

SYLLABUS

(With effect from 2024 -25)

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕ ವರ್ಷ 2024-25)

Bachelor Degree
In
Information 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

(ಎ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

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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

Professionalism

Empathy

Synergy

Commitment

Ethics



DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

About the Department

The Department of Information science and Engineering takes pride in producing quality engineers over the past 20 years. The credit for all the flowery results goes to the highly motivating staff, from whom all students draw inspiration. The Department was started in the year 2000. The present intake of the undergraduate program is 60. The department has well equipped classrooms, computer laboratories with high-end systems, department library. We are proud to produce the first PhD student in our college. Faculty members of the department are involved in research activities in different fields such as Medical Image Processing, Pattern Recognition, and Data Mining etc. The department is using Outcome-based education (OBE), which is a recurring education reform model, and it is affiliated to Visvesvaraya Technological University (VTU). The department has achieved good Placement, conducted International Conferences and other sponsored short-term courses, workshops, National seminars and symposia. The laboratory facilities and the Internet access are available to the staff and students of the Information Science and Engineering

Vision

“The department strives to equip our graduates with Knowledge and Skills to contribute significantly to Information Science & Engineering and enhance quality research for the benefit of society”.

Mission

- M1:** To provide students with state of art facilities and tools of Information Science & Engineering to become productive, global citizens and life-long learners.
- M2:** To prepare students for careers in IT industry, Higher education and Research.
- M3:** To inculcate leadership qualities among students to make them competent Information Science & Engineering professionals or entrepreneurs.

1.2. State the Program Educational Objectives (PEOs)

Graduates of the program will be able to

- PEO1:** Establish a productive Information Science & Engineering career in industry, government or academia.
- PEO2:** Interact with their peers in other disciplines by exhibiting professionalism and team work to contribute to the economic growth of the country.
- PEO3:** Promote the development of solutions to the problems in Information Science using hardware and software integration.
- PEO4:** Pursue higher studies in Engineering, Management or Research.



A. List of Program Outcomes (POs)

Engineering Graduates will be able to:

- PO1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2. Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- PO6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.



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

B. List of Program Specific Outcomes (PSOs)

Information Science & Engineering Graduates will have

PSO1- The Knowledge to excel in IT profession by utilizing mathematical concepts, programming paradigms and software development practices for successful career.

PSO2- The ability to continuously learn and develop solutions in IT world by applying the emerging technologies in multidisciplinary environment.



P.E.S. College of Engineering, Mandya
Department of Information Science & Engineering

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	P22IS501	Software Engineering and Project Management	IS	3	-	-	-	3	50	50	100
2	P22IS502	Computer Networks	IS	3	-	-	-	3	50	50	100
3	P22IS503X	Professional Elective Course - I	IS	3	-	-	-	3	50	50	100
4	P22IS504	Machine Learning (Integrated)	IS	3	-	2	-	4	50	50	100
5	P22IS505	Data Warehousing and Data Mining	IS	3	-	-	-	3	50	50	100
6	P22ISL506	Computer Networks Laboratory	IS	-	-	2	-	1	50	50	100
7	P22NT507	Internship - II	IS	-	-	-	-	2	-	100	100
8	P22HSMC508B	Employability Enhancement Skills – V	HSMC	1	-	-	-	1	50	50	100
9.	P22UHV509	Social Connect and Responsibility	IS	1	-	-	-	1	100	-	100
Total								21			

Professional Elective Course – I (P22IS503X)	
Course Code	Course Title
P22IS5031	Advanced Java and J2EE
P22IS5032	Robotic Process Automation Design and Development
P22IS5033	Computer Graphics with Open GL
P22IS5034	Information Retrieval

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	P22IS601	Software Testing	IS	3	-	-	-	3	50	50	100
2	P22IS602X	Professional Elective Course – II	IS	3	-	-	-	3	50	50	100
3	P22IS603X	Professional Elective Course - III	IS	3	-	-	-	3	50	50	100
4	P22IS604	Cryptography and Network Security (Integrated)	IS	3	-	2	-	4	50	50	100
5	P22ISO605X	Open Elective – I	IS	3	-	-	-	3	50	50	100
6	P22ISL606	Software Testing Laboratory	IS	-	-	2	-	1	50	50	100
7	P22ISMP607	Mini – Project	IS	-	-	2	2	2	50	50	100
8	P22HSMC608B	Employability Enhancement Skills - VI	HSMC	1	-	-	-	1	50	50	100
9.	P22UHV609	Universal Human Values and Professional Ethics	IS	1	-	-	-	1	50	50	100
Total								21			

Professional Elective Course – II (P22IS602X)		Professional Elective Course – III (P22IS603X)		Open Elective – I (P22ISO605X)	
Course Code	Course Title	Course Code	Course Title	Course Code	Course Title
P22IS6021	Advanced Computer Networks	P22IS6031	Cloud Computing	P22ISO6051	Robotic Process Automation
P22IS6022	Object Oriented Modeling and Design	P22IS6032	Unix and Shell Programming	P22ISO6052	Information System Management
P22IS6023	Storage Area Network	P22IS6033	Blockchain Technology	P22ISO6053	Software Engineering
P22IS6024	Augmented and Virtual Reality	P22IS6034	Introduction to Dot Net Framework for Application Development	P22ISO6054	Operating System



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Software Engineering and Project Management [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P22IS501	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: <ol style="list-style-type: none"> 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 language		
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:	Health and Safety Case Studies		
Course Outcomes: On completion of this course, students are able to:			



COs	Course Outcomes with <i>Action verbs</i> for the Course topics.
CO1	Understand the concepts of various software process models.
CO2	Illustrate the importance of software design and development activities.
CO3	Extract the different Software project management methods.
CO4	Estimate the actual budget of various project management techniques.
Text Book(s): <ol style="list-style-type: none">1. Software Engineering – Ian Somerville, 10th Edition, ©2016 / <i>Pearson</i> .2. Earned value Project Management by Quentin W. Fleming PhD MSc and Joel M. Koppelman, fourth Edition 2010, PMI.3. Bob Hughes, Mike Cotterell, and Rajib Mall “Software Project Management”, Fifth Edition, Tata McGraw Hill, 2012.	
Reference Book(s): <ol style="list-style-type: none">1. Agile and Iterative Development by Craieg Larman 20032. Software Engineering: A Practitioners Approach - Roger S. Pressman, 7th Edition, McGraw-Hill, 2007.3. Software Engineering Theory and Practice - Shari Lawrence Pfleeger, Joanne M. Atlee, 3rd Edition, Pearson Education, 2006.4. Ramesh, Gopalaswamy, "Managing Global Projects", Tata McGraw Hill, 2001.5. Royce, “Software Project Management”, Pearson Education,1999.6. Jalote, “Software Project Management in Practice”, Pearson Education,2002	



Computer Networks [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P22IS502	Credits:	03
Teaching Hours/Week (L:T:P):	3:0:0	CIE Marks:	50
Total Theory Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ul style="list-style-type: none">• Describe the fundamentals of data communications and various application layer protocols used by TCP/IP reference model.• Illustrate error control and media access control protocols of data link layer• Discuss different types of data transmission techniques.• Analyze the various protocols, techniques in TCP/IP network architecture			
UNIT – I			8 Hours
Introduction: TCP/IP protocol suite: Layered Architecture, Brief Description of layers, Description of each layer, OSI versus TCP/IP, lack of OSI Model's Success. Physical Layer: Signals: Analog Signals, Digital Signals, Signal Impairment: Attenuation and Amplification, Distortion, Data Rate Limits and Performance, Digital to Digital Conversion, Analog to Digital Conversion, Digital to Analog Conversion, Analog to Analog conversion.			
Self-study component:	Multiplexing		
UNIT – II			8 Hours
Data Link Layer: Introduction, Nodes and links, Two types of links, two sub layers, Framing, Error control, High-Level Data-Link Control, Three types of Addresses, Address Resolution Protocol (ARP)			
Self-study component:	DLC protocols		
UNIT – III			8 Hours
Network Layer1: Packetizing, Routing, Error Control, Flow Control, Congestion Control, Quality of Services, Security. Datagram Approach: Connectionless service, Virtual-Circuit Approach: Connection Oriented Service. Performance: Delay, Throughput, packet loss.IPv4 Addressing.			
Self-study component:	ICMPv4		
UNIT – IV			8 Hours
Network Layer2: Distance-Vector routing Algorithm, Link State routing algorithm, path-vector routing, Routing Information Protocol, Border Gateway Protocol.			
Self-study component:	Multicast Routing		
UNIT – V			8 Hours
Transport Layer: process-to-process communication, Encapsulation and Decapsulation, Multiplexing and Demultiplexing, Flow Control, Error Control, Combination of Flow and Error Control, UDP services, UDP applications, TCP Services. Application Layer: World Wide Web and HTTP, FTP			



Self-study component:	Client/Server Paradigm
Course Outcomes: On completion of this course, students are able to:	
COs	Course Outcomes with <i>Action verbs</i> for the Course topics
CO1	Understand the fundamental concepts of Networking
CO2	Illustrate various Data control and Delivery mechanism over network
CO3	Analyze the working of various routing protocols for Network performance
Text Book(s): 1. Data Communications and Networking with TCP/IP Protocol Suite, Behrouz A.Forouzan, McGraw Hill, 6th Edition, 2021	
Reference Book(s): 1. James F. Kurose and Keith W. Ross: Computer Networking: A Top-Down Approach, 8th edition, Addison-Wesley, 2021. 2. Data and Computer Communication, William Stallings, 10th Edition, Pearson Education, 2017 3. Tanenbaum: Computer Networks, 4th Ed, Pearson Education/PHI, 2018.	
Web and Video link(s): 1. https://nptel.ac.in/courses/106105183/ 2. https://www.coursera.org/learn/network-protocols-architecture	



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Advanced Java and J2EE [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P22IS5031	Credits:	03
Teaching Hours/Week (L:T:P):	3:0:0	CIE Marks:	50
Total Theory Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ul style="list-style-type: none">• Understand the fundamental concepts of Enumerations and Annotations• Apply the concepts of Generic classes in Java programs• Demonstrate the fundamental concepts of String operations• Design and develop web applications using Java servlets and JSP• Apply database interaction through Java database Connectivity			
UNIT – I			8 Hours
Enumerations, Auto boxing and Annotations: Enumerations, Enumeration fundamentals, the values() and value of() methods, Java enumerations are class types, enumerations inherits Enum, example, type wrappers, Autoboxing, Autoboxing methods, Autoboxing/Unboxing occurs in Expressions, Autoboxing/Unboxing, Boolean and character values, Autoboxing/Unboxing helps prevent errors, A word of warning Annotations, Annotation basics, specifying retention policy, obtaining annotations at run time by use of reflection, Annotated element interface, Using default values, Marker Annotations.			
Self-study component:	Single member annotations, Built in annotations		
UNIT – II			8 Hours
Generics: What are Generics, A Simple Generics Example, A Generic Class with Two Type Parameters, The General Form of a Generic Class, Bounded Types, Using Wildcard Arguments, Bounded Wildcards, Creating a Generic Method, Generic Interfaces, Raw types and Legacy code, Generic Class Hierarchies.			
Self-study component:	Erasure, Ambiguity errors, Some Generic Restrictions		
UNIT – III			8 Hours
String Handling: The String Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String, Data Conversion Using value of(), String Buffer, String Builder			
Self-study component:	Changing the case of characters within a String		
UNIT – IV			8 Hours
Background; The life cycle of a servlet; A simple servlet; the servlet API; The javax.servlet package Reading servlet parameter; the javax.servlet.http package; Handling HTTP Requests and Responses; using Cookies; Session Tracking, Java Server Pages (JSP); JSP tags, Variables and Objects, Methods, Control statements, Loops, Request String, Parsing other information, User sessions.			
Self-study component:	Cookies, Session Objects		



UNIT – V		8 Hours
The concept of JDBC; JDBC Driver Types; JDBC packages; A brief overview of the JDBC Process; Database Connection; Associating the JDBC/ODBC Bridge with the Database; Statement Objects; Result Set; Transaction Processing; Exceptions.		
Self-study component:	Metadata, Data Types	
Course Outcomes: On completion of this course, students are able to:		
COs	Course Outcomes with <i>Action verbs</i> for the Course topics	
CO1	Understand and apply the fundamental concepts of Enumerations and Annotations	
CO2	Apply the concepts of String operations and Generic classes in Java programs.	
CO3	Create web based applications using Java servlets and JSP	
CO4	Illustrate database interaction and transaction processing in Java	
Text Book(s): 1. Herbert Schildt: JAVA the Complete Reference. 9th Edition, Tata McGraw-Hill 2. Jim Keogh, The Complete Reference J2EE, Tata McGraw-Hil		
Reference Book(s): 1. Y. Daniel Liang: Introduction to JAVA Programming, 7th Edition, Pearson Education, 2007.		
Web and Video link(s): 1. https://nptel.ac.in/courses/106/105/106105191/ 2. https://nptel.ac.in/courses/106/105/106105225/		



Robotic Process Automation Design and Development [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER - V			
Course Code:	P22IS5032	Credits:	03
Teaching Hours/Week (L:T:P):	3:0:0	CIE Marks:	50
Total Theory Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ul style="list-style-type: none">• Understand the basic concepts of RPA platform.• Describe the different types of variables, control flow and data manipulation techniques.• Understand various control techniques, plugins and extensions in RPA.• Describe various types and strategies to handle events and exceptions.			
UNIT - I			8 Hours
What is Robotic Process Automation? What is Robotic Process Automation? Scope and techniques of automation Robotic process automation, About UiPath, The future of automation. Record and Play: Record and Play, UiPath stack, Downloading and installing UiPath Studio, Learning UiPath Studio, Task recorder.			
Self-study component:	Step-by-step examples using the recorder.		
UNIT - II			8 Hours
Sequence, Flowchart, and Control Flow: Sequence, Flowchart, and Control Flow, Sequencing the workflow, Activities, Control flow, various types of loops, and decision making, Step-by-step example using Sequence and Flowchart. Data Manipulation: Data Manipulation, Variables and scope, Collections, Arguments – Purpose and use, Data table usage with examples, Clipboard management, File operation with step-by-step example.			
Self-study component:	Step-by-step example, using Sequence and Control flow.		
UNIT - III			8 Hours
Taking Control of the Controls: Taking Control of the Controls, Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls – mouse and keyboard activities, Working with UiExplorer, Handling events, Revisit recorder, Screen Scraping, When to use OCR, Types of OCR available, Avoiding typical failure points.			
Self-study component:	How to use OCR		
UNIT - IV			8 Hours
Tame that Application with Plugins and Extensions: Tame that Application with Plugins and Extensions, Terminal plugin, SAP automation, Java plugin, Citrix automation, Mail plugin, PDF plugin, Excel and Word plugins. Handling User Events and Assistant Bots: Handling User Events and Assistant Bots, What are assistant bots? Monitoring system event triggers, monitoring image and element triggers, Launching an assistant bot on a keyboard event.			



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Self-study component:	Credential management	
UNIT - V		8 Hours
Exception Handling, Debugging, and Logging: Exception Handling, Debugging, and Logging, Exception handling, Common exceptions and ways to handle them, Logging and taking screenshots, debugging techniques, Collecting crash dumps.		
Self-study component:	Error reporting.	
Course Outcomes: On completion of this course, students are able to:		
COs	Course Outcomes with <i>Action verbs</i> for the Course topics	
CO1	Demonstrate Robotic Process Automation & Record and Play feature of UiPath Studio.	
CO2	Create different types of variables, control flow and data manipulation techniques.	
CO3	Apply various control techniques, plugins and extensions in RPA.	
CO4	Illustrate various types and strategies to handle events and exceptions.	
Text Book(s): 1. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool – UiPath by Alok Mani Tripathi, Packtpub, March 2018.		
Reference Book(s): 1. Learning ServiceNow by Tim Woodruff, Packtpub, March 2017. 2. ServiceNow Automation by Ashish Rudra Srivastava, Packtpub.		
Web and Video link(s): 1. https://www.uipath.com/rpa/robotic-process-automation 2. https://www.academy.uipath.com		



Computer Graphics with Open GL [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P22IS5033	Credits:	03
Teaching Hours/Week (L:T:P):	3:0:0	CIE Marks:	50
Total Theory Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ul style="list-style-type: none">• Understand the mathematical and theoretical principles of computer graphics.• Implement algorithms for 2D graphics Primitives and attributes.• Implement algorithms related to 2D and 3D Geometric transformations of an Object.• Demonstrate transformations and viewing using different algorithms on 2D and 3D objects.			
UNIT – I			8 Hours
Computer Graphics Hardware: Video Display Devices, Raster-Scan Systems, Computer Graphics Software: Coordinate Representations, Graphics Functions, Introduction to open GL Graphics Output Primitives Coordinate reference frames, Specifying two dimensional world coordinate reference frame in Open GL, Open GL point functions, Open GL line functions, Line drawing algorithms, Circle generation algorithms, Ellipse generation algorithms, Fill area primitives, Polygon fill areas, OpenGL polygon fill area functions, OpenGL Vertex Arrays, OpenGL Pixel-Array Functions, OpenGL Display Lists, OpenGL Display-Window Reshape Function.			
Self-study component:	Software Standards, Character primitives		
UNIT – II			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 Anti-aliasing Functions, OpenGL Query Functions. Implementation Algorithms for Graphics Primitives and Attributes: Line Drawing Algorithms, Circle Generating Algorithms.			
Self-study component:	Parallel line algorithms		
UNIT – III			8 Hours
Two – Dimensional and Three - Dimensional Geometric 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 Systems, OpenGL Functions for Two-Dimensional Geometric Transformations. Three dimensional Translation, Rotation, Scaling, Composite three dimensional transformations.			
Self-study component:	Raster Methods for Geometric Transformations, OpenGL Raster Transformations. Text clipping		



UNIT – IV		8 Hours
Two Dimensional Viewing The two dimensional viewing pipeline, Clipping window, Normalization and viewport transformations, Clipping algorithms, -Two dimensional point clipping, Two dimensional line clipping algorithms (Cohen-Sutherland and Liang Barsky), Polygon fill area clipping(Sutherland- Hodgeman Polygon Clipping)		
Self-study component:	Text clipping, Curve clipping.	
UNIT – V		8 Hours
Three Dimensional Viewing The three dimensional viewing concepts, Three dimensional viewing pipeline, Three dimensional viewing coordinate parameters, Transformation from world to viewing coordinates, Projection transformations, Orthogonal projections, Oblique parallel projections, Perspective projections		
Self-study component:	Normalized perspective projection transformation coordinates.	
Course Outcomes: On completion of this course, students are able to:		
COs	Course Outcomes with <i>Action verbs</i> for the Course topics	
CO1	Understand the basic concepts of Computer graphics interfaces and use OpenGL to draw simple objects.	
CO2	Identify and implement algorithms for 2D graphics Primitives and attributes	
CO3	Analyze line drawing, clipping algorithms and rasterization techniques.	
CO4	Apply viewing and clipping techniques on different types of objects.	
Text Book(s): 1. Text book: 1. Donald Hearn, M.Pauline Baker, Computer Graphics with Open GL, Pearson (Indian Edition), Fourth Edition.		
Reference Book(s): 1. Edward Angel, 'Interactive Computer Graphics' – A top down approach using Open GL, Pearson, Fifth Edition 2. Peter Shirley, Steve Marschner, 'Computer Graphics, Cengage Learning (Indian edition), 2009.		
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		



Information Retrieval [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER - V			
Course Code:	P22IS5034	Credits:	03
Teaching Hours/Week (L:T:P):	3:0:0	CIE Marks:	50
Total Theory Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ul style="list-style-type: none">• Understand the retrieval of relevant information from a text database.• Understand the Term Vocabulary and Postings Lists.• Understand the Index Construction and the Index Compression.• Understand the Vector Space Model.• Understand the Evaluation in information retrieval			
UNIT - I			8 Hours
Boolean retrieval: An example information retrieval problem, A first take at building an inverted index, Processing Boolean queries, The extended Boolean model versus ranked retrieval. The term vocabulary and postings lists: Document delineation and character sequence decoding, Determining the vocabulary of terms, Faster postings list intersection via skip pointers.			
Self-study component:	Positional postings and phrase queries		
UNIT - II			8 Hours
Dictionaries and tolerant retrieval: Search structures for dictionaries, Wildcard queries, Spelling correction, Phonetic correction. Index construction: Hardware basics, Blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, Dynamic indexing.			
Self-study component:	Other types of indexes		
UNIT - III			8 Hours
Index compression: Statistical properties of terms in information retrieval, Dictionary compression, Postings file compression. Scoring, term weighting and the vector space model: Parametric and zone indexes, Term frequency and weighting, The vector space model for scoring.			
Self-study component:	Variant tf-idf functions		
UNIT - IV			8 Hours
Computing scores in a complete search system: Efficient scoring and ranking, Components of an information retrieval system, Vector space scoring and query operator interaction (Boolean retrieval).			
Self-study component:	Wildcard queries and Phrase queries		



UNIT - V		8 Hours
Evaluation in information retrieval: Information retrieval system evaluation, Standard test collections, Evaluation of unranked retrieval sets, Evaluation of ranked retrieval results, Assessing relevance, A broader perspective: System quality and user utility.		
Self-study component:	Results snippets	
Course Outcomes: On completion of this course, students are able to:		
COs	Course Outcomes with <i>Action verbs</i> for the Course topics	
CO1	Demonstrate the retrieval of relevant information from a text database.	
CO2	Apply different data/file structures in building computational search engines.	
CO3	Illustrate index construction and index compression techniques.	
CO4	Demonstrate computing scores in a complete search system.	
CO5	Illustrate information retrieval system evaluation.	
Text Book(s): 1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, “An Introduction to Information Retrieval”, 1 st Edition, Cambridge University Press, 2008.		
Reference Book(s): 1. G.G. Chowdhury, “Introduction to Modern Information Retrieval”, 3 rd Edition, Neal-Schuman publishers, 2010. 2. Gerald J.Kowalski, Mark T.Maybury, “Information storage and Retrieval systems: theory and implementation”, 2 nd Edition, Kluwer Academic Publishers, 2009.		
Web and Video link(s): 1. https://nlp.stanford.edu/IR-book/pdf/irbookonlinereading.pdf		



Machine Learning (Integrated) [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P22IS504	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: <ul style="list-style-type: none">• To understand the basic theory underlying machine learning.• To be able to formulate machine learning problems corresponding to different applications.• To understand a range of machine learning algorithms along with their strengths and weaknesses.• To be able to apply machine learning algorithms to solve problems of moderate complexity.			
UNIT – I			8 Hours
Introduction to Machine Learning, Preparing to Model: Introduction to Machine learning - Human learning, machine learning, types, problems not to be solved using machine learning, Application, Issues Machine learning activities, , Exploring structure of data, Data quality and Remediation, Data Pre-processing.			
Self-study component:	Basic type of data in Machine learning		
Practical Topics: (6 Hours)	<ol style="list-style-type: none">1. Demonstrate the following data preprocessing tasks using python libraries. a) Loading the dataset b) Identifying the dependent and independent variables c) Dealing with missing data2. Demonstrate the following data preprocessing tasks using python library a) Dealing with categorical data b) Scaling the features c) Splitting dataset into Training and Testing Sets		
UNIT – II			8 Hours
Modeling and Evaluation / Feature Engineering–. Selecting the Model, Training the Model, Model Representation and Interpretability, Evaluating performance of a model, Introduction to Feature Engineering, Feature Transformation.			
Self-study component:	Feature Subset Selection		
Practical Topics: (6Hours)	<ol style="list-style-type: none">1. Write Python code to select features in machine learning using Python.2. Write Python code to load the data from a CSV file and select the top 10 features using the chi-squared test. The selected features are to be printed on the console.		
UNIT – III			8 Hours
Supervised learning Bayesian Concept – Bayes theorem and concept learning - Brute force Bayesian algorithm, Naïve Base Classifier Classification: Classification Model, Classification learning steps, Classification Algorithms-k-nearest Neighbor (KNN), Decision Tree, Random Forest Model.			
Self-study component:	Support Vector Machines		



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Practical Topics: (4 Hours)	1. Build a classification model using Decision Tree algorithm on iris dataset. 2. Apply Naïve Bayes Classification algorithm on any dataset. 3. Apply KNN Classification algorithm on any dataset.	
UNIT – IV		8 Hours
Regression: Introduction, Examples of Regression, Regression Algorithms- Simple Linear Algorithms, Multiple Linear Regression, Assumption in Regression Analysis, Main Problems in Regression Analysis, Logistic Regression Other types of learning Overview –Representation Learning, Active Learning, Ensemble Learning Algorithm.		
Self-study component:	Regularization Learning algorithm	
Practical Topics: (4 Hours)	1. Build a model using linear regression algorithm on any dataset. 2. Build a model using multi linear regression algorithm on any dataset.	
UNIT – V		8 Hours
Unsupervised learning : Introduction, Unsupervised/s supervised learning, applications of Unsupervised Learning, Clustering- Clustering as a machine learning task, different types of clustering techniques, Partitioning methods, Hierarchical clustering.		
Self-study component:	Density based Methods – DBSCAN	
Practical Topics: (4 Hours)	1. Apply Hierarchical Clustering algorithm on any dataset. 2. Apply DBSCAN clustering algorithm on any dataset.	
Course Outcomes: On completion of this course, students are able to:		
COs	Course Outcomes with <i>Action verbs</i> for the Course topics	
CO1	Understand the need of data and pre-processing, machine learning techniques for various Application	
CO2	Identify and apply the appropriate techniques to process the data and solve the applications using machine learning techniques	
CO3	Apply the concepts of machine learning techniques to a given problem or dataset.	
CO4	Evaluate the different data processing and machine learning techniques for various application	
Text Book(s): 1. Machine Learning, SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, Pearson, 4 th Impression, 2019, Pearson Publications		
Reference Book(s): 1. Machine Learning, Tom M Mitchel, McGraw Hill publications, ISBN-0070428077 2. Introduction to Machine Learning with Python: A Guide for Data Scientists. Andreas C. Müller, Sarah Guido, 1st Edition, O'Reilly 3. Introduction to Machine Learning, Ethem Alpaydın, 2nd Edition, The MIT Press		



Data Warehousing and Data Mining [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P22IS505	Credits:	03
Teaching Hours/Week (L:T:P):	3:0:0	CIE Marks:	50
Total Theory Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ul style="list-style-type: none"> • Principles of Data Warehousing and Data Mining. • Architecture of Data Warehouse. • Various Data pre-processing Methods. • Data mining techniques. 			
UNIT – I			8 Hours
Data Warehouse and OLAP Technology: Data warehouse definition, Difference between Database System and Data Warehouse, Need for data warehousing, Basic building blocks of Data warehouse, Data Warehouse Models, Metadata in the data warehouse, Data Warehouse Architecture, Dimension and Fact Tables. Multidimensional Data Model: Star, Snowflake, Constellation. Data Cube and OLAP operation.			
Self-study component:	OLAP Server (ROLAP, MOLAP and HOLAP), OLAP based Case Study		
UNIT – II			8 Hours
Introduction to Data Mining: Data Mining-Definition & Functionalities, Applications of Data Mining, Issues in Data Mining, Data Mining Primitives, KDD Process, OLAP VS Data Mining. Data Pre-Processing: Data Objects and Attributes, Inconsistent Data, Need for Data Pre-Processing, Data Pre-processing Techniques: Cleaning, Integration, Transformation, Reduction.			
Self-study component:	Data Transformation and Data Discretization		
UNIT – III			8 Hours
Introduction to Data Mining Approaches: Supervised and Unsupervised Learning Classification: Applications of classification and prediction. Issues regarding Classification and prediction, Classification methods: Decision tree induction, Naïve Bayesian Classification, Association Rule Mining: Application of Association Rule Mining, Frequent Item sets, Mining Association rules from Transactional Databases using Apriori and FP Growth, finding relevant rule using Support, Confidence and Lift ratio.			
Self-study component:	Classification by Back propagation, Model Evaluation.		
UNIT – IV			8 Hours
Cluster Analysis: Applications of Clustering, Types of clustering methods: Partitioning, Hierarchical and Density Based, Evaluation of Clusters. Outlier Analysis: Types of outliers, Challenges of Outlier Detection, Outlier Detection Methods.			
Self-study component:	Grid-Based Method, Statistical Approaches, Proximity-Based Approaches.		



UNIT – V		8 Hours
Advanced Pattern Mining: Pattern Mining: A Road Map, Pattern Mining in Multilevel, Multidimensional Space.		
Classification Advanced Methods: Lazy Learners (or Learning from Your Neighbors), Multiclass Classification, Semi-Supervised Classification, Active Learning, Transfer Learning.		
Advanced Cluster Analysis: Clustering Graph and Network Data: Applications and Challenges, Similarity Measures.		
Self-study component:	Graph Clustering Methods	
Course Outcomes: On completion of this course, students are able to:		
COs	Course Outcomes with <i>Action verbs</i> for the Course topics	
CO1	Analyse the Data warehouse principles, components and architectures	
CO2	Demonstrate data pre-processing techniques and application association rule mining algorithms	
CO3	Apply various classification algorithms and evaluation of classifiers for the given problem	
CO4	Analyse the different advance level methods of pattern mining, classification and cluster analysis	
Text Book(s):		
<ol style="list-style-type: none">1. Jiawei Han, Micheline Kamber and Jian Pei “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2011.2. Paul Raj Poonia, “Fundamentals of Data Warehousing”, John Wiley & Sons, 2nd Edition, 2003.		
Reference Book(s):		
<ol style="list-style-type: none">1. G. K. Gupta “Introduction to Data Mining with Case Studies”, Easter Economy Edition, Prentice Hall of India, 2006.2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar “Introduction to Data Mining”, Pearson Education, 2nd Edition, 2007.3. Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGrawHill, 10th Reprint, 2007.4. K. P. Soman, Shyam Diwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.		
Web and Video link(s):		
<ol style="list-style-type: none">1. https://www.youtube.com/watch?v=7rs0i-9nOjo2. https://www.youtube.com/watch?v=dUm3ptTQr0Q		
E-Books/Resources:		
<ol style="list-style-type: none">1. https://www.vssut.ac.in/lecture_notes/lecture1428550844.pdf2. https://www.tutorialsduniya.com/notes/data-mining-notes/		



Computer Networks Laboratory [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P22ISL506	Credits:	1
Teaching Hours/Week (L:T:P):	0:0:2	CIE Marks:	50
Total Laboratory Hours:	24	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ol style="list-style-type: none">1. Analyze the performance of various network topologies2. Design and demonstrate various data flow control and routing algorithms3. Explore the concept of error detection and routing mechanism4. Explore various Networking tools			
Instructions: Students has to attend one Question from each part in SEE			
COURSE CONTENT			
<u>PART-A</u> <ol style="list-style-type: none">1. Create a Scenario of Star, Ring and Bus topologies through simulation.2. Simulate a stop and wait protocol and sliding window protocol3. Create a Scenario to study the high-level data link control protocol (HDLC) through simulation4. Simulate go back n protocol5. Simulate Selective Repeat protocol			
<u>PART-B</u> <ol style="list-style-type: none">1. Write a C program for error detection using CRC-CCITT (16-bits).2. Write a C program to generate Hamming Code for error detection and correction.3. Write a C program to implement Distance vector Routing algorithm4. Write a C program to implement Open Shortest Path First Routing Algorithm5. Write a C Program to implement Border Gateway Protocol (BGP)			
Course Outcomes: On completion of this course, students are able to:			
COs	Course Outcomes with <i>Action verbs</i> for the Course topics		
CO1	Illustrate networking concepts using C programming language		
CO2	Demonstrate networking concepts using NS2 simulator		



Internship - II

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

SEMESTER – V

Course Code:	P22INT507	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



EMPLOYABILITY ENHANCEMENT SKILLS - V			
[As per Choice Based Credit System (CBCS) & OBE Scheme]			
SEMESTER – V for CSE, ISE, ECE, EEE & CSE(AIML) Branches only			
Course Code:	P22HSMC508B	Credits:	01
Teaching Hours/Week (L:T:P)	0:2:0	CIE Marks:	50
Total Number of Teaching Hours:	30	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ul style="list-style-type: none">• Calculations involving Time and work, Speed & distance, trains, boats and streams and races.• Explain concepts behind logical reasoning modules of clocks and calendars.• Develop problem solving skills through Data structures.			
UNIT – I			06 Hours
Quantitative Aptitude: Time and Work, Time, Speed and Distance. Logical Reasoning: Clocks and Calendars.			
Self-study component:	Decimal fractions		
UNIT – II			06 Hours
Quantitative Aptitude: Trains, Boats and Streams, Races. Verbal Ability: Reading Comprehension, Critical Reasoning.			
Self-study component:	Game based assessments		
UNIT – III	ADVANCED DATA STRUCTURES - I		06 Hours
Priority Queues: Introduction to Priority Queues, Ways to implement priority queues, Introduction to heaps, Introduction to Complete Binary Trees and its implementation, Insert and Delete operations in heaps, Implementing priority queues, Heap sort, Inbuilt Priority Queue Hashmaps: Introduction to Hashmaps, Inbuilt Hashmap, Hash functions, Collision handling, Insert and Delete operation implementation in hashmap, Load factor, Rehashing			
Self-study component:	Applications of Queues: Josephus Problem		
UNIT – IV	ADVANCED DATA STRUCTURES - II		06 Hours
Tries: Introduction to Tries, making a Trie Node class, Insert, Search and Remove operation implementation in Tries, Types of Tries, Huffman coding. Graphs: Introduction to Graphs, Graph Terminology, Graph implementation, Graph Traversals (DFS and BFS), Weighted and Directed Graphs, Minimum Spanning Trees, Cycle Detection in Graphs, Kruskal's algorithm, Prim's algorithm, Dijkstra's algorithm.			
Self-study component:	Optimal Binary Search Trees.		
UNIT – V	ADVANCED DATA STRUCTURES - III		06 Hours
Introduction to Dynamic Programming: Introduction to Memoization, Introduction to Dynamic Programming, Fibonacci numbers using recursion, memoization and dynamic programming			



Applications of Dynamic Programming: Longest Common Subsequence (LCS) using recursion, memorization and dynamic programming, Edit distance using recursion, memorization and dynamic programming, Knapsack problem using recursion, memorization and dynamic programming			
Self-study component:		Lower Bound Arguments, Decision trees.	
Course Outcomes: On completion of this course, students are able to:			
COs	Course Outcomes with <i>Action verbs</i> for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	Solve the problems based on Time and work, Speed & distance, trains, boats and streams and races.	Applying	L3
CO2	Solve logical reasoning problems based on Clocks and calendars and verbal ability skills of reading comprehension and critical reasoning.	Applying	L3
CO3	Analyze and represent various data structures and its operations.	Analyzing	L4
CO4	Develop programs with suitable data structure based on the requirements of the real-time applications	Applying	L3
Text Book(s): <ol style="list-style-type: none">1. Data Structures and Algorithms Made Easy by Narasimha Karumanchi2. Data Structures through C in Depth by by S K Srivastava and Deepali Srivastava3. Quantitative aptitude by Dr. R. S Agarwal, published by S. Chand private limited.4. Verbal reasoning by Dr. R. S Agarwal, published by S. Chand private limited.			
Reference Book(s): <ol style="list-style-type: none">1. Aaron M Tenenbaum, Yedidyah Langsam and Moshe J Augenstein, "Data Structures using C", 2014, low price edition ,Pearson education.2. Seymour Lipschutz, Data Structures with C (Schaum's Outline Series) , July 2017, McGraw Hill Education.3. Quantitative Aptitude by Arun Sharma, McGraw Hill Education Pvt Ltd.			
Web and Video link(s): <ol style="list-style-type: none">1. Data Structures and algorithms offered by NPTEL: https://nptel.ac.in/courses/106102064/2. https://www.youtube.com/watch?v=CBYHwZcbD-s3. https://www.youtube.com/watch?v=2ZLI8Gak1X44. https://www.youtube.com/watch?v=MdG0Vw9f1A4			



COURSE ARTICULATION MATRIX (EMPLOYABILITY ENHANCEMENT SKILLS - V – P22HSMC508B)												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2										
CO2	2	2										
CO3	2	2										
CO4	1	1	2									1



Social Connect and Responsibility [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P22UHV509	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: <ul style="list-style-type: none">• 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 expcert 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 indigenou 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 <i>Action verbs</i> 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										Program Specific outcomes				
		1	2	3	4	5	6	7	8	9	10	1	1	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



Software Testing [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P22IS601	Credits:	03
Teaching Hours/Week (L:T:P):	3:0:0	CIE Marks:	50
Total Theory Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ul style="list-style-type: none"> • Understand the basics of Software Testing • Recognize various types of Software Testing Techniques • Analyze various levels of software testing • Explore software test automation process 			
UNIT – I			8 Hours
Basics of software testing - Basic Definitions, Test Cases, Insights from a Venn Diagram, Identifying Test Cases, Fault Taxonomies, Levels of Testing; Examples: Generalized Pseudo code, The Triangle Problem, The Next Date Function, The Commission Problem			
Self-study component:	The SATM System		
UNIT – II			8 Hours
Boundary value testing, Equivalence class testing, Decision table based testing -Normal, Robust and Worst-case Boundary value testing, special value testing, Examples, Random testing, Traditional and Improved Equivalence class testing, Equivalence class test cases for triangle problem, NextDate function and commission problem, Decision tables, Decision Table Techniques.			
Self-study component:	Decision Table Test cases for triangle problem		
UNIT – III			8 Hours
Path Testing, Data flow testing, Life Cycle–Based Testing -Program Graphs, DD Paths, Test coverage metrics, Basis path testing, Define/Use Testing, Slice-Based Testing, Program Slicing Tools, Traditional Waterfall Testing, Testing in Iterative Life Cycles.			
Self-study component:	Agile Testing, Agile Model–Driven Development		
UNIT – IV			8 Hours
Integration Testing, System testing -Decomposition-Based Integration, Path-Based Integration Example: integration Next Date; Threads, Basis Concepts for Requirements Specification, Model-Based Threads, Use Case–Based Threads, Coverage Metrics for System Testing, Non-functional System Testing.			
Self-study component:	Atomic System Function Testing Example		
UNIT – V			8 Hours
Test Management and Automation -Preparing a Test Plan, Scope Management, Deciding Test Approach, Setting up Criteria for testing; Test Automation and terms used, Skills needed for Automation, Scope of Automation, Process Model for Automation, Selecting a Test tool. Introduction to Selenium - Overview and working with Selenium IDE, Selenium Web Driver			
Self-study component:	Challenges in Automation		



COs	Course Outcomes with <i>Action verbs</i> for the Course topics
CO1	Demonstrate the fundamentals of software testing using real world examples.
CO2	Identify and apply relevant testing techniques suitable for a real world scenario.
CO3	Apply the different levels in testing.
CO4	Implement Test Automation process and experiment with testing tools.
Text Book(s): <ol style="list-style-type: none">1 Paul C. Jorgensen, “Software Testing, A Craftsman’s Approach”, Auerbach Publications, 3rd Edition, First Indian Reprint, 2014, ISBN-13:97814665606802 Srinivasan Desikan Gopaldaswamy, “Software Testing Principles and Practices”, Pearson Education, 5th Edition, 2008 , ISBN: 9788177581218	
Reference Book(s): <ol style="list-style-type: none">1. Unmesh Gunecha, “Learning Selenium Testing Tools with Python”, PACKT Publishing, 2014,ISBN: ISBN 9781783983506	
Web and Video link(s): <ol style="list-style-type: none">1. https://artoftesting.com/selenium-tutorial2. https://katalon.com/resources-center/blog/software-testing3. https://www.tutorialspoint.com/software_testing/index.htm	
E-Books/Resources: <ol style="list-style-type: none">1. https://books.google.mn/books?id=Yt2yRW6du9wC&printsec=copyright&source=gbs_pub_info_r#v=onepage&q&f=false2. https://www.tutorialspoint.com/selenium/selenium_pdf_version.htm	



Advanced Computer Networks [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P22IS6021	Credits:	03
Teaching Hours/Week (L:T:P):	3:0:0	CIE Marks:	50
Total Theory Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ol style="list-style-type: none">1. Describe a variety of network concepts and protocols.2. Analyze the interoperability of networking protocols3. Analyze network traffic, congestion and Congestion controlling mechanism.			
UNIT – I			8 Hours
Foundation: Applications, Classes of Applications, Requirements, Scalable Connectivity, Cost-Effective Resource Sharing, Architecture, Layering and Protocols, Encapsulation, Multiplexing and Demultiplexing, Internet Architecture, Performance, Bandwidth and Latency, Delay × Bandwidth Product, High-Speed Networks, Application Performance Needs, Direct Links: Technology Landscape, Encoding, Reliable Transmission.			
Self-study component:	Framing, Error Detection		
UNIT – II			8 Hours
Internetworking: Switching Basics, Datagrams, Virtual circuit switching, Asynchronous Transfer Mode (ATM), Source Routing, Switched Ethernet, Learning Bridges, Spanning Tree Algorithm, Virtual LANs (VLANs), Internet (IP), What Is an Internetwork?, Service Model, Global Addresses, Datagram Forwarding in IP, Sub netting and Classless Addressing, Classless Addressing, IP Forwarding Revisited, Address Translation (ARP), Host Configuration (DHCP).			
Self-study component:	Network as a Graph		
UNIT – III			8 Hours
Advanced Internetworking: Global Internet, Routing Areas, Interdomain Routing (BGP), Challenges in Interdomain Routing, IP Version 6, Addresses and Routing, Address Space Allocation, Address Notation, Global Unicast Addresses, Packet Format, Advanced Capabilities, Multicast, Multicast Addresses, Multicast Routing (DVMRP, PIM, MSDP), Multiprotocol Label Switching, Destination-Based Forwarding, Explicit Routing, Virtual Private Networks and Tunnels.			
Self-study component:	Routing Among Mobile Devices		
UNIT – IV			8 Hours
End-to-End Protocols: Simple Demultiplexor (UDP), Reliable Byte Stream (TCP), End-to-End Issues, Segment Format, Connection Establishment and Termination, Sliding Window Revisited, Remote Procedure Call, RPC Fundamentals, RPC Implementations (SunRPC, DCE, gRPC).			
Self-study component:	Transport for Real-Time (RTP)		
UNIT – V			8 Hours
Congestion Control: Issues in Resource Allocation, Network Model, Queuing Disciplines, TCP Congestion Control, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit and Fast Recovery, Advanced Congestion Control, Active Queue Management (DECbit, RED, ECN), Source-Based Approaches (Vegas, BBR, DCTCP).			



Self-study component:	Quality of Service
Course Outcomes: On completion of this course, students are able to:	
COs	Course Outcomes with <i>Action verbs</i> for the Course topics
CO1	Understand fundamental concepts in network and IP addressing.
CO2	Analyze the working of various routing protocols for network performance.
CO3	Apply the algorithms/techniques of congestion control to solve problems related to computer Networks.
Text Book(s): 1. Larry Peterson and Bruce S Davis “Computer Networks: A System Approach” 6 th Edition, Elsevier.2019	
Reference Book(s): 1. Douglas E Comer, “Internetworking with TCP/IP, Principles, Protocols and Architecture” 6 th Edition, PHI 2. Uyles Black, “Computer Networks, Protocols, standards and Interface” 2 nd Edition-PHI 3. Behrouz A Forouzan, “TCP/IP Protocol Suite” 4 th Edition-Tata McGraw-Hill	
Web and Video link(s): 1. https://www.youtube.com/watch?v=K5SvnM3goxg&list=PLRvnry7Sqkdjys3j-hUn1-D6jTr6fctVH 2. https://www.youtube.com/watch?v=YdkksvhkQGQ	



Object Oriented Modeling and Design [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P22IS6022	Credits:	03
Teaching Hours/Week (L:T:P):	3:0:0	CIE Marks:	50
Total Theory Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ol style="list-style-type: none">1. Analyze and identify the modelling design techniques.2. Understanding of Class Models, State and Interaction Models with diagrams with advanced notations.3. Acquire the knowledge and understanding of the process of System Conception, Domain and Application Analysis.4. Improve the creativity in developing a overall Class Design and fine tuning of classes and relationships.			
UNIT – I			8 Hours
INTRODUCTION: Object Orientation, OO development, OO themes; Evidence for usefulness of OO development; OO modeling history. INTRODUCING THE UML: An Overview of the UML, A Conceptual Model of the UML, Architecture, and Software Development Life Cycle. MODEL: The Importance of Modeling, Principles of Modeling, Object-Oriented Modeling. MODELING CONCEPTS: Modeling as Design Technique; Modeling; abstraction; The three models. DIAGRAMS: Terms and Concepts, Common Modeling Techniques- Modeling different views of a system, modeling different levels of abstraction, Modeling complex views.			
Self-study component:	MODEL: The Importance of Modeling, Principles of Modeling, Object-Oriented Modeling.		
UNIT – II			8 Hours
CLASS MODELING: Object and class concepts; Link and associations concepts; Generalization and inheritance; A sample class model; Navigation of class models; Practical tips. ADVANCED CLASS MODELING: Advanced object and class concepts; Association ends; N-ary associations; Aggregation; Abstract classes; Multiple inheritance; Metadata; Reification; Constraints; Derived data; Packages.			
Self-study component:	Constraints; Derived data; Packages.		
UNIT – III			8 Hours
STATE MODELING: Events, States, Transitions and Conditions; State diagrams; State diagram behavior; Practical tips. ADVANCED STATE MODELING: Nested state diagrams; Nested states; Signal generalization; Concurrency; A sample state model; Relation of class and state models. INTERACTION MODELING: Use case models; Sequence models; Activity models. Use case relationships; Procedural sequence models; Special constructs for activity models.			
Self-study component:	A sample state model; Relation of class and state models		
UNIT – IV			8 Hours
PROCESS OVERVIEW: Development stages; Development life cycle. SYSTEM CONCEPTION: Devising a system concept; Elaborating a concept; Preparing a problem statement. DOMAIN ANALYSIS: Overview of analysis; Domain class model; Domain state model; Domain interaction model; Iterating the analysis. APPLICATION ANALYSIS: Application interaction model; Application class model; Application state model; Adding operations.			



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Self-study component:	Application state model; Adding operations	
UNIT – V		8 Hours
CLASS DESIGN: Overview of class design; Bridging the gap; Realizing use cases; Designing algorithms; Recursing downwards, Refactoring; Design optimization; Reification of behavior; Adjustment of inheritance; Organizing a class design; ATM example. IMPLEMENTATION MODELING: Overview of Implementation; Fine-tuning classes; Fine-tuning generalizations; Realizing associations; Testing.		
Self-study component:	Realizing associations; Testing	
Course Outcomes: On completion of this course, students are able to:		
COs	Course Outcomes with <i>Action verbs</i> for the Course topics	
CO1	Realize the concepts of Object-Oriented Analysis and Design, UML Architecture, Notations and Diagrams and also demonstrate an understanding of modeling as a design technique	
CO2	Construct advanced Class, State and Interaction models and know their importance in realistic situations	
CO3	Apply the process of System Conception for any given problem and understand the process of Domain and Application analysis with respect to its Class, State and Interaction model	
CO4	Create a Class model and enhance its design and associated relationships	
Text Book(s): 1. Object-Oriented Modeling and Design with UML – Michael Blaha, James Rumbaugh, 2 nd Edition, Pearson , 2012 First Impression. (Chapters 1,2,3,4,5,6,7,10,11,12,13,15,17&23).		
Reference Book(s): Object-Oriented Analysis and Design with Applications – Grady Booch et al, 3 rd Edition, Pearson Education, 2007		



Storage Area Network			
[As per Choice Based Credit System (CBCS) & OBE Scheme]			
SEMESTER – VI			
Course Code:	P22IS6023	Credits:	03
Teaching Hours/Week (L:T:P):	3:0:0	CIE Marks:	50
Total Theory Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to:			
<ul style="list-style-type: none"> • Define a storage system and data center environment, review the evolution of storage technology, and introduce intelligent storage systems. • Understand about storage area networks like FC-SAN, IPSAN, FCoE. • Exploration on information availability and business continuity solutions in both virtualized and non-virtualized environments • Understand on the business drivers, definition, essential characteristics, and phases of journey to the Cloud. • Discussion on framework and domains of storage security along with covering security implementation at storage networking 			
UNIT – I			8 Hours
Storage System Introduction to evolution of storage architecture, key data center elements, virtualization, and cloud computing. Key data center elements – Host (or compute), connectivity, storage. RAID implementations, techniques, and levels along with the impact of RAID on application performance. Components of intelligent storage systems and virtual storage provisioning.			
Self-study component:	Disk Drive Components, RAID Impact on Disk Performance.		
UNIT – II			8 Hours
Storage Networking Technologies and Virtualization Fibre Channel SAN components, connectivity options, and topologies including access protection mechanism ‘zoning’, FC protocol stack, addressing and operations, SAN-based virtualization and VSAN technology, iSCSI and FCIP protocols for storage access over IP network, Converged protocol FCoE and its components.			
Self-study component:	Fibre Channel Architecture, Fabric Services.		
UNIT – III			8 Hours
Backup, Archive, and Replication Information, Business continuity terminologies, planning and solutions, Failure Analysis. Backup Purpose, Backup Considerations, Backup Granularity, Recovery Considerations, Backup Methods, Backup Architecture, Backup and Restore Operations, Backup Topologies, Backup in NAS Environments, Backup Targets, Data Deduplication for Backup.			
Self-study component:	Backup in Virtualized Environments, Data Archive, Archiving Solution Architecture.		
UNIT – IV			8 Hours
Local Replication and Remote Replication Replication Terminology, Uses of Local Replicas, Replica Consistency, Local Replication Technologies, Tracking Changes to Source and Replica, Restore and Restart Considerations, Modes of Remote Replication, Remote Replication Technologies, Three-Site Replication, Data Migration Solutions, Remote Replication and Migration in a Virtualized Environment. Cloud Computing Cloud Enabling Technologies,			



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Characteristics of Cloud Computing, Benefits of Cloud Computing, Cloud Service Models, Cloud Deployment Models, Cloud Computing Infrastructure.		
Self-study component:	Restore and Restart Considerations, Local Replication in a Virtualized Environment, Cloud Challenges.	
UNIT – V		8 Hours
Securing and Managing Storage Infrastructure Information Security Framework, Risk Triad, Storage Security Domains, Security Implementations in Storage Networking, Securing Storage Infrastructure in Virtualized and Cloud Environments, Monitoring the Storage Infrastructure, Storage Infrastructure Management Activities, Storage Infrastructure Management Challenges, Developing an Ideal Solution.		
Self-study component:	Concepts in Practice: RSA and VMware Security Products, Information Lifecycle Management, Storage Tiering.	
NOTE		
Course Outcomes: On completion of this course, students are able to:		
COs	Course Outcomes with <i>Action verbs</i> for the Course topics	
CO1	Identify key challenges in managing information and analyze different storage networking technologies and virtualization	
CO2	Describe components and the implementation of Storage areas.	
CO3	Analyze types of archives and forms of virtualization.	
CO4	Illustrate the storage infrastructure and management activities.	
Text Book(s): 1. Information Storage and Management, Author :EMC Education Services, Publisher: Wiley ISBN: 9781118094839		
Reference Book(s): 1. Storage Virtualization, Author: Clark Tom, Publisher: Addison Wesley Publishing Company ISBN : 9780321262516		
Web and Video link(s): 1. https://nptel.ac.in/courses/106108058		



Augmented and Virtual Reality [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER –VI			
Course Code:	P22IS6024	Credits:	03
Teaching Hours/Week (L:T:P):	3:0:0	CIE Marks:	50
Total Theory Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ol style="list-style-type: none">1. Understand the system of human vision and its implication on perception and rendering2. Explain the concepts of motion and tracking in VR systems3. Analyse and understand the working of various state of the art AR devices4. To study about Virtual Hardware and Software			
UNIT – I			8 Hours
INTRODUCTION: The Three I's of Virtual Reality, A Short History of Early Virtual Reality, Input Devices: Trackers, Navigation, and Gesture Interfaces, Three-Dimensional Position Trackers, Tracker Performance Parameters, Mechanical Trackers, Magnetic Trackers, Ultrasonic Trackers, Optical Trackers, Hybrid Inertial Trackers.			
Self-study component:	Navigation and Manipulation Interfaces Tracker-Based Navigation/Manipulation Interfaces, Trackballs		
UNIT – II			8 Hours
OUTPUT DEVICES: Graphics, Three-Dimensional Sound, and Haptic Displays: Graphics Displays, The Human Visual System, Personal Graphics Displays, Large-Volume Displays, Sound Displays, The Human Auditory System, The Convolvotron, Speaker-Based Three-Dimensional Sound.			
Self-study component:	Tactile Feedback Interfaces, Force Feedback Interfaces		
UNIT – III			8 Hours
COMPUTING ARCHITECTURES FOR VR: The Rendering Pipeline, PC Graphics Architecture, Workstation-Based Architectures, Distributed VR Architectures.			
Self-study component:	MODELING		
UNIT – IV			8 Hours
What Is Augmented Reality? , where did Augmented Reality come from?, Why Digital Enhancement of the Real World Rather Than Physical Enhancement?, The Physical World Is Augmented by Digital Information That Is Superimposed on a View of the Physical World, The Physical World Is Augmented by Digital Information That Is Superimposed on a View of the Physical World, The Relationship Between Augmented Reality and Other technologies.			
Self-study component:	Communication augmented reality applications		
UNIT – V			8 Hours
MAJOR HARDWARE COMPONENTS FOR AUGMENTED REALITY SYSTEMS, Sensors, Roles of Sensors, Tracking, Optical Tracking, Acoustical Tracking, Electromagnetic Tracking, Mechanical Tracking Depth Sensors for Tracking, Processors, Roles of Processors, Handheld, Laptop or Desktop Computer with Server, Application Run as a Web Application, Displays, Visual Displays, Stationary Visual Displays, Visual Displays That Move with the Participant's Head.			



Self-study component:	Computer vision system
Course Outcomes: On completion of this course, students are able to:	
COs	Course Outcomes with <i>Action verbs</i> for the Course topics.
CO1	Interpret the concepts and principles of virtual reality and its application.
CO2	Illustrate the contextual knowledge of Generic VR system and Computing Architectures for VR/AR applications.
CO3	Analyze the various hardware requirements of AR.
Text Book(s): <ol style="list-style-type: none">1. Virtual Reality Technology, Gregory C. Burdea & Philippe Coiffet, John, 2nd Edition, 2013 Wiley & Sons, Inc., ISBN: 978-0-471-36089-6.2. Alan B. Craig, "Understanding Augmented Reality", Concepts and Applications, Morgan Kaufmann, 1st Edition, 2013 ISBN: 9780240824086.	
Reference Book(s): <ol style="list-style-type: none">1. Oliver Bimber and Ramesh Raskar, Spatial Augmented Reality: Merging Real and Virtual Worlds, 2005. ISBN 1-56881-230-22. Computer Graphics, second Edition in C, James. D Foley, Andries Van Dam, Steven K Feiner, John F Hughes, Kindle edition.	
Web and Video link(s): <ol style="list-style-type: none">1. https://www.coursera.org/learn/ar2. https://elearn.nptel.ac.in/shop/iit-workshops/completed/foundation-course-on-virtual-reality-and-augmented-reality/	



Cloud Computing [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER - VI			
Course Code:	P22IS6031	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: <ul style="list-style-type: none">• Understand Cloud Computing Fundamentals & Virtualization.• Identify the Cloud Types and Services, Technologies and Applications.• Analyze the Data-Intensive Technologies for Cloud Computing.• Explore and Scheduling Service Oriented Workflows Inside Clouds & Data Security in the Cloud			
UNIT – I			8 Hours
Cloud Computing Fundamentals: Introduction, Types of Cloud Computing, Cloud Computing Versus Cloud Services Enabling Technologies, Virtualization, Web Service and Service Oriented Architecture, Web 2.0 and Mashup, Cloud Computing Features, Cloud Computing Standards, Cloud Computing Security, Cloud Computing Platforms, Example of Web Application Deployment, Cloud Computing Challenges.			
Self-study component:	Cloud Computing in the Future		
UNIT – II			8 Hours
Cloud Types and Services: Cloud Types, Cloud Services and Cloud Roles, Platform as a Service, Software as a Service, Cloud Computing Technologies and Applications: Cloud Computing: IT as a Service, Cloud Computing Security, Cloud Computing Model Application Methodology, Cloud Computing Tactics Planning Phase, Cloud Computing Deployment Phase, Cloud Computing in Development/Test, Cloud-Based High Performance Computing Clusters.			
Self-study component:	Use Cases of Cloud Computing		
UNIT – III			8 Hours
Data-Intensive Technologies for Cloud Computing: Data-Intensive Computing Applications, Data-Parallelism, Characteristics of Data-Intensive Computing Systems, Data-Intensive System Architectures, Hadoop vs. HPCC Comparison.			
Self-study component:	Architecture Comparison		
UNIT – IV			8 Hours
Scheduling Service Oriented Workflows Inside Clouds Using an Adaptive Agent Based Approach: Related Work on DS Scheduling, Scheduling Issues Inside Service Oriented Environments, Workflow Scheduling, Distributed Agent Based Scheduling Platform Inside Clouds.			
Self-study component:	Prototype Implementation Details		



UNIT – V		8 Hours
Data Security in the Cloud: The Current State of Data Security in the Cloud, Cloud Computing and Data Security Risk, Cloud Computing and Identity, The Cloud, Digital Identity, and Data Security, Content Level Security—Pros and Cons Legal Issues in Cloud Computing: Data Privacy and Security Issues, Cloud Contracting models, Jurisdictional Issues Raised by Virtualization and Data Location		
Self-study component:	Commercial and Business Considerations—A Cloud	
Text Books 1) Handbook of Cloud Computing, Borko Furht, Armando Escalante, Editors, Springer Science+Business Media, LLC. 2) Computing Principles and Paradigms, Rajkumar Buyya , James Broberg, Andrzej Goscinsk, i Willey, 2014.		
Reference Book 1) Cloud Computing For Dummies ®, Published by Wiley Publishing, Inc. 111 River Street Hoboken, NJ 07030-5774 www.wiley.com Copyright © 2010 by Wiley Publishing, Inc., Indianapolis, Indiana		



Unix and Shell Programming			
[As per Choice Based Credit System (CBCS) & OBE Scheme]			
SEMESTER – VI			
Course Code:	P22IS6032	Credits:	03
Teaching Hours/Week (L:T:P):	3:0:0	CIE Marks:	50
Total Theory Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to:			
<ul style="list-style-type: none"> • To teach principles of UNIX operating system including File handling utilities, Process utilities, Disk utilities, Basic Linux commands, Scripts and filters. • To familiarize fundamentals of the Bourne again shell (bash), shell programming, pipes, input and output redirection Control structures, arithmetic in shell interrupt processing, functions, debugging shell scripts. 			
UNIT – I			8 Hours
Introduction to the Unix Operating System: The operating system, The UNIX operating system, knowing your machine, System Administrator, logging in and out, POSIX and the Single UNIX specification, The Linux and GNU, The UNIX Architecture, Features of UNIX.			
Becoming Familiar with UNIX Commands: Command basics, command structure, flexibility of command usage, man, the man documentation, echo, printf, script, using Email with mails, password, username, who, date, stty, the X window system.			
Self-study component:	A Hands-On Session, How It All Clicked		
UNIT – II			8 Hours
The File System: The file, what in a file name? the file system hierarchy, the unix file system, Using Absolute Pathnames with Commands, The HOME Variable and ~: The Home Directory, pwd and cd, Relative Pathnames, mkdir, rmdir, ls, cp, mv, rm, cat, more, pico, wc, lp, od, tar, gzip, zip. File Attributes: ls Revisited, File Permissions, chmod, the directory, umask, File Systems and Inodes, ln, ln Again, File Ownership, Modification and Access Times, find.			
Self-study component:	dos2unix, unix2dos		
UNIT – III			8 Hours
The vi/vim Editor: Vi basics, input mode, Saving Text and Quitting, recovering from a Crash, Navigation, Editing Text without Operators, correcting a C Program, Editing Text with Operators, Copying and Moving Text from One File to Another, Undoing Last Editing Instructions, searching for a Pattern, Repeating the Last Command, Substitution, set, map, abbr.			
The Shell: The Shell as Command Processor, Shell Offerings, Pattern Matching, Escaping and Quoting Redirection, Collective Manipulation, /dev/null and /dev/tty, Pipes, tee: Creating a Tee, Command Substitution, Shell Variables, Shell Scripts, The Shell’s Treatment of the Command Line, More Wild Cards.			
Self-study component:	xargs: Building a Dynamic Command Line		
UNIT – IV			8 Hours
The Process: Process Basics, The Shell and init, ps: Displaying Process Attributes, The Process Creation Mechanism, Inherited Process Attributes, When You Can’t Use a Separate Process, Process States and Zombies, Signal Handling, Running Jobs in Background, Job Control, at and batch: Execute Later. Simple Filters: pr, comparing files, cmp, comm, diff, head, tail, cut, paste, sort, uniq, tr, applying filters, Filters Using Regular Expressions—grep and sed.			



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Self-study component:	cron and crontab: Running Jobs Periodically.
UNIT – V	
8 Hours	
Filtering and Programming with awk: awk preliminaries, using print and printf, number processing, variables and expressions, the comparison and logical operators, the -f option, BEGIN and END section, positional parameters, arrays, built-in variables, Functions, control flow, looping with for and while.	
Shell Programming: Shell Scripts, read: Making Scripts Interactive, Using Command-Line Arguments,	
exit and \$?: Exit Status of a Command, The Logical Operators && and —Conditional Execution, The if Conditional, Using test and [] to Evaluate Expressions, Two Important Programming Idioms, The case Conditional, expr, bc and base name: Computation and String Handling, for: Looping with a List, while: Looping, break and continue, Manipulating Positional Parameters with set and shift, The Here Document (<<), Shell Functions, trap, eval, exec.	
Self-study component:	Sample Program 1: Automatically Selects Last C Program, Sample Script 2: Providing Numeric Extensions to Backup Files, Sample Script 3: A Table of Contents for Downloaded Files.
Course Outcomes: On completion of this course, students are able to:	
COs	Course Outcomes with <i>Action verbs</i> for the Course topics.
CO1	Analyze the role of various components in the architecture of Unix Operating System and use the various UNIX commands to interact with the operating system.
CO2	Interpret and manipulate file attributes and execute the programs using vi editor.
CO3	Demonstrate the importance of process, shell and essential shell programming.
CO4	Develop shell scripts involving regular expressions.
CO5	Design Report generation language using awk.
Text Book(s): 1. Your UNIX-The Ultimate Guide, Sumitabha Das, Tata McGraw Hill, 3rd edition.	
Reference Book(s): 1. UNIX: Concepts and Applications, Sumitabha Das, Tata McGraw Hill 2. “Beginning Shell Scripting”, Eric Foster-Johnson, John C Welch, Micah Anderson, Wrox publication	
Web and Video link(s): 1. https://www.youtube.com/@TechArkit 2. https://www.youtube.com/@ampcode	
E-Books/Resources: 1. https://usermanual.wiki/Document/YourUNIXtheultimateguideSumitabhaDas.1387537707.pdf	



Blockchain Technology			
[As per Choice Based Credit System (CBCS) & OBE Scheme]			
SEMESTER – VI			
Course Code:	P22IS6033	Credits:	03
Teaching Hours/Week (L:T:P):	3:0:0	CIE Marks:	50
Total Theory Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to:			
<ul style="list-style-type: none"> • Be Able to explain concepts related to BlockChain. • Be able to explain the need for BlockChain and the real world problems that BlockChain is trying to solve. • Understand and describe how BlockChain works. • Explain the underlying technology of transactions, blocks, proof-of-work, and consensus building. • How does BlockChain exist in the public domain (decentralized, distributed) yet maintain transparency, privacy, anonymity, security, immutability, history. 			
UNIT – I			8 Hours
Introduction to Block chain: Backstory of Block chain, what is Block chain? Centralized vs. Decentralized Systems, Layers of Block chain, why is BlockChain Important?, BlockChain Uses and Use Cases How BlockChain Works-1: Laying the BlockChain Foundation, Cryptography, Symmetric Key Cryptography, Cryptographic Hash Functions.			
Self-study component:	Limitations of Centralized Systems		
UNIT – II			8 Hours
How BlockChain Works-2: Asymmetric Key Cryptography, Diffie-Hellman Key Exchange, Symmetric vs. Asymmetric Key Cryptography, Nash Equilibrium, Prisoner’s Dilemma, Byzantine Generals’ Problem, Zero-Sum Games, Why to Study Game Theory, Computer Science Engineering, The BlockChain, Merkle Trees, BlockChain Transactions, Distributed Consensus Mechanisms, Scaling BlockChain, Off-Chain Computation, Sharding BlockChain State.			
Self-study component:	Game Theory		
UNIT – III			8 Hours
How Bitcoin Works: The History of Money, Dawn of Bitcoin, What Is Bitcoin? Working with Bitcoins, The Bitcoin BlockChain, Block Structure, The Genesis Block, The Bitcoin Network, Network Discovery for a New Node, Bitcoin Transactions, Consensus and Block Mining, Block Propagation, Bitcoin Scripts, Bitcoin Transactions Revisited, Bitcoin Wallets.			
Self-study component:	Putting it All Together		
UNIT – IV			8 Hours
How Ethereum Works: From Bitcoin to Ethereum, Ethereum as a Next-Gen Blockchain, Design Philosophy of Ethereum, Enter the Ethereum Blockchain, Ethereum Blockchain, Ethereum Accounts, Trie Usage, Merkle Patricia Tree, RLP Encoding, Ethereum Transaction and Message Structure, Ethereum State Transaction Function, Gas and Transaction Cost, Ethereum Smart Contracts, Contract Creation.			



Self-study component:	Ethereum Ecosystem
UNIT – V	
8 Hours	
BlockChain Application Development: Libraries and Tools, interacting with the Bitcoin BlockChain, Setup and Initialize the bitcoin js Library in a node.js Application, Create Key pairs for the Sender and Receiver, Get Test Bitcoins in the Sender’s Wallet, Get the Sender’s Unspent Outputs, Prepare Bitcoin Transaction, Sign Transaction Inputs, Create Transaction Hex, Broadcast Transaction to the Network, Interacting Programmatically with Ethereum— Sending Transactions, Set Up Library and Connection, Set Up Ethereum Accounts, Get Test Ether in Sender’s Account, Prepare Ethereum Transaction, Sign Transaction, Send Transaction to the Ethereum Network.	
Self-study component:	Public Nodes vs. Self-Hosted Nodes
Course Outcomes: On completion of this course, students are able to:	
COs	Course Outcomes with <i>Action verbs</i> for the Course topics
CO1	Understand the structure of a BlockChain and why/when it is better than a simple distributed database.
CO2	Explain the significance of cryptographic algorithms in BlockChain.
CO3	Describe the features and importance of Bitcoin.
CO4	Explain about the principles of Ethereum Virtual Machine.
CO5	Design, build, and deploy smart contracts and distributed applications.
Text Book(s): 1. Beginning Blockchain: A Beginner’s Guide to Building Blockchain Solutions by BikramadityaSinghal, GautamDhameja and PriyansuSekhar Panda.	
Reference Book(s): 1. Blockchain Technology: Cryptocurrency and Applications by S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, Oxford University Press 2019. 2. Bitcoin and cryptocurrency technologies: a comprehensive introduction by Arvind Narayanan et. Al, Princeton University Press 2016	
Web and Video link(s): 1. https://www.coursera.org/specializations/introduction-to-blockchain 2. https://nptel.ac.in/courses/106/104/106104220/	



Introduction to Dot Net Framework for Application Development [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER -VI			
Course Code:	P22IS6034	Credits:	03
Teaching Hours/Week (L:T:P):	3:0:0	CIE Marks:	50
Total Theory Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ul style="list-style-type: none">• Inspect Visual Studio programming environment and toolset designed to build applications for Microsoft Windows.• Understand Object Oriented Programming concepts in C# programming language.• Interpret Interfaces and define custom interfaces for application.• Build custom collections and generics in C#.• Construct events and query data using query expressions.			
UNIT - I			8 Hours
Introducing Microsoft Visual C# and Microsoft Visual Studio: Welcome to C#, Working with variables, operators and expressions, Writing methods and applying scope, Using decision statements, Using compound assignment and iteration statements, Managing errors and exceptions.			
Self-study component:	Installing Microsoft Visual Studio and building a simple C# application		
UNIT - II			8 Hours
Understanding the C# object model: Creating and Managing classes and objects, Understanding values and references, Creating value types with enumerations and structures, Using arrays.			
Self-study component:	Using the methods and properties of the <i>System. Array</i> class in Microsoft Visual Studio		
UNIT - III			8 Hours
Understanding parameter arrays, Working with inheritance, Creating interfaces and defining abstract classes, Using garbage collection and resource management.			
Self-study component:	Using the methods and properties of the <i>System. GC</i> class in Microsoft Visual Studio		
UNIT - IV			8 Hours
Defining Extensible Types with C#: Implementing properties to access fields, Using indexers, introducing generics, Using collections.			
Self-study component:	Implementing extensible types with C# using Microsoft Visual Studio		
UNIT - V			8 Hours
Enumerating Collections, Decoupling application logic and handling events, Querying in- memory data by using query expressions, Operator overloading.			
Self-study component:	Demonstrating operator overloading using Microsoft Visual Studio		
Course Outcomes: On completion of this course, students are able to:			



COs	Course Outcomes with <i>Action verbs</i> for the Course topics
CO1	Build applications on Visual Studio .NET platform by understanding the syntax & semantics of C#.
CO2	Demonstrate Object Oriented Programming concepts in C# programming language.
CO3	Design custom interfaces for applications and leverage the available built-in interfaces in building complex applications.
CO4	Illustrate the use of generics and collections in C#.
CO5	Compose queries to query in-memory data and define own operator behavior.
Text Book(s): 1. John Sharp, Microsoft Visual C# Step by Step, 8 th Edition, PHI Learning Pvt. Ltd. 2016	
Reference Book(s): 1. Christian Nagel, "C# 6 and .NET Core 1.0", 1 st Edition, Wiley India Pvt Ltd, 2016. Andrew Stellman and Jennifer Greene, "Head First C#", 3 rd Edition, O'Reilly Publications, 2013. 2. Mark Michaelis, "Essential C# 6.0", 5 th Edition, Pearson Education India, 2016. 3. Andrew Troelsen, "Prof C# 5.0 and the .NET 4.5 Framework", 6 th Edition, Apress and Dreamtech Press, 2012.	
Web and Video link(s): 1. https://ict.iitk.ac.in/courses/introduction-to-c-sharp/	



Cryptography & Network Security (Integrated) [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P22IS604	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: <ul style="list-style-type: none"> • To provide a practical survey of both the principles and practice of cryptography and network security. • The basic issues to be addressed by a network security capability are explored by providing a tutorial and survey of cryptography and network security technology. • Practice of network security and Practical applications that have been implemented and are in use to provide network security. 			
UNIT – I			8 Hours
Computer & Network security Concepts: Computer Security concepts, security attacks, security services, Security Mechanisms Classical Encryption Techniques Symmetric Cipher Model, substitution Techniques, Transposition Techniques, Rotor Machine, Steganography, Block Ciphers and the data encryption standard: Traditional block Cipher structure, The data encryption standard, A DES example, The strength of DES, Black cipher design Principals.			
Self-study component:	A model for Network security.		
Practical Topics: (4 Hours)	1) Write and Implement Program to Encrypt as well as Decrypt the given Plain Text message. 2) Write a Program to Encrypt the Chosen Plain Text by using Caser Cipher.		
UNIT – II			8 Hours
Public-Key Cryptography and RSA: Principles of public-key cryptosystems. The RSA algorithm, description of the algorithm, computational aspects, the security of RSA. Other Public-Key Cryptosystems: Diffie-hellman key exchange, Elgamal Caryptographic System, Pseudorandom Number generation Based on asymmetric cipher.			
Self-study component:	Elliptic Curve Arithmetic, Elliptic curve Cryptography.		
Practical Topics: (6 Hours)	1) To write a program to implement Data Encryption Standard (DES). 2) Write a Program to Implement the RSA Algorithm.		
UNIT – III			8 Hours
Key Management and Distribution: Symmetric key distribution using Symmetric encryption, Symmetric key distribution using Asymmetric encryption, Distribution of Public Keys, X-509 certificates, Public Key Infrastructure, User Authentication: Remote user Authentication principles, Remote user Authentication Using Symmetric Encryption, Kerberos, Federated Identity Management.			
Self-study component:	Personal Identity Verification, Remote user Authentication using Asymmetric encryption.		
Practical Topics: (6 Hours)	1) Write and Implement Deffi-hellman Key-Exchange Algorithm.		



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UNIT – IV		8 Hours
Network Access Control & Cloud Security: Network Access Control, Extensible Authentication Protocol, Cloud Security Risk and Countermeasures, Cloud Computing, Cloud Security Risks and Counter measures, Data Protection in the Cloud. Transport Level Security: Web Security Consideration, Transport Layer security, HTTPS, Secure shell(SSH).		
Self-study component:	Cloud Security as a Service.	
Practical Topics: (4 Hours)	1) Write a program to Implement SSH to Execute Remote Commands.	
UNIT – V		8 Hours
Electronic Mail Security: Internet Mail Architecture, Email Formats, Email threats and Comprehensive Email Security, S/MIME, Pretty Good Privacy. IP Security: IP Security overview, IP Security Policy, Encapsulating Security payload, Combining Security Associations.		
Self-study component:	DNSSEC, Internet Key Exchange.	
Practical Topics: (4 Hours)	1) Case study on Types of Email Security Threats and Best Practices to Ensure Email Security.	
NOTE		
Course Outcomes: On completion of this course, students are able to:		
COs	Course Outcomes with <i>Action verbs</i> for the Course topics	
CO1	Analyze and design classical encryption techniques, block ciphers and data encryption standard.	
CO2	Identify the security issues in the network.	
CO3	Understand the most common type of cryptographic algorithm.	
CO4	Implementing various encryption techniques.	
Text Book(s): 1. William Stallings: Cryptography and Network Security, Pearson 7th edition.		
Reference Book(s): 1. V K Pachghare: Cryptography and Information Security, PHI 2nd Edition.		
Web and Video link(s): 1. https://www.youtube.com/watch?v=C7vmouDOJYM 2. https://youtu.be/Hm35SS_PY5g 3. https://youtu.be/jSsehESW37c		
E-Books/Resources: 1. https://archive.nptel.ac.in/courses/106/105/106105162/#		



Robotic Process Automation [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER -VI			
Course Code:	P22ISO6051	Credits:	03
Teaching Hours/Week (L:T:P):	3:0:0	CIE Marks:	50
Total Theory Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ul style="list-style-type: none">• Understand the basic concepts of RPA platform.• Describe the different types of variables, control flow and data manipulation techniques.• Understand various control techniques, plugins and extensions in RPA.• Describe various types and strategies to handle events and exceptions.			
UNIT - I			8 Hours
What is Robotic Process Automation? Scope and techniques of automation Robotic process automation, About UiPath, The future of automation. Record and Play: Record and Play, UiPath stack, Downloading and installing UiPath Studio, Learning UiPath Studio, Task recorder.			
Self-study component:	Step-by-step examples using the recorder.		
UNIT - II			8 Hours
Sequence, Flowchart, and Control Flow: Sequence, Flowchart, and Control Flow, Sequencing the workflow, Activities, Control flow, various types of loops, and decision making, Step-by-step example using Sequence and Flowchart. Data Manipulation: Data Manipulation, Variables and scope, Collections, Arguments – Purpose and use, Data table usage with examples, Clipboard management, File operation with step-by-step example.			
Self-study component:	Step-by-step example, using Sequence and Control flow.		
UNIT - III			8 Hours
Taking Control of the Controls: Taking Control of the Controls, Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls – mouse and keyboard activities, Working with UiExplorer, Handling events, Revisit recorder, Screen Scraping, When to use OCR, Types of OCR available, Avoiding typical failure points.			
Self-study component:	How to use OCR		
UNIT - IV			8 Hours
Tame that Application with Plugins and Extensions: Tame that Application with Plugins and Extensions, Java plugin, Mail plugin, PDF plugin, Excel and Word plugins. Handling User Events and Assistant Bots: Handling User Events and Assistant Bots, What are assistant bots? Monitoring system event triggers, monitoring image and element triggers, Launching an assistant bot on a keyboard event.			
Self-study component:	Credential management		



UNIT - V		8 Hours
Exception Handling, Debugging, and Logging: Exception Handling, Debugging, and Logging, Exception handling, Common exceptions and ways to handle them, Logging and taking screenshots, debugging techniques, Collecting crash dumps.		
Self-study component:	Error reporting.	
Course Outcomes: On completion of this course, students are able to:		
COs	Course Outcomes with <i>Action verbs</i> for the Course topics	
CO1	Demonstrate Robotic Process Automation & Record and Play feature of UiPath Studio.	
CO2	Create different types of variables, control flow and data manipulation techniques.	
CO3	Apply various control techniques, plugins and extensions in RPA.	
CO4	Illustrate various types and strategies to handle events and exceptions.	
Text Book(s): 1. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool – UiPath by Alok Mani Tripathi, Packtpub, March 2018.		
Reference Book(s): 1. Learning ServiceNow by Tim Woodruff, Packtpub, March 2017. 2. ServiceNow Automation by Ashish Rudra Srivastava, Packtpub.		
Web and Video link(s): 1. https://www.uipath.com/rpa/robotic-process-automation 2. https://www.academy.uipath.com		



Information System Management [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P22ISO6052	Credits:	03
Teaching Hours/Week (L:T:P):	3:0:0	CIE Marks:	50
Total Theory Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ul style="list-style-type: none"> • Enable students to understand how systems, such as decision support systems and expert systems aid in the decision making process. • Enable students to understand the use of information systems to gain competitive advantage with management of information as an organizational resource. • Provide an overview of the uses of organizational systems, such as operations, finance, marketing, and human resources. 			
UNIT – I			8 Hours
Foundations of Information Systems in Business: The Real World of Information Systems, The Fundamental Roles of IS in Business, Types of Information Systems, Managerial Challenges of Information Technology, System Concepts: A Foundation, Components of Information Systems, Information System Resources, Information System Activities.			
Self-study component:	Trends in Information Systems.		
UNIT – II			8 Hours
Competing with Information Technology: Competing with Information Technology: Strategic IT, Strategic Uses of Information Technology, building a Customer-Focused Business, The Value Chain and Strategic IS, Reengineering Business Processes, creating a Virtual Company, building a Knowledge-Creating Company.			
Self-study component:	Agile company		
UNIT – III			8 Hours
E-Business Systems: Introduction, Cross-Functional Enterprise Applications, Enterprise Application Integration, Transaction Processing Systems, Enterprise Collaboration Systems. Functional Business Systems: Introduction, Marketing Systems, Targeted Marketing, Manufacturing Systems, Human Resource Systems, Accounting Systems.			
Self-study component:	Financial system		
UNIT – IV			8 Hours
Enterprise Business Systems: Introduction, what is CRM? The Three Phases of CRM, Benefits and Challenges of CRM. Enterprise Resource Planning: Introduction, what is ERP? Benefits and Challenges of ERP. Supply Chain Management: introduction, what is SCM? Benefits and Challenges of SCM.			
Self-study component:	Trends in CRM, ERP and SCM.		
UNIT – V			8 Hours
E-Commerce Fundamentals: Introduction to e-Commerce, Scope of E-commerce, Essential E-commerce Processes, Electronic Payment Processes, e-Commerce Success Factors, Web Store Requirements. Decision Support in Business: Introduction, Decision Support Trends, Decision Support Systems, Management Information Systems, Online Analytical Processing.			



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Self-study component:	Using Design Support Systems, Executive Information Systems.
Course Outcomes: On completion of this course, students are able to:	
COs	Course Outcomes with <i>Action verbs</i> for the Course topics
CO1	Understand the current generation of computing and information technologies for business and Apply the concepts of Management Information Systems to enhance business processes and support decision making.
CO2	Develop a strategy to gain a competitive advantage using information technology.
CO3	Interpret and recommend the use information technology to solve business problems.
CO4	Apply a framework and process for aligning organization's IT objectives with business strategy
Text Book(s): 1. James A. O' Brien, George M. Marakas: "Management Information Systems", 7th Edition, Tata McGraw Hill, Reprint 2013.	
Reference Book(s): 1. Kenneth C. Laudon Jone and P. Laudon, "Management Information Systems", 13th Edition, Pearson Education Limited 2014. 2. Ralph M. Stair and George W. Reynolds, "Principles of Information Systems - A Managerial Approach", 9th edition, Course Technology 2013. 3. W.S. Jawadekar: Management Information Systems, Tata McGraw Hill 2008.	
Web and Video link(s): 1. https://youtu.be/5JMkdGQCm4k?list=PLE04B26C87FB0C0C6 2. https://youtu.be/-18Py3sX5sM	
E-Books/Resources: 1. https://industri.fatek.unpatti.ac.id/wp-content/uploads/2019/03/186-Management-Information-Systems-James-A.-O%E2%80%99Brien-George-M.-Marakas-Edisi-10-2010.pdf	



Software Engineering [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P22ISO6053	Credits:	03
Teaching Hours/Week (L:T:P):	3:0:0	CIE Marks:	50
Total Theory Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ol style="list-style-type: none">1. Gain the knowledge relating to Software Engineering, Software reengineering and maintenance. Understand the principles of large scale software systems.2. Apply the process of analysis and design using object oriented approach.3. Identify the importance of testing in assuring the quality of software.4. Acquire and develop many valuable skills such as the ability to use developed software by Communicating with working group.5. Evaluate requirements for a software system.			
UNIT – I			8 Hours
Overview and Requirements Introduction to Software engineering, Professional and ethical responsibility; software process models, process iteration, software specification, software design and implementation, software validation, software evaluation; Software Requirements: Functional and Non-functional requirements; User requirements; System requirements; the software requirements document; requirements engineering processes: feasibility studies, requirements elicitation and analysis, requirement validation.			
Self-study component:	Functional and Non-functional requirements.		
UNIT – II			8 Hours
Software Design Architectural Design: system structuring, control models, modular decomposition, object oriented design: Objects and Object Classes, An Object-Oriented design process. Design evolution			
Self-study component:	Design evolution		
UNIT – III			8 Hours
Verification and Validation Verification and Validation (V & V): Planning; Software inspections; Automated static analysis, clean room software development; software testing: defect testing, integration testing, object oriented testing, Testing workbenches.			
Self-study component:	Testing Workbenches		
UNIT – IV			8 Hours
Management Managing People: limits to thinking, group working, choosing and keeping people, the people capability maturity model; software cost estimation: productivity, estimation techniques, algorithmic cost modeling, project duration and staffing.			
Self-study component:	Software Cost Estimation.		



UNIT – V		8 Hours
Evolution Software change: program evolution dynamics, software maintenance, architectural evolution; Software Re-engineering: source code translation, reverse engineering process, program modularization, data re-engineering.		
Self-study component:	Reverse Engineering Process	
Course Outcomes: On completion of this course, students are able to:		
COs	Course Outcomes with <i>Action verbs</i> for the Course topics	
CO1	Apply the principles and techniques of Software Engineering	
CO2	Analyze the various steps involved in the design process and the different design approaches which include function-oriented design and object-oriented design.	
CO3	Acknowledge the activities in project management, requirement engineering process and to identify the different types of system models.	
CO4	Acquire the knowledge of design engineering in software development activities.	
Text Book(s): 1. Software Engineering– Ian Somerville, 8th Edition, Pearson Education, 2007.		
Reference Book(s): 1. Software Engineering: A Practitioners Approach - Roger S. Pressman, 7 th Edition, McGraw-Hill, 2007. 2. Software Engineering Theory and Practice -Shari Lawrence Pfleeger, Joanne M. Atlee, 3rd Edition, Pearson Education, 2006. 3. Software Engineering Principles and Practice –Waman S Jawadekar, Tata McGraw Hill, 2004 4. Software Engineering – Pankaj Jalote, Tata Mc Graw Hill.		



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Operating System [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P22ISO6054	Credits:	03
Teaching Hours/Week (L:T:P):	3:0:0	CIE Marks:	50
Total Theory Teaching Hours:	40	SEE Marks:	50
Total Laboratory Hours:	-		
Course Learning Objectives: This course will enable the students to: <ul style="list-style-type: none">• Familiarize the operations performed by OS as a resource Manager.• Impart various scheduling and Memory Management techniques of OS.			
UNIT – I			8 Hours
Introduction: Role of operating systems, Computer System Architecture, Operating System Structure, Operating System Operations, Computing Environments, Open Source Operating Systems.			
Self-study component:	Activities of Process, Storage and Memory Management.		
UNIT – II			8 Hours
System Structures: Operating System Services, System Calls, System Programs, Operating System Structures. Process Management: Process Concept, Process Scheduling, Inter-process Communication.			
Self-study component:	Operations on Processes.		
UNIT – III			8 Hours
Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms (FCFS, SJF & Round Robin only), Algorithm Evaluation. Synchronization: Back ground, The Critical Section Problem, Peterson’s Solution, Mutex Locks, Semaphores, The Dining Philosopher’s Problem.			
Self-study component:	Multiple-Processor Scheduling.		
UNIT – IV			8 Hours
Deadlock: Deadlock Characterization, Methods Handling Deadlocks, Recovery from Deadlock. Memory Management Strategies: Background, Contiguous Memory Allocation, Segmentation, Paging.			
Self-study component:	Swapping.		



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UNIT – V		8 Hours
Virtual Memory: Demand Paging, Page Replacement. File System Structure: Directory and Disk Structure. File-System Implementation: Allocation Methods. Mass Storage Structure: Disk Scheduling.		
Self-study component:	Copy-on-Write.	
Course Outcomes: On completion of this course, students are able to:		
COs	Course Outcomes with <i>Action verbs</i> for the Course topics	
CO1	Understand the fundamental concepts of services provided by operating system.	
CO2	Apply different Process Scheduling, Disk Scheduling and page replacement algorithms to explore Operating System functionalities.	
CO3	Analyze concepts of operating system to acquire knowledge about the course.	
Text Book(s): 1. Operating Systems Concepts- Abraham Silberschatz, Peter B Galvin, Gerg Gagne, Ninth Edition, Wiley.		
Reference Book(s): 1. The Minix Book Operating Systems Design and Implementation, Third Edition, Andrew S. Tanenbaum and Albert S Woodhull, Pearson.		
Web and Video link(s): 5. https://www.youtube.com/watch?v=vBURTt97EkA&list=PLBlnK6fEYqRiVhbXDGLXDk_OQAeuVcp2O . 6. https://www.youtube.com/watch?v=783KAB-tuE4&list=PLIemF3uozcAKTgsCIj82voMK3TMR0YE_f		
E-Books/Resources: 1. https://www.researchgate.net/publication/354665053_Operating_System_Concepts_9th_2012 .		



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Software Testing Laboratory [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P22ISL606	Credits:	01
Teaching Hours/Week (L:T:P):	0:0:2	CIE Marks:	50
Total Number of Lab Hours:	24	SEE Marks:	50
Part – A			
Design and write a program to implement the following			
Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of boundary value testing, derive different test cases, execute these test cases and discuss the test results.			
Design, develop, code and run the program in any suitable language to implement the Next Date function. Analyze it from the perspective of boundary value testing, derive different test cases, execute these test cases and discuss the test results.			
Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of equivalence class testing, derive different test cases, execute these test cases and discuss the test results.			
Design, develop, code and run the program in any suitable language to implement the NextDate function. Analyze it from the perspective of equivalence class value testing, derive different test cases, execute these test cases and discuss the test results.			
Design, develop, code and run the program in any suitable language to implement the triangle problem. Analyze it from the perspective of boundary value testing, derive different test cases, execute these test cases and discuss the test results.			
Part – B			
Write a script to login a specific web page.			
Write a script to count number of items present on a desktop.			
Write a script to update 06 student records into table into Excel file.			
Write a script to provide total number of objects present / available on the page.			
Write a script to get the number of items in a list / combo box.			
COs	Course Outcomes with <i>Action verbs</i> for the Course topics		
CO1	Apply the appropriate test cases for any given problem		
CO2	Implement Test Automation process and experiment with testing tools		



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Mini - Project [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P22ISMP607	Credits:	02
Teaching Hours/Week (L:T:P)	0:0:2	CIE Marks:	50
Total Number of Teaching Hours:	26	SEE Marks:	50
<p>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)</p> <p>CIE procedure for Mini-project:</p> <p>(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.</p> <p>(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.</p> <p>SEE for Mini-project:</p> <ul style="list-style-type: none">▪ 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.			



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EMPLOYABILITY ENHANCEMENT SKILLS - VI [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI for CSE, ISE, ECE, EEE & CSE(AIML) Branches only			
Course Code:	P22HSMC608B	Credits:	01
Teaching Hours/Week (L:T:P)	0:2:0	CIE Marks:	50
Total Number of Teaching Hours:	30	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ul style="list-style-type: none">• Calculations involving permutations and combinations, probability, ages and data interpretation.• Explain concepts behind logical reasoning modules of syllogisms and data sufficiency.• Prepare students for Job recruitment process and competitive exams.• Develop problem solving skills through various programming language.			
UNIT – I			06 Hours
Quantitative Aptitude: Permutation and Combination, Probability, Ages.			
Self-study component:	Inferred meaning		
UNIT – II			06 Hours
Quantitative Aptitude: Data Interpretation. Logical Reasoning: Syllogisms, Data Sufficiency.			
Self-study component:	Chain rule		
UNIT – III			06 Hours
Soft skills: Group Discussions, Resume Writing, LinkedIn Profiling, Interview Skills. Interview Preparation: Mock GDs, Resume Validation and Personal Interviews.			
Self-study component:	Interpersonal communication		
UNIT – IV	COMPETITIVE CODING - I		06 Hours
Arrays: Find a peak element which is not smaller than its neighbors, K th Smallest largest element, Kadane's Algorithm, Missing number in array, Rearrange Array Alternately, Sort 0s, 1s and 2s, Trapping Rain Water, Chocolate Distribution Problem, Array Leaders, Minimum Number of Platforms Required for a Railway/Bus Station, Rotate a matrix by 90 degree without using any extra space, Find maximum element of each row in a matrix, Print matrix in snake pattern. Strings: Reverse words in a given string, Converting Roman Numerals to Integer, Find the minimum distance between the given two words, Check whether two Strings are anagram of each other, Remove duplicates from a given string, Multiply Strings, Find largest word in dictionary, Longest			



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Common Prefix, Reduce the string by removing K consecutive identical characters, Check if given String is Pangram or not, Compare Version Numbers.			
Self-study component:		Logarithmic Complexity with Binary Search	
UNIT – V	COMPETITIVE CODING - II		06 Hours
<p>Linked List: Print the Middle of a given linked list, Reverse a Linked List, Reverse a Doubly Linked List, Rotate a Linked List, Delete middle of linked list, Pairwise Swap Nodes of a given Linked List, Remove duplicates from a sorted linked list, Convert singly linked list into circular linked list, Merge two sorted linked lists, check if a singly linked list is palindrome, Insert a node in the 5th position in a singly linked list.</p> <p>Stacks and Queues: Parenthesis Checker, Reverse a String using Stack, Reverse an array using Stack, Delete Middle element from stack, Find Next Greater Element using Stack, The Stock Span Problem, Reverse First k Elements of Queue, insert one element at front using queue, Implement a Queue using an Array, Maximum number of diamonds that can be gained in K minutes, Sorting a Queue without extra space.</p> <p>Database: Introduction to database, Types of SQL statements, MySQL commands.</p>			
Self-study component:		Schema change statements in SQL.	
Course Outcomes: On completion of this course, students are able to:			
COs	Course Outcomes with <i>Action verbs</i> for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	Solve the problems based on Permutation and combination, Probability, ages and data interpretation.	Applying	L3
CO2	Solve logical reasoning problems based on Syllogisms and Data Sufficiency.	Applying	L3
CO3	Apply suitable programming language and / or suitable data structures to solve the given problem.	Applying	L3
<p>Text Book(s):</p> <ol style="list-style-type: none"> 1. Guide to Competitive Programming: Learning and Improving Algorithms Through Contests by Antti Laaksonen 2. Cracking the Coding Interview by Gayle Laakmann McDowell 3. Fundamentals of Database Systems – Elmasri and Navathe, 6th Edition, Addison-Wesley, 2011. 4. Quantitative aptitude by Dr. R. S Agarwal, published by S. Chand private limited. 			



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5. How to sharpen your interview skills by Prem Vas

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.
2. Data Base System Concepts – Silberschatz, Korth and Sudharshan, 5th Edition, Mc-Graw Hill, 2006
3. An Introduction to Database Systems – C.J. Date, A. Kannan, S. Swamynatham, 8th Edition, Pearson Education, 2006.
4. Quantitative Aptitude by Arun Sharma, McGraw Hill Education Pvt Ltd.

Web and Video link(s):

1. Problem Solving through Programming in C -
<https://archive.nptel.ac.in/courses/106/105/106105171/>
2. https://onlinecourses.nptel.ac.in/noc22_cs91/
3. <https://youtu.be/c5HAwKX-suM>
4. https://onlinecourses.nptel.ac.in/noc18_cs15/preview
5. <http://nptel.ac.in/courses/106106093/>
6. <http://nptel.ac.in/courses/106106095/>

COURSE ARTICULATION MATRIX

(EMPLOYABILITY ENHANCEMENT SKILLS - VI – P22HSMC608B)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2										
CO2	2	2										
CO3	2	2	1									1



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Universal Human Values and Professional Ethics [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P22UHV609	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: <ol style="list-style-type: none">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. <ol style="list-style-type: none">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);	
<ul style="list-style-type: none">• 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:	
<ol style="list-style-type: none">1. Ethical human conduct2. Socially responsible behaviour3. Holistic vision of life4. Environmentally responsible work5. Having Competence and Capabilities for Maintaining Health and Hygiene6. Appreciation and aspiration for excellence (merit) and gratitude for all	



P.E.S. College of Engineering, Mandya

Department of Information Science & Engineering

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 kantik, 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>