	
Self-study component: RMON2 – The RMON2 Management Information Base.	
UNIT – V	**8 Hours**
Network Management Applications: Configuration Management- Network Provisioning, Inventory Management, Network Topology, Fault Management- Fault Detection, Fault Location and Isolation Techniques, **Performance** Management – Performance Metrics, Data Monitoring, Problem Isolation, Performance Statistics; Security Management – Policies and Procedures, Resources to prevent Security Breaches, Firewalls, Cryptography, Authentication and Authorization, Client/Server Authentication Systems.	
Self-study component: Event correlation Techniques: Rule based and Model based	

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Enumerate the applications of NM and challenges pertaining to security management of an IT Manager	Remember	L1
CO2	Articulate network management standards and models	Remember	L1
CO3	Develop insight knowledge about SNMP network management	Understand	L2
CO4	Identify various network management applications to monitor a network	Apply	L3

Text Book(s):

- Mani Subramanian: Network Management- Principles and Practice, 2nd Pearson Education, 2010.

Text Book Link: https://taufikcool.files.wordpress.com/2015/11/network-management-principles-and-practices-2nd-edition.pdf

Reference Book(s):

- J. Richard Burke: Network management Concepts and Practices: Hands-On Approach, PHI, 2008.

Web and Video link(s):

- https://www.youtube.com/watch?v=liBB_Q7Go5k
- https://www.youtube.com/watch?v=FmKbxjUZhmk&t=10s
- https://www.youtube.com/watch?v=J_Z1BsfB1gM
- https://www.youtube.com/watch?v=Lq7j-QipNrI&t=36s
- https://www.youtube.com/watch?v=o6rtuFcYofo

E-Books/Resources:

- Network Management Fundamentals, Alexander Clemm, Cisco Press, 1st Edition.

CO's	Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	Enumerate the applications of NM and challenges pertaining to security management of an IT Manager	**2**											**1**	**1**		**1**
CO2	Articulate network management standards and models	**2**											**1**	**1**		**1**
CO3	Develop insight knowledge about SNMP network management	**2**											**1**	**1**		**2**
CO4	Identify various network management tools in monitoring a network	**2**	**2**										**1**	**1**		**2**

Service Oriented Architecture

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21CS6023**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives:

1. Comprehend the need for SOA and its evolution.
2. Explore various patterns of service design and techniques.
3. Formulate experiments with various levels and factors.
4. Demonstrate applicability of SOA in various domains.
5. Understand PoC-Requirements Architectures of LMS SOA based integration

UNIT – I	**SOA Basics**	**8 Hours**

SOA BASICS: Software Architecture: Need for Software Architecture, Objectives of Software Architecture, Types of IT Architecture, Architecture Patterns and Styles, Service oriented Architecture; Service Orientation in Daily Life, Evolution of SOA, Drives for SOA, Dimension of SOA, Key components, perspective of SOA, Enterprise-wide SOA; Considerations for Enterprise-Wide SOA, Straw man Architecture For Enterprise-Wide-SOA-Enterprise, SOA Layers, Application Development Process.

Self-study component:	SOA Methodology For Enterprise

UNIT – II	**Enterprise Applications**	**8 Hours**

Enterprise Applications; Architecture Considerations, Solution Architecture for enterprise application, Software platforms for enterprise Applications; Package Application Platforms, Enterprise Application Platforms, Service-oriented-Enterprise Applications; Considerations for Service-Oriented Enterprise Applications, Patterns for SOA, Pattern-Based Architecture for Service-Oriented Enterprise Application(java reference model only).Composite Applications.

Self-study component:	SOA programming models

UNIT – III	**SOA ANALYSIS AND DESIGN**	**8 Hours**

SOA ANALYSIS AND DESIGN; Need For Models, Principles of Service Design, Design of Activity Services, Design of Data services, Design of Client services and Design of business process services, Technologies of SOA; Technologies For Service Enablement, Technologies For Service Integration.

Self-study component:	Technologies for Service orchestration

UNIT – IV	**Business case for SOA**	**8 Hours**

Business case for SOA: Stakeholder OBJECTIVES, Benefits of SOA, Cost Savings, Return on Investment, SOA Governance, Security and implementation; SOA Governance, SOA Security, approach for enterprise wide SOA implementation, Trends in SOA; Technologies in Relation to SOA.

Self-study component:	Advances in SOA

UNIT – V	SOA Technologies-PoC(proof of Concepts)	8 Hours

SOA Technologies-PoC; Loan Management System(LMS), PoC-Requirements Architectures of LMS SOA based integration; integrating existing application, SOA best practices, Basic SOA using REST.

Self-study component:	Role of WSDL,SOAP and JAVA/XML Mapping in SOA

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Explore** the different IT architectures	Remember	L1
CO2	**Elaborate** SOA based applications.	Understanding	L2
CO3	**Asses** web service and realization of SOA	Understanding	L2
CO4	**Derive** restful services	Applying	L3
CO5	**Understand** SOA Technologies-PoC	Understanding	L2

Text Book(s):

1. **Shankar Kambhampaly**, "Service–Oriented Architecture for Enterprise Applications",Wiley Second Edition, 2014.
2. **Mark D. Hansen**, "SOA using Java Web Services", Practice Hall, 2007

Reference Book(s):

1. **WaseemRoshen**, "SOA-Based Enterprise Integration", Tata McGraw-HILL, 2009, 2004

CO-PO Mapping

Semester : VI		**Course code : P21CS6023**					**Title : Service oriented Architecture**									
CO	**Statement**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 01**	**PSO 02**	**PSO 03**
1	**Explore** the different IT Architectures.	3	1		3						2			1	1	
2	**Elaborate** SOA based applications	2	2	2				1	1	1		2		2	2	
3	**Asses** web service and realization of SOA	2	2		2				1		2	1		2	2	
4	**Derive** restful services.	2	2	2	2			1	1	1	2	1		2	2	
5	**Understand** SOA Technologies-PoC	2	2		1			1	1			1	1	1	2	

Software Testing

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21CS6024**	**Credits:**	**04**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Differentiate the various testing techniques
- Analyze the problem and derive suitable test cases.
- Apply suitable technique for designing of flow graph and tool support for model-based testing.

UNIT – I	**Basics of Software Testing**	**8 Hours**

Basics of Software Testing and Examples: Basic definitions, Test cases, Insights from a Venn diagram, Identifying test cases, Error and fault taxonomies, Levels of testing. Examples: Generalized pseudo code, the triangle problem, The Next Date function, The commission problem.

Self-study component:	Currency converter.

UNIT – II	**Decision Table-Based Testing**	**8 Hours**

Software Testing, Decision Table-Based Testing: SATM problem, Decision tables, Test cases for the triangle problem, Test cases for the Next Date function. Data Flow Testing: Definition-Use testing, Slice-based testing. Levels of Testing: Traditional view of testing levels, Alternative life-cycle models.

Self-study component:	The SATM system, separating integration and system testing, case study.

UNIT – III	**System Testing**	**8 Hours**

System Testing: Threads, Basic concepts for requirements specification, Finding threads, Structural strategies and functional strategies for thread testing, SATM test threads, System testing guidelines. Interaction Testing: Context of interaction, taxonomy of interactions, Client/Server Testing.

Self-study component:	Interaction, composition, and determinism

UNIT – IV	**Object-Oriented Integration Testing**	**8 Hours**

Object-Oriented Integration Testing: UML support for integration testing, MM-paths for object-oriented software, A framework for object-oriented dataflow integration testing.GUI Testing: The currency conversion program, Unit testing, Integration Testing and System testing for the currency conversion program. Object-Oriented System Testing: Currency converter UML description, UML-based system testing.

Self-study component:	State chart-based system testing.

UNIT – V	**Exploratory Testing**	**8 Hours**

Exploratory Testing: The context-driven school, Exploring exploratory testing, Exploring a familiar example, Exploratory and context-driven testing observations. Model-Based Testing: Testing based on models, Appropriate models, Use case-based testing, Commercial tool support for model-based testing. Test-Driven Development: Test-then-code cycles, Automated test execution, Java and JUnit example, Pros, cons, and open questions of TDD.

Self-study component:	Retrospective on MDD versus TDD.

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Derive** test cases for any given problem	Remember	L1
CO2	**Compare** the different testing techniques	understand	L2
CO3	**Classify** the problem into suitable testing model	understand	L2
CO4	**Apply** the appropriate technique for the design of flow graph and tool support for model-based testing	Applying	L3

Text Book(s):

1. Paul C. Jorgensen: Software Testing, A Craftsman's Approach, 4rd Edition, Auerbach Publications, 2014.

Reference Book(s):

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

CO-PO Mapping

		Course code : P21CS6024					**Title : Software Testing**									
CO	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	**Derive** test cases for any given problem	2	1	2	2	-	-	-	-	-	-	-	-	2	-	-
CO2	**Compare** the different testing techniques	2	2	2	2	-	-	-	-	-	-	-	-	2	-	-
CO3	**Classify** the problem into suitable testing model	2	2	2	2	-	-	-	-	-	-	-	-	2	-	-
CO4	**Apply** the appropriate technique for the design of flow graph and tool support for model-based testing	3	2	2	2	2	-	-	-	-	-	-	-	2	-	-
		2.25	1.75	2	2	2	-	-	-	-	-	-	-	2	-	-

Soft Computing

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21CS6031**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Understand soft computing concepts and techniques and foster their abilities in designing and implementing soft computing based solutions for real-world and engineering problems.
- Describe Artificial Neural Networks and various categories of ANN
- Understand fuzzy logic systems and its applications.

UNIT – I	**8 Hours**
Introduction to Soft Computing: Neural Networks, Fuzzy Logic, Genetic Algorithm, Hybrid Systems. Artificial Neural Network: Fundamental Concept, Evolution of Neural Networks, Basic Models of Artificial Neural Network, Important Terminologies of ANNs, McCulloch-Pitts Neuron, Hebb Network.	
Self-study component:	Linear Separability

UNIT – II	**8 Hours**
Perceptron Networks(Theory, Perceptron Learning Rule, Architecture, Flowchart, Training Algorithm(single class), Training Algorithm(Multiple classes), Testing Algorithm), Adaptive Linear Neuron(Theory, Architecture, Flowchart, Training Algorithm, Testing Algorithm), Multiple Adaptive Linear Neuron (Theory, Architecture, Flowchart, Training Algorithm)	
Self-study component:	Radial Basis Function Network

UNIT – III	**8 Hours**
Back-Propagation Network (Theory, Architecture, Flowchart, Training Algorithm, Testing Algorithm). Introduction to Fuzzy Logic, Classical Sets-Operations on classical sets, Properties, Function mapping of classical sets, Fuzzy Sets-Fuzzy set operations, Properties.	
Self-study component:	Learning factors of Back-Propagation Network

UNIT – IV	**8 Hours**
Classical Relations-Introduction, Cartesian Product of Relation, Classical Relation, Fuzzy Relations, Tolerance and Equivalence Relations, Membership Functions-Introduction, Features, Fuzzification, Methods of Membership Value Assignments.	
Self-study component:	Fuzzy Arithmetic

UNIT – V	**8 Hours**
Defuzzification-Introduction, Methods, Fuzzy Decision Making-Introduction, Individual, Multi person, Multi objective, Multi attribute, Fuzzy Bayesian decision making, Fuzzy Logic Control System-Control System Design, Architecture and Operation, System Models, Application.	
Self-study component:	Fuzzy Measures

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Understand soft computing techniques and their applications.	Understand	L2
CO2	Apply basics of Neural Networks to solve the given problem	Apply	L3
CO3	Apply basics of fuzzy logic to solve the given problem.	Apply	L3

Text Book(s):

1. "*Principles of Soft Computing*" S. N. Sivanandam, S. N. Deepa Second Edition (2015), Wiley Publication.

Reference Book(s):

1. "*Neural Networks A Classroom Approach*", Satish Kumar, Tata McGrawHill.
2. "*Fuzzy Set Theory and its Applications*", Zimmermann H.S Kluwer, Academic Publishers.
3. "*Genetic Algorithms: Search, Optimization and Machine Learning*", Davis E.Goldberg, Addison Wesley, N.Y., 1989.
4. "*Neural Network Design*", Hagan, Demuth, Beale, CENGAGE Learning, India Edition.

Web and Video link(s):

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

E-Books/Resources:

- www.myreaders.info/html/soft_computing.html

CP-PO Mapping

CO	Statements	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understand soft computing techniques and their applications.	**2**												**1**		
CO2	Apply basics of Neural Networks to solve the given problem.	**2**	**2**	**1**										**1**	**1**	
CO3	Apply basics of fuzzy logic to solve the given problem.	**2**	**2**	**1**										**1**	**1**	

Fundamentals of DevOp's

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21CS6032**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- The objective of the course is to acquaint students with the principles and philosophies of DevOps and to explain the foundational material for DevOps.
- It also introduces students to basic DevOps tools used in the industry for DevOps Engineering.
- Students will have a hands-on experience of building a CI/CD pipeline for continuous Integration, continuous delivery from start to finish.
- It also introduces students to Docker and its details.
- It also introduces students to Kubernetes and its details.

UNIT – I	**DevOps and Infrastructure**	**8 Hours**

DevOps Culture and Practices,Getting started with DevOps,Implementing CI/CD and continuous deployment, Continuous integration(CI), Implementing CI,Continuous delivery(CD),Continuous deployment,Understanding IaC practices,The benefits of IaC, IaC languages and tools,Scripting types, Declarative types,The IaC topology, The deployment and provisioning of the infrastructure, Server configuration, Immutable infrastructure with containers, Configuration and deployment in Kubernetes, IaC best practices

Optimizing Infrastructure Deployment with Packer:

Technical requirements,An overview of Packer, Installing Packer,Installing manually, Installing by script, Installing Packer by script on Linux, Installing Packer by script on Windows, Integrating Packer with Azure Cloud Shell, Checking the Packer installation, Creating Packer templates for Azure VMs with scripts,The structure of the Packer template, The builders section, The provisioners section, The variables section,Building an Azure image with the Packer template,Using Ansible in a Packer template,Writing the Ansible playbook,Integrating an Ansible playbook in a Packer template,Executing Packer,Configuring Packer to authenticate to Azure,Checking the validity of the Packer template,Running Packer to generate our VM image

Self-study component:	Practically implement the above concepts

UNIT – II	**DevOps CI/CD Pipeline I**	**8 Hours**

Managing Your Source Code with Git,Technical requirements, Over viewing Git and its command lines, Git installation, Configuration Git, Git vocabulary, Git command lines, Retrieving a remote repository, Initializing a local repository, Configuring a local repository, Adding a file for the next commit, Creating a commit, Updating the remote repository, Synchronizing the local repository from the remote, Managing branches, Understanding the Git process and GitFlow pattern,Starting with the Git process,Creating and configuring a Git repository, Committing the code, Archiving on the remote repository, Cloning the repository, The code update, Retrieving updates,Isolating your code with branches, Branching strategy with GitFlow, The GitFlow pattern, GitFlow tools.

Self-study component:	Practically implement the above concepts

UNIT – III	DevOpsCI/CDPipeline II	8 Hours
Continuous Integration and Continuous Delivery, Technical requirements, The CI/CD principles, Continuous integration(CI) ,Continuous delivery(CD),Using a package manager,Private NuGet and npm repository, Nexus Repository OSS,Azure Artifacts,Using Jenkins,Installing and configuring Jenkins, Configuring a GitHub webhook, Configuring a Jenkins CI job,Executing the Jenkins job,Using Azure Pipelines, Versioning of the code with Git in Azure Repos,Creating the CI pipeline,Creating the CD pipeline :the release, Using GitLab CI, Authentication at GitLab, Creating a new project and managing your code source, Creating the CI pipeline,Accessing the CI pipeline execution details.		
Self-study component:	Practically implement the above concepts	
UNIT – IV	**Containerized Applications with Docker**	**8 Hours**
Containerizing Your Application with Docker, Technical requirements, Installing Docker, Registering on Docker Hub, Docker installation, An overview of Docker's elements, Creating a Dockerfile , Writing a Dockerfile, Dockerfile instructions overview, Building and running a container on a local machine,Building a Docker image,Instantiating a new container of an image, Testing a container locally, Pushing an image to Docker Hub, Deploying a container to ACI with a CI/CD pipeline, The Terraform code for ACI, Creating a CI/CD pipeline for the container.		
Self-study component:	Practically implement the above concepts	
UNIT – V	**Containerized Applications with Kubernetes**	**8 Hours**
Managing Containers Effectively with Kubernetes, Technical requirements, Installing Kubernetes, Kubernetes architecture overview, Installing Kubernetes on a local machine, Installing the Kubernetes dashboard, First example of Kubernetes application deployment, Using HELM as a package manager, Using Azure Kubernetes service, Configuring kubectl for Azure Kubernetes services Advantages of Azure Kubernetes Service, Creating a CI/CD pipeline for Kuberrnetes with Azure Pipelines, The build and push of the image in the Decker Hub , Automatic deployment of the application in Kubermetes		
Self-study component:	Practically implement the above concepts	

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Apply** various **Concepts** and **Principles** used in the topics to understand the theory related to DevOps.	Remember	L1
CO2	**Discuss** the fundamental **Definitions** of DevOps &Github relevant to Software development and deployment.	Understanding	L2
CO3	**Assess** the CI/CD **problems** by applying proper solutions to verify the theoretical concepts.	Understanding	L2
CO4	**Understand** the various **Properties** and **Applications** pertaining **to Dockers.**	Applying	L3
CO5	**Understand** the various **Properties** and **Applications** pertaining to Kubernetes.	Applying	L3

Text Book(s):

1. Mikel Krief: Learning DevOps, Published by Packt Publishing Ltd, October 2019.
2. Mitesh Soni: DevOps Bootcamp, Published by Packt Publishing Ltd, May 2017.

Reference Book(s):

3. Michael Duffy: DevOps Automation Cookbook,Published by Packt Publishing Ltd, Nov 2015.
4. Jennifer Davis: Effective DevOps,Published by O'Reilly Media,in. June 2016
5. David Gonzalez: implementing Modern DevOps,Published by Packt Publishing Ltd,Oct 2017

Web and Video link(s):

3 https://learn.microsoft.com/en-us/azure/devops
4 https://www.guvi.in/devops
5 **https://www.youtube.com/watch?v=hQcFE0RD0cQ**

E-Books/Resources:

6 https://www.edureka.co/blog/ebook/devops-ebook
7 https://www.dynatrace.com/resources/ebooks/devops

CO-PO Mapping

Semester : VI		**Course Code: P21CS6033**					**Title : Fundamentals of DevOp's**									
CO	**Statement**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 01**	**PSO 02**	**PSO 03**
1	**Apply** various **Concepts** and **Principles** used in the topics to understand the theory related toDevOps	3	2						2	1	2		1	2		1
2	**Discuss** the fundamental **Definitions** of DevOps &Github relevant to Software development and deployment.	2	2	3	2				2	1				2		3
3	**Assess** the CI/CD **problems** by applying proper solutions to verify the theoretical concepts.	2	2		2		1	1						2		1
4	**Understand** the various **Properties** and **Applications** pertaining **to Dockers.**	2			3				1					2		2
5	**Understand** the various **Properties** and **Applications** pertaining to Kubernetes.	2			3				1					2		2

Unix System Programming

[As per Choice Based Credit System (CBCS) & OBE Scheme]

Semester – VI

Course Code:	**P21CS6033**	**Credits:**	**03**
Teaching Hours/Week (L: T: P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

The main objective of this course is to learn Fundamentals of **Unix Operating System**. This course introduces important concepts in **Unix OS** such as user/group, processes, file systems, I/O etc. Knowledge of Unix helps to understand **OS** level programming. This course involves basics commands, shell scripting, file processing, Processes, Inter process communication.

Students will learn standard **Unix system utilities** commands and shell scripting, and practice applying them to automate tasks and perform text processing.

System programming (using system calls, library functions and other low-level interfaces) using C/C++ to perform file I/O, memory allocation, process creation and inter-process communication are studied and practiced.

Course Learning Objectives: The Objective of this course is to expose the students to the fundamental concepts of Unix Operating System:

- This course will prepare the students to work on UNIX ENVIRONMENT, Basic UNIX commands, files and directories - File management, User management, in understanding process.
- Shell programming: This course introduces students to the shell programming. The course covers in detail basic commands, the vi editor, the file structure, the shell environment and shell scripts.
- To facilitate students in understanding Inter process communication - Pipe - Shared memory - Signal - semaphore and shared memory.

To facilitate students Upon completion of this course, the student will be familiar with Fundamentals of Unix operating systems, Unix file system and environment, C memory allocation, development tools, processes and signals and programming for security.

Recommended Prior Knowledge:

- Knowledge of the following is essential for taking up this course:
  - Operating System
  - System Programming
  - Computer Organization

UNIT – I	**Introduction to Unix, Unix Commands**	**8 Hours**

Introduction to Unix and Unix Utilities: A brief history of **UNIX / LINUX**, architecture of **UNIX / LINUX** features of **UNIX / LINUX** introduction to **VI** editor.

Introduction to Unix commands: PATH, man, echo, printf, script, passwd, uname, who, date, stty, pwd, cd, mkdir, rmdir, ls, cp, mv, rm, cat, more, wc, lp, od, tar, gzip, file handling utilities, security by file permissions, process utilities, disk utilities, networking commands, unlink, du, df, mount, unmount, find, unmask, ulimit, ps, w, finger, arp, ftp, telnet, rlogin.

Self-Study:

Text Processing utilities and backup utilities, tail, head, sort, nl, cut, paste, join, tee, pg, comm, cmp, diff, tr, awk, cpio

UNIT – II	Shell Programming - 1	8 Hours
Introduction to Shells: **UNIX / LINUX** Session, Standard Streams, Redirection, Pipes, Tee Command, Command Execution, Command-Line Editing, Quotes, Command Substitution, Job Control, Aliases, Variables, Predefined Variables, Options, Shell/Environment Customization. **Filters**: Filters and Pipes, Concatenating files, Display Beginning and End of files, Cut and Paste, Sorting, Translating Characters, Files with Duplicate Lines, Count Characters, Words or Lines, Comparing Files.		
Self-Study: **Sed:** Scripts, Operation, Addresses, commands, Applications, sed.		
UNIT – III	**Shell Programming - 2**	**8 Hours**
Unix File Structure: Introduction to UNIX file system, inode (Index Node), file descriptors, system calls and device drivers. **File Management:** File Structures, System Calls for File Management – create, open, close, read, write, lseek, link, symlink, unlink, stat, fstat, lstat, chmod, chown, Directory API – opendir, readdir, closedir, mkdir, rmdir, umask.		
Self-Study: **Grep:** Operation, grep Family, Searching for File Content.		
UNIT – IV	**Process and Signals**	**8 Hours**
Process and Signals: Process, process identifiers, process structure: process table, viewing processes, system processes, process scheduling, starting new processes: waiting for a process, zombie processes, orphan process, fork, vfork, exit, wait, waitpid, exec, signals functions, unreliable signals, interrupted system calls, kill, raise, alarm, pause, abort, system, sleep functions, signal sets.		
Self-Study: **File locking**: creating lock files, locking regions, use of read and write with locking, competing locks, other lock commands, deadlocks.		
UNIT – V	**Inter process communication**	**8 Hours**
Inter Process Communication: Pipe, process pipes, the pipe call, parent and child processes, **named pipes**: fifos, **semaphores**: semget, semop, semctl, **message queues**: msgget, msgsnd, msgrcv, msgctl,		
Self-Study: **Shared memory**: shmget, shmat, shmdt, shmctl, ipc status commands.		

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Ability to use various **UNIX / LINUX** commands that are used to manipulate Operating System operations.	Applying	L3
CO2	Ability to write Shell Programming using **UNIX / LINUX** commands.	Applying	L3
CO3	Analyze a given problem and apply requisite facets of SHELL programming in order to devise a SHELL script to solve the problem.	Analyze	L4
CO4	Demonstrate **UNIX / LINUX** commands for process control and Signal	Applying	L3
CO5	Ability to use various Unix systems programming, signals, forking, stdio libraries, etc.	Applying	L3

Text Book(s):

1. Advanced Programming in the UNIX Environment, W. Richard. Stevens, Stephen A. Rago, 3rd edition, 2013,Pearson Education, New Delhi, India.
2. Shell Programming in Unix, Linux and OS X, Stephen G. Kochan, Patrick Wood, 4th Edition, 2017, Pearson Education Inc.

Reference Book(s):

1. Linux Kernel Development, Robert Love, Third Edition, 2010, Pearson Education, Inc.
2. Linux Shell Scripting Cookbook, Clif Flynt, Sarath Lakshman, Shantanu Tushar, Third Edition, 2017, Packt Publishing

CO-PO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO -1	PSO -1	PSO -1
CO-1	1												1		
CO-2	2												1		
CO-3		3											3		
CO-4	2												1		
CO5	2												1		

Pervasive Computing

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21CS6034**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- To understand the characteristics and principles of Pervasive computing and the solutions that are in use
- To design and implement pervasive applications
- To realize the role of wireless protocols in shaping the future Internet
- To give an introduction to the enabling technologies of pervasive computing

UNIT – I	**8 Hours**

INTRODUCTION: Pervasive Computing: Basics and vision: Living in a Digital World, Modelling the Key Ubiquitous Computing Properties, Ubiquitous System Environment Interaction, Architectural Design for Unicom Systems: Smart DEI Model. Applications and requirements: Everyday Applications in the Virtual, Human and Physical World, HCI, HHI, HPI and CPI. Smart devices and services: Service Architecture Models, Service Provision Life Cycle, Service Invocation, Virtual Machines and Operating Systems. **Smart mobiles, cards and device networks**.

Self-study component:	Smart mobiles, Cards and Device Networks.

UNIT – II	**8 Hours**

PROTOCOLS: Open protocols- Service discovery technologies- SDP, Jini, SLP, UpnP protocols– data synchronization- SyncML framework - Context aware mobile services - Context aware sensor networks, addressing and communications- **Context aware security.**

Self-study component:	Context aware security

UNIT – III	**8 Hours**

TECHNOLOGIES: Past, Present and Future. Application Examples. Device Technology. Device Connectivity. Web application Concepts-WAP and Beyond-Voice Technologies-Personal Digital Assistants.

Self-study component:	Application Examples

UNIT – IV	**8 Hours**

ARCHITECTURE : Server side programming in Java- Servlets, Extensible Markup Language, Web services, Model view Controller Pattern Pervasive Web application Architecture- Develop of Pervasive web applications, Pervasive application architecture.

Self-study component:	Simple Pervasive Web Application

UNIT – V	**8 Hours**

User Interface: Applications: Example Application- Architecture, Implementation. Access via PCs- Smart card based authentication via the Internet Internet. Access via WAP-WAP functionality, Implementation. Access via PDA and Voice. Real time applications.

Self-study component:	Applications related to Case study

Course Outcomes: On completion of this course, students are able to:			
CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Understand the Performance Requirements of Ubiquitous Computing Applications.	Understand	L2
CO2	Analyze and compare the performance of different data dissemination techniques and algorithms for mobile real-time applications	Analyze	L2
CO3	Analyze the performance of different sensor data management and routing algorithms for sensor networks	Apply	L3
CO4	Analyze the problems related to Pervasive Computing System through Investigation.	Analyze	L3

Text Book(s):

1. Ubiquitous Computing -Smart devices, Environments, Interactions , Stefan Poslad
2. Seng Loke, Context-Aware Computing Pervasive Systems, Auerbach Pub., New York, 2007.
3. Jochen Burkhardt, , Stefan Hepper, Klaus Rindtorff, Thomas Schaeck "Pervasive Computing-Technology and Architecture of Mobile Internet Application",Pearson Education,sixth Edition 2009.

Reference Book(s):

Jochen Burkhardt, Pervasive Computing: Technology and Architecture of Mobile Internet Applications 14th Edition, Pearson Education Singapore Pte Ltd 2002.

E-Books/Resources:

1. http://pervasivecomputing.se/M7012E_2014/material/Wiley.Ubiquitous.Computing.Smart.Devices.Environments.And.Interactions.May.2009.eBook.pdf

CO-PO Mapping

CO	Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	Understand the Performance Requirements of Ubiquitous Computing Applications.	1	1	1				1				1			1	1
CO2	Analyze and compare the performance of different data dissemination techniques and algorithms for mobile real-time applications	2	2	1	1			1				1			1	1
CO3	Analyze the performance of different sensor data management and routing algorithms for sensor networks	1	2	1	1			1				1			1	1
CO4	Analyze the problems related to Pervasive Computing System through Investigation.	2	1	1				1				2			1	2

Computer Architecture (Integrated)

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21CS604**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40+24**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Understand the Architecture of computer systems, measure the performance of architectures.
- Understand the pipelining concept and deal with different types of hazards.
- Understand the concept of Instruction level Parallelism.
- Understand the concept of parallel Processes and threads and Open MP interface.

UNIT – I	**Fundamentals of Computer Design**	**8 Hours**

Introduction, Classes of Computers, Defining Computer Architecture, Trends in Technology, Dependability, Measuring, Reporting and Summarizing Performance, Quantitative Principles of Computer Design.

Self-study component:	Trends in Power in Integrated Circuit, Trends in Cost.
Practical Topics: **4 Hours**	1. Familiarization with a RISC V Simulator "QtRVSim". 2. RISC V assembly program that inputs two integers from the user, perform arithmetic operations and display the result of each operation.

UNIT – II	**Pipelining: Basic and Intermediate Concepts**	**8 Hours**

Introduction, How is pipelining implemented, The major hurdle of Pipeling – pipeline hazards, Data Hazards, Branch Hazards, Reducing the Cost of Branches Through Prediction, Static Branch Prediction.

Self-study component:	Extending the RISC V Integer pipeline to handle Multicycle operations.
Practical Topics: **4 Hours**	Write a RISC V assembly program for bubble sort 1. Execute it in pipelined manner. 2. Identify the hazards in the program and 3. Rewrite the program to eliminate those hazards.

UNIT – III	**Instruction-Level parallelism and its Exploitation**	**8 Hours**

Instruction –Level Parallelism: Concepts and Challenges, Basic Complier Techniques for Exposing ILP, Reducing Branch costs with Prediction, Overcome Data Hazards with Dynamic Scheduling, Dynamic Scheduling: Examples and the Algorithm.

Self-study component:	Hardware based Speculation, Studies of the Limitations of ILP.
Practical Topics: **4 Hours**	**1.** Write a RISC V Assembly code, which adds a scalar to a vector and explore Loop Unrolling mechanism.

UNIT – IV	**Threading and Parallel Programming**	**8 Hours**

System Overview of Threading: Defining Threads, System View of Threads, Threading above the Operating System, Threads inside the OS, Threads inside the Hardware, What Happens When a Thread Is Created. **Fundamental Concepts of Parallel Programming**: Designing for Threads, Task

Decomposition, Data Decomposition, Data Flow Decomposition, Implications of Different Decompositions, Challenges You'll Face, Parallel Programming Patterns.	
Self-study component:	Application Programming Models and Threading, A Motivating Problem: Error Diffusion, Analysis of the Error Diffusion Algorithm.
Practical Topics: **6 Hours**	1. Write an OpenMp program which performs C=A+B & D=A-B in separate blocks/sections where A,B,C& D are arrays. 2. Write an OpenMp program to add all the elements of two arrays A & B each of size 1000 and store their sum in a variable using reduction clause. 3. Write an OpenMp program to multiply two matrices A & B and find the resultant matrix C.

UNIT – V	**Open MP**	**8 Hours**

Open MP: A Portable Solution for Threading : Challenges in Threading a Loop, Loop carried Dependence, Data-race Conditions, Managing Shared and Private Data, Loop Scheduling and Portioning, Effective Use of Reductions, Minimizing Threading Overhead, Work-sharing Sections, Compilation, Debugging, performance.

Self-study component:	Open MP Library Functions, Open MP Environment Variables
Practical Topics: **6 Hours**	1. Write an Open Mp program to show how thread private clause works. 2. Write an Open Mp program to show how first private clause works (Factorial program). 3. Write an Open MP program to find prime numbers (split).

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Understand** the characteristics of Computer Architecture.	Understand	L2
CO2	**Analyze** the pipeline hazards and mechanism of Instruction-Level parallelism.	Analyze	L3
CO3	**Define** fundamental concepts of parallel programming and its design issues.	Understand	L2
CO4	**Design and develop** parallel programs using OpenMP programming interface.	Apply	L3

Text Book(s):

1. John L. Hennessy and David A. Patterson : Computer Architecture, A quantitative approach, Sixth Edition, Morgan Kaufmann Publishers, Elsevier 2019
2. Multicore Programming, Increased Performance through Software Multi-threading by Shameem Akhter and Jason Roberts , Intel Press , 2006

Reference Book(s):

1. Kai Hwang & Naresh Jotwani," Advanced Computer Architecture", Parallelism, scalability, Programmability 3rd edition McGraw Hill 2017.
2. John P Hayes, Computer Architecture & Organization 3rd Ed. McGraw Hill 2017.
3. Thomas Rauber and Gudula Runger Parallel Programming for Multicore and cluster systems, Springer International Edition, 2009.

Web and Video link(s):

1. Project source code and releases https://github.com/cvut/qtrvsim
2. https://comparch.edu.cvut.cz/publications/ewC2022-Dupak-Pisa-Stepanovsky-QtRvSim.pdf
3. https://www.youtube.com/watch?v=J6AcPZZ_ISg&t=12s

E-Books/Resources:

2. http://archive.nitjsr.ac.in/course_assignment/CS01CS6021.BookwithcommentComputerarchitecture-AQuantitativeApproachbyJohnL.HennesseyandDavidA.Patterson,6thEdition.pdf
3. https://dl.acm.org/doi/book/10.5555/2821564
4. http://grsotudeh.ir/pardazeshmovazi/%DA%A9%D8%AA%D8%A7%D8%A8%D9%87%D8%A7%DB%8C%20%D9%BE%D8%B1%D8%AF%D8%A7%D8%B2%D8%B4%20%D9%85%D9%88%D8%A7%D8%B2%DB%8C/Multi-Core_Programming_Digital_Edition_(06-29-06).pdf

CO – PO Mapping

CO	Statements	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	**Understand** the characteristics of Computer Architecture.	3	2			2								1		
CO2	**Analyze** the pipeline hazards and mechanism of Instruction-Level parallelism.	3	2	2	1	2								2		
CO3	**Define** fundamental concepts of parallel programming and its design issues.	3	2	3		2								2		
CO4	**Design and develop** parallel programs using Open MP programming interface.	3	2	3	2	2								2		

Introduction to Web Programming

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21CSO6051**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Introduce the fundamentals of internet and the principles of web design.
- Construct basic websites using HTML and CSS.
- Build dynamic web pages with validation using javascript objects and by applying different event handling mechanisms.
- Develop modern interactive web applications using Ajax and jQuery.

UNIT – I	**8 Hours**

Fundamentals of Web: Internet, WWW, Web Browsers and Web Servers, URLs, DOM, MIME, HTTP, Localhost, Internet protocol, how world wide web works, Single page application, Multi page application,
Client server Architecture, JSON

Self-study component:	Security, The Web Programmers Toolbox

UNIT – II	**8 Hours**

Introduction to HTML/XHTML: Origins and evolution of HTML and XHTML, Basic syntax, Standard XHTML document structure, Basic text markup, Images, Hypertext Links.Lists, Tables, Forms, Syntactic differences between HTML and XHTML.

Self-study component:	HTML 5

UNIT – III	**8 Hours**

Cascading Style Sheets: 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, The and tags.
The Basics of 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.

Self-study component:	Pattern matching using regular expressions, Errors in scripts.

UNIT – IV	**8 Hours**

JavaScript and HTML documents: The JavaScript execution environment; The Document Object Model; Element access in JavaScript, Events and event handling; Handling events from the Body elements, Button elements, Text box and Password elements.
Dynamic documents with javascript: Introduction to dynamic documents; Positioning elements; Moving elements; Element visibility; Changing colors and fonts; Dynamic content.

Self-study component:	Stacking elements, Slow movement of elements, Dragging and dropping elements.

UNIT – V	8 Hours

Introduction to AJAX : Overview of Ajax, the basics of Ajax, Return document Forms, Ajax toolkits.

Introduction to jQuery: What jquery can do for you, Who develops jquery, Obtaining jquery, Programming conventions, Markup and CSS conventions, Javascript conventions.

Self-study component:	Security and Ajax, Installing jquery

COs	**Course Outcomes** with ***Action verbs*** for theCourse topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Summarize the concepts of world wide web and the requirements of effective web design	Understand	L2
CO2	Develop web pages using HTML and CSS features with different layouts as per need of application.	Apply	L3
CO3	Develop dynamic web pages with the use of javascript.	Apply	L3
CO4	Simplify the programming for special visual effect with Ajax and jQuery.	Analyze	L4

Text Book(s):

1. Programming the World Wide Web –Robert W. Sebesta, 8th Ed., Pearson Ed., 2015.
2. Web Development with Jquery - Richard York, 2nd Edition, 2015.

Reference Book(s):

1. Internet & World Wide Web How to program – M. Deitel, P.J Deitel, A. B. Goldberg, 3rd Edition, Pearson Education / PHI, 2004.
2. Web Programming Building Internet Applications – Chris Bates, 3rd Edition, Wiley, India, 2006.
3. The Web Warrior Guide to Web Programming – Xue Bai et al.

Web and Video link(s):

1. https://onlinecourses.swayam2.ac.in/aic20_sp11/preview

E-Books/Resources:

1. https://www.amazon.in/Programming-World-Wide-Robert-Sebesta/dp/0133775984
2. https://www.amazon.in/Web-Development-jQuery-Richard-York/dp/111886607X
3. https://www.teamwerx.org/wp-content/uploads/2017/10/Web-Development-with-jQuery.pdf

CO- PO MAPPING:

CO	Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO-1	Summarize the concepts of world wide web and the requirements of effective web design	2	1	1									1
CO-2	Develop web pages using HTML and CSS features with different layouts as per need of application.	2	2	2									1
CO-3	Develop dynamic web pages with the use of javascript.	2	2	1									1
CO-4	Simplify the programming for special visual effect with Ajax and jQuery.	2	2	1									1

Design and Analysis of Algorithms

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21CSO6052**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Describe various methods of algorithm analysis.
- Explain various problem-solving techniques.
- Apply appropriate techniques to design and find the solution to a given problem.

UNIT – I	**8 Hours**

Introduction: What is an Algorithm? Fundamentals of Algorithmic Problem Solving, Fundamentals of the Analysis of Algorithm Efficiency: The Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive Algorithm, Mathematical Analysis of Recursive Algorithms.

Self-study component:	Important Problem Types

UNIT – II	**8 Hours**

Brute Force and Exhaustive Search: Selection Sort and Bubble Sort, Sequential Search and Brute-Force String Matching, Depth-First Search and Breadth-First Search.

Self-study component:	Exhaustive Search

UNIT – III	**8 Hours**

Decrease-and-Conquer: Insertion Sort, Topological Sorting, Algorithms for Generating Combinatorial Objects, Binary Search, Computing Median and the Selection Problem, GCD of two numbers.

Self-study component:	Josephus Problem

UNIT – IV	**8 Hours**

Divide-and-Conquer: Merge sort, Quick sort, and Strassen's Matrix Multiplication
Transform-and-Conquer: Presorting, Heaps and Heap sort

Self-study component:	Multiplication of Large Integers

UNIT – V	**8 Hours**

Dynamic Programming: Warshall's, Floyd's and The Knapsack Problem [Without Memory Functions].
Greedy Technique: Dijkstra's Algorithm, Prim's Algorithm, Kruskal's Algorithm, Huffman Code

Self-study component:	Optimal Binary Search Trees

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Understand the concepts of algorithm design techniques.	Understand	L2
CO2	Ability to analyze time complexity of Recursive and Non-recursive algorithms using asymptotic notations.	Analyze	L3
CO3	Ability to design efficient algorithms using various design techniques.	Design	L3
CO4	Apply appropriate algorithmic techniques to solve the given problem	Apply	L3

Text Book(s):

1. Introduction to the Design and Analysis of Algorithms Anany Levitin Third Edition Pearson 2011.
2. Introduction to Algorithms Thomas H Cormen , Charles E Leiserson, Ronald L Rivest, Clifford Stein Third Edition The MIT Press 2009

Reference Book(s):

1. Fundamentals of Computer Algorithms Ellis Horowitz, SatrajSahni and Rajasekharam 2nd Edition University Press Pvt. Ltd, 2009
2. Analysis and design of Algorithms Padma Reddy, Sri Nandi Publications 2009

Web and Video link(s):

1. Algorithms: Design and Analysis, Part 1 (Coursera) | MOOC List (mooc-list.com)
2. https://onlinecourses.nptel.ac.in/noc15 _cs02/preview

CO-PO Mapping

CO's	Statements	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	Understand the concepts of algorithm design techniques.	**3**											
CO2	Ability to analyze time complexity of Recursive and Non-recursive algorithms using asymptotic notations.	**1**	**2**										
CO3	Ability to design efficient algorithms using various design techniques.	**1**	**2**	**2**									
CO4	Apply appropriate algorithmic techniques to solve the given problem	**2**	**2**	**1**									

Fundamentals of Data Mining [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	**P21CSO6053**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Define the fundamental concepts of data and data processing techniques.
- Explain the concepts and theories of data mining techniques.
- Build a foundation in classifying and clustering different types of data.

UNIT – I	**8 Hours**

Introduction: What is data mining?; Data mining: an essential step in knowledge discovery; Diversity of data types for data mining; Mining various kinds of knowledge – Multidimensional data summarization, Mining frequent patterns, associations, and correlations, Classification and regression for predictive analysis, Cluster analysis, Deep learning, Outlier analysis, Are all mining results interesting?; Data mining: confluence of multiple disciplines – Statistics and data mining, Machine learning and data mining, Data base technology and data mining, Data mining and data science, Data mining and other disciplines; Data mining and applications; Summary.

Self-study component:	Data mining and society

UNIT – II	**8 Hours**

Data, measurements, and data pre-processing: Data types – Nominal attributes, Binary attributes, Ordinal attributes, Numeric attributes, Discrete vs. continuous attributes; Statistics of data – Measuring the central tendency, Measuring the dispersion of data; Similarity and distance measures- Data matrix vs. dissimilarity matrix, Proximity measures for nominal attributes, Proximity measures for binary attributes, Dissimilarity of numeric data : Minkowski distance; Data quality, data cleaning, and data integration – Data quality measures, Data cleaning, Data integration; Data transformation – Normalization, Discretization; Summary.

Self-study component:	Dimensionality reduction – Principal Component Analysis;

UNIT – III	**8 Hours**

Pattern mining: basic concepts and methods: Basic concepts- Market basket analysis: a motivating example, Frequent item sets, closed item sets, and association rules; Frequent item set mining methods – Apriori algorithm: finding frequent item sets by confined candidate Generation, Generating association rules from frequent item sets, Improving the efficiency of Apriori, A pattern-growth approach for mining frequent item sets, Mining frequent item sets using the vertical data format; Summary

Self-study component:	Mining closed and max patterns

UNIT – IV	**8 Hours**

Classification: basic concepts and methods: Basic concepts – What is classification, General approach to classification; Decision tree induction – Decision tree induction, Attribute selection measures, Tree pruning; Bayes classification methods - Bayes' theorem, Naïve Bayesian classification; Lazy learners (or learning from your neighbors) - k-nearest-neighbor classifiers; Summary

Self-study component:	Case-based reasoning

UNIT – V	8 Hours

Cluster analysis: basic concepts and methods: Cluster analysis – What is cluster analysis?, Requirements for cluster analysis, Overview of basic clustering methods; Partitioning methods - k-Means: a centroid-based technique, Variations of k-means; Hierarchical methods – Basic concepts of hierarchical clustering, Agglomerative hierarchical clustering, Divisive hierarchical clustering; Density-based and grid-based methods - DBSCAN: density –based clustering based on connected regions with High density; Summary

Self-study component:	Grid-based methods

Course Outcomes: On completion of this course, students are able to:

CO's	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Understand** the fundamental concept of different types of data used in data mining.	Remember	L1
CO2	**Apply** different preprocessing techniques for different data types.	Apply	L3
CO3	**Generate** different frequent item sets using mining methods.	Apply	L3
CO4	**Apply** suitable classification or clustering technique to classify the given data set.	Apply	L3

Text Book(s):

1. Jiawei Han, Jian Pei, Hanghang Tong , "Data Mining Concepts and Techniques", 4th Edition, 2022, Elsevier, MK Publishers.

Reference Book(s):

1. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", 3rd Edition, 2012, Elsevier, MK Publishers.
2. Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar, "Introduction to Data Mining", 2nd Edition, 2021, Pearson Publishers.

Web and Video links:

1. https://onlinecourses.nptel.ac.in/noc21_cs06/preview
2. https://onlinecourses.nptel.ac.in/noc20_cs12/preview
3. https://nptel.ac.in/courses/106105174
4. https://onlinecourses.swayam2.ac.in/cec20_cs12/preview

E-Books/Resources:

1. https://link.springer.com/book/10.1007/978-3-540-34351-6

CO-PO MAPPING

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**Understand** the fundamental concept of different types of data used in data mining.	2	1										
CO2	**Apply** different preprocessing techniques for different data types.	2	2	1									
CO3	**Generate** different frequent item sets using mining methods.	2	2	1									
CO4	**Apply** suitable classification or clustering technique to classify the given data set.	2	1	1									

Fundamentals of Machine Learning [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	**P21CSO6054**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. Understand the basic theory on machine learning.
2. Differentiate supervised, unsupervised and reinforcement learning
3. Understand the basic concepts of learning and decision trees.
4. Understand Bayesian techniques for solving machine learning problems
5. Understand the basic design of learning system (or intelligent system).

UNIT – I	**8 Hours**
Introduction: What is Machine Learning? Why Use Machine Learning? Types of Machine Learning Systems: Supervised/Unsupervised Learning, Batch and Online Learning, Instance-Based Versus Model-Based Learning. Main Challenges of Machine Learning: Insufficient Quantity of Training Data, Non-representative Training Data, Poor-Quality Data, Irrelevant Features, Overfitting the Training Data, Underfitting the Training Data, Testing and Validating: Hyperparameter Tuning and Model Selection , Data Mismatch.	
Self-study component:	Training and running a linear model using Scikit-Learn

UNIT – II	**8 Hours**
The Machine Learning Toolbox: Data, Infrastructures, Algorithms, Visualization, DATA Scrubbing: Feature selection, Row Compression, One-hot Encoding, Binning, Normalization, Standardization, Missing Data, Setting up your Data: Cross validation.	
Self-study component:	Needs of data to train the model

UNIT – III	**8 Hours**
Concept learning and Learning Problems: Introduction, A Concept learning task, Concept Learning as search **:** General-to-Specific Ordering of Hypothesis, FIND-S algorithm, Version Spaces and The CANDIDATE-ELIMINATION algorithm.	
Self-study component:	Model complexity based on prediction error

UNIT – IV	**8 Hours**
Supervised & Un-Supervised Learning Techniques: Regression Analysis, Logistic regression, SVM classifier, Clustering: Overview on K-means clustering, Problems on K- means clustering. Overview on K-Nearest Neighbor (KNN), Problems on KNN, Bias and Variance.	
Self-study component:	Problems on Bayes Optimal Classifier

UNIT – V	**8 Hours**
Introduction to Bayesian learning: Bayesian learning, Bayes theorem, Example on Bayes theorem, Overview Naïve Bayesian classifier, Problems on Naïve Bayesian classifier**,** Decision Trees, Example of building a Decision Tree.	
Self-study component:	Examples on Version spaces and Candidate elimination

Course Outcomes: On completion of this course, students are able to:			
CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Understand** the basic concept of Machine Learning	Understand	L2
CO2	**Apply** various machine learning tools for visualization and validation	Apply	L3
CO3	**Apply** Concept Learning System for building intelligence system	Apply	L3
CO4	**Apply** various classification and clustering methods in applications.	Apply	L3

Text Book(s):

1. Aurelien Geron, Hands-on Machine Learning with Scikit-Learn &TensorFlow , O'Reilly, Shroff Publishers and Distributors Pvt. Ltd 2019.
2. Machine Learning For Absolute Beginners: A Plain English Introduction, Third Edition by Oliver Theobald**,** 2017.
3. "Machine Learning: An Artificial Intelligence Approach" by Tom M. Mitchell

Reference Book(s):

1. Machine Learning, Step-by-Step Guide to Implement Machine Learning Algorithms with Python by Rudolph Russell.
2. Machine Learning A Probabilistic Perspective Kevin P. Murphy, The MIT Press Cambridge, Massachusetts, London, England.
3. Introduction to Machine Learning, 3rd edition, Ethem Alpaydın, The MIT Press Cambridge, Massachusetts, London, England

Web and Video link(s):

1. https://www.youtube.com/playlist?list=PL1xHD4vteKYVpaIiy295pg6_SY5qznc77
2. https://nptel.ac.in/courses/106/106/106106139/

E-Books/Resources:

1. https://www.analyticsvidhya.com/machine-learning/
2. https://www.hackerearth.com/practice/machine-learning/machine-learning-algorithms/ml-decision-tree/tutorial/

CO-PO MAPPING

CO's	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	**Understand** the basic concept of Machine Learning	1											
CO2	**Apply** various machine learning tools for visualization and validation	1	2	1									
CO3	**Apply** Concept Learning system for building intelligence system	1	2	1									
CO4	**Apply** various classification and clustering methods in applications.	1	2	1									

DATA ANALYTICS LABORATORY

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21CSL606**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**24**	**SEE Marks:**	**50**

SI.No.	Experiment Name
1	**Demonstrate the Negative (–ve) and Positive (+ve) Correlation between two attributes of Women data set & mtcars dataset**
2	**Create box plot** for the two Variables group of LungCapData dataset. having 6 variables each signifying lung capacity, age, height, smoke('yes' for a smoker and 'no' for a non-smoker), gender(male/female), and Caesarean(yes/no) of a person divide the ages into groups and then try to plot stratified box plots for the lung capacity of smokers vs non-smokers with age strata.
3	**Perform Data Cleaning on Air Quality data set** Load Air Quality dataset and also perform the followings. a. Check all the observations with missing values b. Check the outliers with box plot c. Clean the data by removing outliers and treat missing values. d. Impute the missing values in the original dataset with "mean" of the respectivevariables
4	**Principal Component Analysis** Perform Multivariate Analysis using PCA on IRIS data set for developing a predictivemodel.
5	**Similarity Measure with Data Normalization:** Three friends with age and education isgiven in the table below Compute the following a Calculate the Euclidean distance between these friends to find the most similar friends b Do the same calculation measuring the ages in decades(Divide the age by 10) c Normalize the data using min-max method and find the most similar friends d Compare the results with normalized and without normalized data
6	**Data Conversion from Qualitative to Quantitative** Dimensionality Reduction: Attribute Selection – Filters In the given table, name of the contact, the maximum temperature registered last week in their town, their weight, height, year of experience and gender, together with the information on how good their company is given. Show how similar the behavior of each predictive attribute is to the target attribute Company and rank the attributes according to Pearson correlation and filter the predictive attribute with correlation below the given threshold

Name	Age(in years)	Education
Bala	43	2.0
Ganesh	38	4.2
Jeevan	42	4.1

Contact	Max temp	Weight	Height	Years	Gender	Company
Andrew	25	77	175	10	M	Good
Bernhard	31	110	195	12	M	Good
Carolina	15	70	172	2	F	Bad

Dennis	20	85	180	16	M	Good
Eve	10	65	168	0	F	Bad
Fred	12	75	173	6	M	Good
Gwyneth	16	75	180	3	F	Bad
Hayden	26	63	165	2	F	Bad
Irene	15	55	158	5	F	Bad
James	21	66	163	14	M	Good
Kevin	30	95	190	1	M	Bad
Lea	13	72	172	11	F	Good
Marcus	8	83	185	3	F	Bad
Nigel	12	115	192	15	M	Good

7 **K-Means Clustering in R Programming:** Perform K means Clustering with three different cluster sizes. And Display the Cluster Vector and Perform Sum of squares within clusters.

8 Find the **frequent item sets** and generate **association rules for the following given transaction dataset**. Assume that minimum support threshold (support = 50%) and minimum confident threshold (confidence = 80%).

Transaction ID	Items
T1	Hot Dogs, Buns, Ketchup
T2	Hot Dogs, Buns
T3	Hot Dogs, Coke, Chips
T4	Chips, Coke
T5	Chips, Ketchup
T6	Hot Dogs, Coke, Chips

9 Implement K Nearest Neighbor algorithm to classifies iris data set and classify the dataset to new data point into the target class, depending on the features of its neighboring data points.

10 **Implement Simple Linear Regression algorithm for** predictive analysis and performthe following.

a. Visualize the Data
b. Perform Simple Linear Regression
c. Create Residual Plots
d. Predict the value for new sample.

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	Apply statistical and computational methods to **solve** problems and clearly communicate the results.	Apply	L3
CO2	Apply data pre-processing methods on the given data set.	Apply	L3
CO3	Implement classification and regression algorithms for given dataset.	Apply	L3

CO-PO Mapping

CO's	Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	Apply statistical and computational methods to **solve** problems and clearly communicate the results.	**2**	**2**			**2**									**2**	
CO2	Apply data pre-processing methods on the given data set.	**2**	**2**			**2**									**2**	
CO3	Implement classification and regression algorithms for given dataset.	**2**	**2**			**2**									**2**	

Mini - Project [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	**P21CSMP607**	**Credits:**	**02**
Teaching Hours/Week (L:T:P)	**0:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**26**	**SEE Marks:**	**50**

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students. (or Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications)

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio of 50:25:25. **The marks awarded for the project report shall be the same for all the batch mates.**

(ii) **Interdisciplinary**: CIE shall be group-wise at the college level with the participation of all the guides of the college through Dean (III). The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE for Mini-project:

- **Single discipline**: Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department through Viva-Voce examination.
- **Interdisciplinary**: Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) through Viva-Voce examination conducted separately at the departments to which the student/s belongs to.

Employability Enhancement Skills (EES) - VI
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – VI

Course Code:	**P21HSMC608**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:2:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**28**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable students to:

- Explain the basic concepts in Race and games, Linear equations, mensuration, height and distance.
- Apply the logical skills in decoding Number, letter series and Game based assessments.
- Calculations involving Time, Speed and distance, HCF & LCM, Averages and Partnerships

UNIT – I	**10 Hours**

Quantitative Aptitude: Race and games, Linear equations

Logical Reasoning: Number and letter series

Self-Study: Types of cryptarithm.

UNIT – II	**10 Hours**

Quantitative Aptitude: Mensuration, Height & distance.

Logical Reasoning: Game based assessments.

Self-Study: Inferred meaning, Chain rule.

UNIT – III	**08 Hours**

Quantitative Aptitude: Time, Speed and distance, HCF & LCM, Averages and Partnerships

Self-Study: Decimal fractions

Course Outcomes: On completion of this course, students are able to:

CO – 1:	Solve the problems based on Race and games, Linear equations, mensuration, height and distance.
CO – 2:	Solve logical reasoning problems based on Number, letter series and Game based assessments.
CO – 3:	Solve the problems based on HCF & LCM, averages and partnerships.

Text Book(s):

1. Quantitative aptitude by Dr. R. S Agarwal, published by S.Chand private limited.
2. Verbal reasoning by Dr. R. S Agarwal, published by S. Chand private limited.

Reference Book(s):

1. Quantitative Aptitude by Arun Sharma, McGraw Hill Education Pvt Ltd
2. A Modern Approach to Verbal & Non-Verbal Reasoning by R.S. Agarwal.
3. CAT Mathematics by Abhijith Guha, PHI learning private limited.

COURSE ARTICULATION MATRIX [Employability Enhancement Skills (EES) - VI**]**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	2	2	-	-	-	-	-	-	-	-	-	2
CO-2	2	2	-	-	-	-	-	-	-	-	-	2
CO-3	2	2	-	-	-	-	-	-	-	-	-	2

Universal Human Values and Professional Ethics
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – VI

Course Code:	**P21UHV609**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**1 : 0 : 0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**25 + 5**	**SEE Marks:**	**50**

Course objectives:

This course is intended to:

1. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
4. This course is intended to provide a much-needed orientation input in value education to the young enquiring minds.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
2. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the activities will develop students' theoretical and applied skills.
3. State the need for UHV activities and its present relevance in the society and Provide real-life examples.
4. Support and guide the students for self-study activities.
5. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
6. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student in every activity, leading to continuous selfevolution.
7. Encourage the students for group work to improve their creative and analytical skills.

Module - 1

Introduction to Value Education **(3 hours)**

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

Module - 2
Harmony in the Human Being : (3 hours) Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health
Module - 3
Harmony in the Family and Society : (3 hours) Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order
Module - 4
Harmony in the Nature/Existence : (3 hours) Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence
Module - 5
Implications of the Holistic Understanding – a Look at Professional Ethics : (3 hours) Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession
Course outcome (Course Skill Set) At the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); • They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. • They would have better critical ability. • They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). • It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction. Expected to positively impact common graduate attributes like: 1. Ethical human conduct 2. Socially responsible behaviour 3. Holistic vision of life 4. Environmentally responsible work 5. Having Competence and Capabilities for Maintaining Health and Hygiene 6. Appreciation and aspiration for excellence (merit) and gratitude for all

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.
- CIE paper shall be set for 25 questions, each of the 02 marks. The pattern of the question paper is MCQ (multiple choice question). The time allotted for SEE is 01 hour. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

The sum of two tests, will be out of 100 marks and will be scaled down to 50 marks
Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for **50 questions,** each of the 01 marks. **The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books for READING:

Text Book and Teachers Manual

- The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 47-1
- The Teacher‟s Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)
14. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
15. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972,

Limits to Growth – Club of Rome's report, Universe Books.
16. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
17. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
18. A N Tripathy, 2003, Human Values, New Age International Publishers.
19. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
20. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press
21. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
22. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
23. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Web links and Video Lectures (e-Resources):

Value Education websites,

- https://www.uhv.org.in/uhv-ii,
- http://uhv.ac.in,
- http://www.uptu.ac.in
- Story of Stuff,
- http://www.storyofstuff.com
- Al Gore, An Inconvenient Truth, Paramount Classics, USA
- Charlie Chaplin, Modern Times, United Artists, USA
- IIT Delhi, Modern Technology – the Untold Story
- Gandhi A., Right Here Right Now, Cyclewala Productions
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
- https://fdp-si.aicte-india.org/8dayUHV_download.php
- https://www.youtube.com/watch?v=8ovkLRYXIjE
- https://www.youtube.com/watch?v=OgdNx0X923I
- https://www.youtube.com/watch?v=nGRcbRpvGoU
- https://www.youtube.com/watch?v=sDxGXOgYEKM