Syllabus
IV B.Tech I SEM

ADHOC & SENSOR NETWORKS
(PROFESSIONAL ELECTIVE–III)

Subject Code: UGAI7T0122		L	T	P	C
IV Year / I Semester		3	0	0	3

PRE-REQUISITES:	
➢ Students should have a basic knowledge in computer networks	
COURSE OBJECTIVE:	
➢ Understand the design issues in ad hoc and sensor networks.	
➢ Learn the different types of MAC protocols.	
➢ Be familiar with different types of adhoc routing protocols.	
➢ Be expose to the TCP issues in adhoc networks.	
➢ Learn the architecture and protocols of wireless sensor networks.	
➢ Have an exposure to mote programming platforms and tools	
SYLLABUS:	
UNIT I:	**(8 hrs)**
INTRODUCTION Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum – Characteristics of the Wireless Channel -mobile ad hoc networks (MANETs) and wireless sensor networks (WSNs) :concepts and architectures. Applications of Ad Hoc and Sensor networks.	
UNIT II:	**(8 hrs)**
MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS Issues in designing a MAC Protocol- Classification of MAC Protocols- Contention based protocols-Contention based protocols with Reservation Mechanisms- Contention based protocols with Scheduling Mechanisms	
UNIT III:	**(14 hrs)**
ROUTING PROTOCOLS AND TRANSPORT LAYER IN AD HOC WIRELESS NETWORKS Issues in designing a routing and Transport Layer protocol for Ad hoc networks- proactive routing, reactive routing (on-demand), hybrid routing- Classification of Transport Layer solutions-TCP over Ad hoc wireless Networks. **WIRELESS SENSOR NETWORKS (WSNS) AND MAC PROTOCOLS** Single node architecture: hardware and software components of a sensor node – WSN Network architecture: typical network architectures-data relaying and aggregation strategies -MAC layer protocols: self-organizing, Hybrid TDMA/FDMA and CSMA based MAC- IEEE 802.15.4.	
UNIT V:	**(8 hrs)**
WSN ROUTING, LOCALIZATION & QOS Issues in WSN routing – OLSR- Localization – Indoor and Sensor Network Localization-	

absolute and relative localization, triangulation-QOS in WSN-Energy Efficient Design

UNIT VI:	**(7 hrs)**

SENSOR NETWORK PLATFORMS AND TOOLS
Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, nesC, CONTIKIOS, Node-level Simulators – NS2 and its extension to sensor networks, COOJA, TOSSIM

COURSE OUTCOMES:

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

CO1:	Explain the concepts, network architectures and applications of ad hoc and wireless sensor networks
CO2:	Analyze the protocol design issues of ad hoc and sensor networks
CO3:	Design routing protocols for ad hoc and wireless sensor networks with respect to some protocol design issues
CO4:	Evaluate the QoS related performance measurements of ad hoc and sensor networks
CO5:	Be familiar with the OS used in Wireless Sensor Networks and build basic modules

MAPPING OF COs TO POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	2	3	-	-	-	-	-	-	-	3	-	-
CO3	3	2	2	3	-	-	-	-	-	-	-	3	-	-
CO4	3	2	2	3	-	-	-	-	-	-	-	3	-	-
CO5	3	2	2	3	-	-	-	-	-	-	-	3	-	-

TEXT BOOKS:

1.	Ad Hoc Wireless Networks Architectures and Protocols, C. Siva Ram Murthy and B. S. Manoj, Prentice Hall, PTR, 2004.
2.	Protocols and Architectures for Wireless Sensor Networks, Holger Karl and Andreas Willig, Wiley, 2005

REFERENCE BOOKS:

1.	sensor networks: a survey, I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, ─Wireless computer networks, Elsevier, 2002, 394 - 422.
2.	Wireless Sensor Networks, Feng Zhao and Leonides Guibas, Elsevier Publication – 2002.
3.	Ad Hoc Networking, Charles E. Perkins, Addison Wesley, 2000.
4.	Wireless Sensor Networks-Technology, Protocols, and Applications, Kazem Sohraby, Daniel Minoli, & Taieb Znati, John Wiley, 2007.
5.	Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.

REINFORCEMENT LEARNING
(PROFESSIONAL ELECTIVE–III)

Subject Code: UGAI7T0222		L	T	P	C
IV Year / I Semester		**3**	**0**	**0**	**3**

PRE-REQUISITES:	
➢ Theory of Probability ➢ Applied Statistics ➢ Machine learning foundation	
COURSE OBJECTIVE:	
➢ Able to identify the decision problems ➢ To understand the dynamic programming polices ➢ To understand the policy evaluation and controls ➢ To understand the value prediction methods and controls	
SYLLABUS:	
UNIT I:	**(9 hrs)**
REINFORCEMENT PROBLEM: Introduction, Elements of RL, History of RL, Evaluative feedback, Goals and rewards, Returns, Markovian Decision Problem (MDP), Value functions, Optimality Criterion in MDPs.	
UNIT II:	**(8 hrs)**
DYNAMIC PROGRAMMING(DP): Policy Evaluation, Policy Improvement, Value Iteration, asynchronous DP, Efficiency of DP.	
UNIT III:	**(14 hrs)**
MONTE CARLO METHODS: Policy Evaluation, Policy Improvement, On-policy and off, policy Monte Carlo controls, Incremental implementation. **TEMPORAL DIFFERENCE LEARNING(TD)**: TD-prediction, Optimality of TD, Sarsa, Q-Learning, R- Learning, Actor, Critic Model, Unifying Monte Carlo and TD, Traces, Games.	
UNIT IV:	**(9 hrs)**
FUNCTION APPROXIMATION: Value prediction and control, Gradient Descent methods, Linear methods, Artificial Neural Network based approximation.	
UNIT V:	**(7 hrs)**
PLANNING AND LEARNING:Model based learning and planning, prioritized sweeping, Heuristic search. CASE STUDIES	

COURSE OUTCOMES:

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

CO1:	Enumerate the principles of Positive reinforcement, negative reinforcement, extinction, and punishment.
CO2:	Describe about the selective exposure, selective perception, and selective retention
CO3:	Analyze the general-purpose formalism for automated decision-making and AI
CO4:	Illustrate the methods on policy, a reward function, a value function, and, optionally, a model of the environment
CO5:	Identify the machine learning training method based on rewarding desired behaviors and/or punishing undesired ones.

MAPPING OF COs TO POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	3
CO3	3	-	-	2	-	-	-	-	-	-	-	-	-	3
CO4	3	-	-	2	-	-	-	-	-	-	-	-	-	3
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	3

TEXT BOOKS:

1.	Sutton R. S. and Barto A. G., "Reinforcement Learning: An Introduction", MIT Press, 2012.
2.	CsabaSzepesvári, "Algorithms for Reinforcement Learning", Morgan & Claypool, 2013.
3.	Kevin Murphy , "Machine Learning - A Probabilistic Perspective" , MIT press, 2012.
4.	Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.

REFERENCE BOOKS:

1.	Probability, Statistics, and Random Processes for Electrical Engineering", 3rd Edition, Alberto Leon-Garcia
2.	Machine Learning: A Probabilistic Perspective", Kevin P. Murphy

ONLINE REFERENCES:

1.	http://cse.iitkgp.ac.in/~adas/courses/rl_aut2021/syllabus.html
2.	http://www.cse.iitm.ac.in/~ravi/courses/Reinforcement%20Learning.html
3	https://sdean.website/cs4789.html

SOCIAL MEDIA ANALYTICS
(PROFESSIONAL ELECTIVE–III)

Subject Code: UGAI7T0322		L	T	P	C
IV Year / I Semester		3	0	0	3

PRE-REQUISITES:
➢ Basic programming skills (in Python), Social Media Insights.

COURSE OBJECTIVE:

➢ To understand the role of social media data and analytics in helping organizations achieve their goals and understand their publics;
➢ To identify and select key performance indicators to accurately measure the success of social media efforts;
➢ To analyze social media data using native analytics (e.g. Facebook, Twitter, Instagram) and social media measurement tools.
➢ To draw meaningful insights and provide actionable and strategic recommendations based on thorough social media data analysis;
➢ To develop social media measurement plans and analytics reports, and communicate findings and recommendations effectively

SYLLABUS:

UNIT I:	(07 hrs)

INTRODUCTION TO SOCIAL MEDIA ANALYTICS
Social media landscape, Need for SMA; SMA in Small organizations; SMA in large organizations; Application of SMA in different areas.
NETWORK FUNDAMENTALS AND MODELS
The social networks perspective - nodes, ties and influencers, social network and web data and methods. Graphs and Matrices- Basic measures for individuals and networks. Information visualization

UNIT II:	(07 hrs)

Network Centrality Measures, Community detection and link prediction

UNIT III:	(08 hrs)

CONNECTIONS & WEB ANALYTICS TOOLS
Making connections: Link analysis. Random graphs and network evolution. Social contexts: Affiliation and identity.
Web analytics tools: Clickstream analysis, A/B testing, online surveys, Web crawling and Indexing. Natural Language Processing Techniques for Micro-Text Analysis

UNIT IV:	(06 hrs)

SOCIAL ANALYTICS (FACEBOOK, INSTAGRAM, TWITTER)
Introduction, parameters, demographics. Analyzing page audience. Reach and Engagement analysis. Post- performance on FB. Social campaigns. Measuring and analyzing social campaigns, defining goals and evaluating outcomes, Network Analysis.

UNIT V:	(08 hrs)

PROCESSING AND VISUALIZING DATA
Processing and Visualizing Data, Influence Maximization, Link Prediction, Collective

Classification, Applications in Advertising and Game Analytics.
CASE STUDY IMPLEMENTATION
Collecting and analyzing social media data; visualization and exploration
Practical component: CASE STUDY Students should analyze the social media of any
ongoing campaigns and present the findings.

COURSE OUTCOMES:

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

CO1:	Explain the basic concepts of social network analysis.
CO2:	Collaborative with peers to apply these methods to a variety of social media.
CO3:	Describe the link between qualitative and quantitative methods of social network analysis.
CO4:	Explain how these social technologies impact society and vice Versa
CO5:	Examine the ethical and legal implications of leveraging social media data

MAPPING OF COs TO POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	3	3	2	-	-	-	-	-	-	-	-	-
CO2	-	-	-	3	2	-	-	-	-	-	-	-	-	-
CO3	-	-	3	3	2	-	-	-	-	-	-	-	-	-
CO4	-	-	-	3	2	-	-	-	-	-	-	-	-	-

TEXT BOOKS:

1.	Marshall Sponder(2017), Social Media Analytics, McGraw Hill, Latest edition
2.	Jim Sterne, Social Media Metrics: How to Measure and Optimize Your Marketing Investment, Wiley, Latest Edition

REFERENCE BOOKS:

1.	Jim Sterne(2021), Social Media Metrics: How to Measure and Optimize Your Marketing Investment, Wiley Latest Edition
2.	Tracy L. Tuten, Michael R. Solomon, Social Media Marketing, Sage, Latest Edition

E BOOKS
1. https://libribook.com/ebook/6316/python-social-media-analytics-pdf

MOOC

1. https://www.coursera.org/learn/social-media-data-analytics

SOFTWARE TESTING METHODOLOGIES
(PROFESSIONAL ELECTIVE–III)

Subject Code: UGAI7T0422		L	T	P	C
IV Year / I Semester		3	0	0	3

PRE-REQUISITES:
  ➢ Basic concepts of Programming, software engineering and analytical skills.

COURSE OBJECTIVE:

This course enables the learners to have a higher level knowledge related to software testing of a product in IT industry.
  ➢ It focuses on various principles, methods and techniques related to various types of software testing as well as efficient testing strategies, software quality management, and automation & testing tools.
  ➢ Learners will get exposure to various real time testing practices testing different types of software through this course.

SYLLABUS:

UNIT I:	(7 hrs)

SOFTWARE TESTING:

Introduction, Evolution, Myths & Facts, Goals, Psychology, Definition, Model for testing, Effective Vs Exhaustive Software Testing.

Software Testing Terminology and Methodology: Software Testing Terminology, Software Testing Life Cycle, Software Testing Methodology**. [T1]**

UNIT II:	(8 hrs)

VERIFICATION AND VALIDATION:

Verification & Validation Activities, Verification, Verification of Requirements, High level and low level designs, how to verify code, Validation**. [T2]**

Dynamic Testing, I: Black Box testing techniques: Boundary Value Analysis, Equivalence class Testing, State Table based testing, Decision table based testing, Cause-Effect Graphing based testing, Error guessing. [**T1**]

UNIT III:	(7 hrs)

DYNAMIC TESTING II:

White-Box Testing: need, Logic coverage criteria, Basis path testing, Graph matrices, Loop testing, data flow testing

Static Testing: inspections, Structured Walkthroughs, Technical reviews. [**T1**]

UNIT IV:	(7 hrs)

VALIDATION ACTIVITIES:

Unit testing, Integration Testing, Function testing, system testing, acceptance testing.

Regression testing: Progressives Vs regressive testing, Objectives of regression testing, when regression testing done? Regression testing types, Regression testing

techniques. [**T1**]	
UNIT V:	**(10 hrs)**

AUTOMATION AND TESTING TOOLS:
Need for automation, categorization of testing tools, selection of testing tools, Cost incurred, Guidelines for automated testing, overview of some commercial testing tools.
Testing Web based Systems: Challenges in testing for web based software, quality aspects, web engineering, testing of web based systems, Testing mobile systems. **[T1]**

COURSE OUTCOMES:

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

CO1:	Understand various testing issues & solutions in software (**L2**)
CO2:	Apply modern software testing processes in relation to software Development and project management. **(L3)**
CO3:	Analyze different types of verification & validation techniques to ensure the Functioning of a software system. **(L4)**
CO4:	Create and execute test cases for object oriented and web based Projects. **(L6)**
CO5:	Evaluate different testing tools and their Working mechanisms **(L5)**

MAPPING OF COs TO POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	3	-	-	-	-
CO4	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	3	3	-	-	-	-	-	-	-	-	-

TEXT BOOKS:

1.	Naresh Chauhan , Software Testing, Principles and Practices, , Oxford.
3.	Yogesh Singh, Software Testing- CAMBRIDGE

REFERENCE BOOKS:

1.	Baris Beizer, Software testing techniques - International Thomson computer press, second edition.
2.	M G Limaye, Software Testing, Principles, techniques and Tools, TMH

HUMAN COMPUTER INTERACTION
(PROFESSIONAL ELECTIVE-IV)

Subject Code: UGAI7T0521		L	T	P	C
IV Year / I Semester		3	0	0	3

PRE-REQUISITES:	
➢ Basic concepts of system analysis and design and exposure to various user interface designs related to web and mobile.	

COURSE OBJECTIVE:

Upon successful completion of this course, students should be able to:
- ➢ Design clear, easy-to-understand and use interfaces and screens for graphical and Web systems.
- ➢ Describe and apply core theories, models and methodologies from the field of HCI.

SYLLABUS:

UNIT I	(8 hrs)

The User Interface – An Introduction and Overview: Importance of User Interface, Defining the User Interface, importance of Good Design, Benefits of Good Design, A brief history of the Human-Computer Interface**.**

Characteristics of Graphical and Web User Interfaces: The Graphical User Interface, popularity of Graphics, the concept of direct manipulation, Graphical systems: Advantages and Disadvantages, Characteristics of the Graphical User Interface, The Web User Interface, The Popularity of the Web, Characteristics of a Web Interface, Principles of user interface Design.

UNIT II	(8 hrs)

The User Interface Design process: Obstacles and Pitfalls in the Development Path, Usability, The Design Team, Understanding How People Interact with Computers, Important Human Characteristics in Design, Human Considerations in Design, Human Interaction Speeds.

Understand the Business Function: Business Definition and Requirements Analysis, Determining Basic Business Functions, Design Standards or Style Guides, System Training and Documentation Needs.

UNIT III	(14 hrs)

Develop System Menus and Navigation Schemes: Structures of Menus, Functions of Menus, Content of Menus, Formatting of Menus, Phrasing the Menu, Selecting Menu Choices, Navigating Menus, Kinds of Graphical Menus.

Select the Proper Kinds of Windows: Window Characteristics, Components of a Window, Window Presentation Styles, Types of Windows, Window Management, Organizing Window Functions, Window Operations, Web Systems

UNIT IV	(9 hrs)

Select the Proper Device-Based Controls: Characteristics of Device-Based Controls, Selecting the Proper Device-Based Controls.	
Choose the Proper Screen-Based Controls: Operable Controls, Text Entry/Read-Only Controls, Selection Controls, Combination Entry/Selection Controls, Other Operable Controls, Custom Controls, Presentation Controls, Selecting the Proper Controls.	
UNIT V:	**(9 hrs)**
Components: Words, Sentences, Messages and Text, Text for Web Pages. **Create Meaningful Graphics, Icons and Images:** Icons, Multimedia. **Choose the Proper Colors:** Color, Color Uses, Possible Problems with Color, Color and Human Vision, Choosing Colors, Choosing Colors for Textual Graphic Screens, Choosing Colors for Statistical Graphics Screens, Choosing Colors for Web Pages, Colors to Avoid.	

COURSE OUTCOMES:

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

CO1:	Interpret the basic principles of user interface & GUI design concepts.
CO2:	Apply interactive design principles in real-time application development with client and system requirements.
CO3:	Classify various interface design components by using modern tools.

MAPPING OF COs TO POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	3	-	3	3	-	-	3	3	3	3	-	-
CO3	3	-	3	-	3	3	-	-	-	-	-	3	-	-

TEXT BOOKS:

1.	Wilbert O Galitz, "The Essential Guide To User Interface Design", Wiley DreamaTech.
2.	Ben Shneidermann, "Designing The User Interface", 3rd Edition, Pearson Education Asia.

REFERENCE BOOKS:

1.	Alan Dix, Janet Fincay, Gre Goryd, Abowd, Russell Bealg, "Human Computer Interaction", Pearson.
2.	Prece, Rogers, Sharps, "Interaction Design", Wiley Dreamtech.
3.	Soren Lauesen, "User Interface Design", Pearson Education.

DATA PRIVACY AND SECURITY

CYBER SECURITY and CYBER LAWS
(Professional Elective-IV)

Subject Code: UGAI7T0621		L	T	P	C
IV Year / I Semester		3	0	0	3

COURSE OBJECTIVE:
➢ To understand various types of cyber-attacks and cyber-crimes   ➢ To learn threats and risks within context of the cyber security   ➢ To have an overview of the cyber laws & concepts of cyber forensics   ➢ To study the defensive techniques against these attacks.

SYLLABUS:	
UNIT I:	**(08 hrs)**
Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.	
UNIT II:	**(08 hrs)**
Cyberspace and the Law & Cyber Forensics: Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics	
UNIT III:	**(12 hrs)**
Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Organizational security Policies and Measures in Mobile Computing Era, Laptops. **Cyber Security:** Organizational Implications: Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications	
UNIT IV:	**(12 hrs)**
Social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations. **Privacy Issues:** Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy	

Attacks, Datalinking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial domains	
UNIT V:	**(06 hrs)**
Examples and Mini-Cases Examples: Indian Banks Lose Millions of Rupees, Parliament Attack, e-mail spoofing instances. Mini-Cases: The Indian Case of online Gambling, An Indian Case of Intellectual Property Crime, Financial Frauds in Cyber Domain.	

COURSE OUTCOMES:

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

CO1:	Analyse cyber-attacks, types of cybercrimes, cyber laws and also how to protect them self and ultimately the entire Internet community from such attacks.
CO2:	Interpret and forensically investigate security incidents
CO3:	Apply policies and procedures to manage Privacy issues
CO4:	Design and develop secure software modules

MAPPING OF COs TO POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	-	3	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	3	-	-	-	-	-	-	-	-	-	-
CO4	-	-	3	-		-	-	-	-	-	-	-	-	-

TEXT BOOKS:

1.	Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and SunitBelpure,Wiley
2.	Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, B.B.Gupta, D.P.Agrawal, Haoxiang Wang, CRC Press, ISBN 9780815371335, 2018

REFERENCE BOOKS:

1.	Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRCPress.
2.	Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&F Group.

WEB INTELLIGENCE
(PROFESSIONAL ELECTIVE–IV)

Subject Code : UGAI7T0721		L	T	P	C
IV Year / I Semester		3	0	0	3

PRE-REQUISITES:
➢ The student must have a solid background in mathematics, algorithms, and data structures.
COURSE OBJECTIVE:
➢ Student will study how to search and gather the data in the web and process as well as mine that data to extract meaningful information to understand its application to search engines. Students will gain an understanding of the strategic and operational aspects of Web analytics.

SYLLABUS:	
UNIT I:	**(8 hrs)**

INTRODUCTION TO WEB:

Introduction to Internet, web, blogs, tweets, wikis, grid, and cloud. Collaborative mapping, Components of typical web, Characteristics and benefits of the Web.

UNIT II:	**(8 hrs)**

WEB INTELLIGENCE:

Semantic web, Social intelligence, Search engine techniques, Web information retrieval and filtering, Levels of WI, Goal of WI, Characteristics of web intelligence, Challenges and issues of WI, Future of WI.

UNIT III:	**(14 hrs)**

:WEB INFORMATION RETRIEVAL:

Managing web data. Web search engines, Google searching, Introduction to web crawler, Architecture of a web crawler, Distributed crawling, Focused spiders/crawlers, Collaborative crawling, Some tools and open source for web crawling, Models of information retrieval.

WEB MINING:

Introduction to data mining: Classification & clustering, Pattern recognition, Introduction to web mining, Evolution, Process, Web content mining, Web usage mining, Web structure mining.

UNIT IV:	**(7 hrs)**

INTELLIGENT WEB ALGORITHMS:

The intelligent-algorithm lifecycle, Classes of intelligent algorithm, Recommendation engines based on users, items, and content.

UNIT V:	**(7 hrs)**

WEB ANALYTICS:

How Web Analytics Works – Basic Concepts, collection of Web Data and other types

of data, basic dashboards, Predictive Analytics, Web Analytics Ecosystem and Tools, Data Visualization, Acquisition and Conversions.

COURSE OUTCOMES:

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

CO1:	Understand the concepts of web, web mining, web intelligence and analytics.
CO2:	Implement Web Mining using web intelligent algorithms.
CO3:	Apply how to retrieve information from web.
CO4:	Deploy web/social analytics platforms such as Google Analytics.

MAPPING OF COs TO POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	3	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	3	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	3	-	-	-	-	-	-	-	3	-

TEXT BOOKS:

1.	Priti Srinivas Sajja, Rajendra Akerkar, Intelligent Technologies for Web Applications - CRC Press - Taylor & Francis Group.
2.	Douglas G. McIlwraith, HaralambosMarmanis, and Dmitry Babenko , Algorithms of the Intelligent Web, Second Edition -Manning Publications.

REFERENCE BOOKS:

1.	Matthew A. Russell and Mikhail Klassen, Mining the Social Web, Third Edition, Published by O'Reilly Media. 4.
2.	Ian Witten, Eibe Frank, Mark Hall, Christopher Pal, Data Mining Practical Machine Learning Tools and Techniques, Fourth Edition, Elsevier.

PARALLEL COMPUTING
(PROFESSIONAL ELECTIVE–IV)

Subject Code : UGAI7T0722		L	T	P	C
IV Year / I Semester		3	0	0	3

PRE-REQUISITES:
• Exposure to Operating Systems, Computer Architecture and Computer Networks is desirable.
COURSE OBJECTIVE:
• In the multi-core age of today, parallel programming is pervasive and assists in addressing a lot of practical scientific issues. Significant hardware and software difficulties are associated with massive parallelism.
• The course is structured so that the participants understand challenges in efficient execution of large-scale parallel applications. The assignments will be designed to strengthen understanding of parallel programming. The course will also involve a research-based project component.
SYLLABUS:

UNIT I:	(6 hrs)
INTRODUCTION Why parallel computing? Shared memory and distributed memory parallelism, Amdahl's law, speedup and efficiency, supercomputers.	

UNIT II: MESSAGE PASSING	(6 hrs)
MPI basics, point-to-point communication, collective communication, synchronous/ asynchronous send/ receive, algorithms for gather, scatter, broadcast, reduce.	

UNIT III:	(10 hrs)
PARALLEL COMMUNICATION Network topologies, network evaluation metrics, communication cost, routing in interconnection networks, static and adaptive routing, process-to-processor mapping. **PERFORMANCE:** Scalability, benchmarking, performance modeling, impact of network topologies, parallel code analysis and profiling.	

UNIT IV:	(7 hrs)
DESIGNING PARALLEL CODES Domain decomposition, communication-to-computation ratio, load balancing, adaptivity, case studies: weather and material simulation codes.	

UNIT V:	(8 hrs)
PARALLEL I/O: MPI I/O algorithms, contemporary large-scale I/O architecture, I/O bottlenecks.	

COURSE OUTCOMES:

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

CO1:	Understand the concepts of Parallel Computing concepts and Supercomputer Familiarity.
CO2:	Comprehension of the Concepts of Message Passing.
CO3:	Analyse the Parallel Communication and Estimate the Performance of the system.
CO4:	Designing Parallel Codes for various case studies.
CO5	Comprehending the concept of parallel input/output (I/O)

MAPPING OF COs TO POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	-	-

TEXT BOOKS:

1.	Peter S Pacheco, An Introduction to Parallel Programming, Morgan Kaufmann, 2011.
2.	DE Culler, A Gupta and JP Singh, Parallel Computer Architecture: A Hardware/Software Approach Morgan-Kaufmann, 1998.
3.	Marc Snir, Steve W. Otto, Steven Huss-Lederman, David W. Walker and Jack Dongarra, MPI - The Complete Reference, Second Edition, Volume 1, The MPI Core
4.	William Gropp, Ewing Lusk, Anthony Skjellum, Using MPI : portable parallel programming with the message-passing interface, 3rd Ed., Cambridge MIT Press, 2014.
5.	A Grama, A Gupta, G Karypis, and V Kumar, Introduction to Parallel Computing. 2nd Ed., Addison-Wesley, 2003.

REFERENCE BOOKS:

1.	JL Hennessy and DA Patterson, Computer Architecture: A Quantitative Approach, 4th Ed., Morgan Kaufmann/Els India, 2006.
2.	MJ Quinn, Parallel Computing: Theory and Practice, Tata McGraw Hill, 2002.

ROBOTIC PROCESS AUTOMATION
(Professional Elective-IV)

Subject Code: UGAI7T0822		L	T	P	C
IV Year / I Semester		3	0	0	3

COURSE OBJECTIVE:
➢ To provide insights on Robotic Process Automation (RPA) technology and its value proposition   ➢ To introduce different platforms for RPA   ➢ To illustrate basic programming concepts and the underlying logic/structure related to RPA   ➢ To describe the different types of variables, Control Flow and data manipulation techniques in a RPA   ➢ platform   ➢ 5. To describe automation to Email and various types of Exceptions and strategies to handle

SYLLABUS:	
UNIT I: Introduction to Robotic Process Automation	**(08 hrs)**
Emergence of Robotic Process Automation (RPA), Evolution of RPA, Future of RPA, Differentiating RPA from Automation, Defining Robotic Process Automation & its benefits, What RPA is Not, Types of Bots, Application areas of RPA, How Robotic Process Automation works, RPA development methodology and key considerations.	
UNIT II:Overview of Robotic Process Automation Tools	**(08 hrs)**
Introduction to Robotic Process Automation Tools, Basic components in a RPA platform, Installation details of RPA tools, Types of Templates, User Interface, Domains in Activities, Workflow Files in the RPA platform.	
UNIT III: Process Components and Activities	**(08 hrs)**
Process Components and Activities: User Interface Automation Activities, System Activities, Variables, Arguments, Imports Panel and User Events.	
UNIT IV:App Integration, Recording and Scraping	**(10 hrs)**
App Integration, Recording, Scraping, Selector, Workflow Activities. Example of Automate login to your (web) Email account, Recording mouse and keyboard actions to perform an operation, Scraping data from website and writing to CSV.	
UNIT V:Data Manipulation and PDF Automation	**(08 hrs)**
Data Manipulation, Automation of Virtual Machines, Introduction to Native Citrix Automation, Text and Image Automation, PDF Automation, Computer Vision. Programming, Debugging and Logging:Programming, Debugging, Error Handling, Logging, Extensions, Project Organization	

COURSE OUTCOMES:

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

CO1:	Gain insights into Robotic Process Automation Technology
CO2:	Demonstrate the underlying logic/structure related to RPA
CO3:	Classify several types of data inside a workflow and, gain skills in building workflows in a RPA platform
CO4:	Comprehend different types of variables, Control Flow and data manipulation techniques
CO5:	Identify Text and Data Tables Automation and Design automation to Email and various types of Exceptions and strategies to handle.

MAPPING OF COs TO POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	3	-	-	3	-	-	-	-	-	-	-	-	-

TEXT BOOKS:

1.	Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath by Alok Mani Tripathi, Packt Publishing, Mumbai, 2018.
2.	Tom Taulli , "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", Apress publications, 2020.

REFERENCE BOOKS:

1.	Richard Murdoch, "Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant" (1st Edition), Independently published, 2018. ISBN 978-1983036835
2.	A Gerardus Blokdyk, "Robotic Process Automation Rpa A Complete Guide ", 2020
3.	Frank Casale, Rebecca Dilla, Heidi Jaynes and Lauren Livingston, "Introduction to Robotic Process Automation: A Primer

E-COMMERCE & DIGITAL MARKETING
(PROFESSIONAL ELECTIVE–V)

Subject Code: UGAI7T0921		L	T	P	C
IV Year / I Semester		3	0	0	3

PRE-REQUISITES:

1. Knowledge on traditional commerce and business processes
2. Basics of internet and online related transactions

COURSE OBJECTIVE:

The students will learn the following:
- ➢ Basic concepts of e-business and e-commerce, including presentation and discussion of the strategies and technologies involved
- ➢ Concepts and challenges of e-business, including a balanced coverage of both the technical and the management (operational, tactical and strategic) aspects of successful e-business
- ➢ Concepts of business strategies, and technologies involved in the design and deployment of business and Digital Marketing on the internet and World Wide Web.

SYLLABUS:

UNIT I:	(08 hrs)

Electronic Commerce: Frame work, anatomy of E-Commerce applications, E-Commerce Consumer applications, E-Commerce organization applications, Consumer Oriented Electronic commerce, Mercantile Process models, **Search Engine Optimization:**

UNIT II:	(08 hrs)

Electronic Payment Systems: Smart Cards, Credit Cards, Risks in Electronic Payment systems.
Inter Organizational Commerce: EDI, EDI Implementation, Value added networks.

UNIT III:	(08 hrs)

Intra Organizational Commerce - work Flow, Automation Customization and internal Commerce, Supply chain Management.
Corporate Digital Library: Document Library, digital Document types, corporate Data Warehouses, Advertising and Marketing - Information based marketing, Advertising on Internet, on-line marketing

UNIT IV:	(08 hrs)

Introduction to Digital Marketing: Origin of Digital Marketing, traditional Vs Digital Marketing, internet users, Digital Marketing strategy, Digital marketing Advertisement in India

UNIT V:	(08 hrs)
Digital Marketing Strategies: Social median marketing, Facebook Marketing-Introduction, Anatomy of an ad campaign, adverts.	

COURSE OUTCOMES:

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

CO1:	Comprehend the increasing significance of E- Commerce and its applications in Business and Various Sectors
CO2:	To identify various Payment, Security, Privacy and Legal Issues.
CO3:	To develop skills of students in relation with application of IT in E-Commerce.
CO4:	To explore the students to the latest trends in marketing.
CO5:	Analyze the confluence of Digital marketing and operations in real- time delivery.

MAPPING OF COs TO POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	3	-	-	-	3	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO3	-	-	3	-	3	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO5	-	-	-	-	3	-	-	-	-	-	-	-	-	-

TEXT BOOKS:

1.	Frontiers of electronic commerce, Ravi Kalakata, Andrew B.Whinston, Pearson education.
2.	Digital Marketing, Seema Gupta, McGraw HILL Education.

REFERENCE BOOKS:

1.	E-Commerce fundamentals and applications by Hendry Chan, Raymond Lee, Tharam Dillon, Ellizabeth Chang, - John Wiley.
2.	E-Commerce by S.Jaiswal – Galgotia.
3.	E-Commerce by EfrainTurbon, Jae Lee, David King, H.Michael Chang.
4.	Electronic Commerce by Gary P.Schneider – Thomson

BIO INFORMATICS
(PROFESSIONAL ELECTIVE-V)

Subject Code: UGA17T0922		L	T	P	C
IV Year / I Semester		3	0	0	3

PRE-REQUISITES:
• The student should have knowledge of Bio Informatics &Biological Information.
COURSE OBJECTIVE:
• It provides an elementary knowledge in Bioinformatics and Biological Information on the web.
SYLLABUS:

UNIT I:	(10 hrs)
BASICS OF HANDLING GENOMIC DATA: The central dogma-genome-the human genome project and the need for databases and annotation, Biological Databases-file formats; annotated sequence databases; Retrieval of biological data. **[T1]**	
UNIT II:	**(08 hrs)**
SEQUENCE BASED ALGORITHMS AND SEARCHES: Similarity and identity among biological sequences; Amino acid substitution matrices: PAM and BLOSUM Sequence similarity searches; FASTA and BLAST; local and global alignment algorithms, multiple sequence alignment.**[T1]**	
UNIT III:	**(08 hrs)**
PHYLOGENETIC ANALYSIS: Cladogram and Phylogram, Distance and Character Based Methods, Computer tools for phylogenetic analysis, Construction and Visualization of Phylogenetic analysis, Applications of Phylogenetic Analysis.**[T1]**	
UNIT IV:	**(08 hrs)**
STRUCTURAL BIOINFORMATICS: Relationship of protein three -dimensional structure to protein function; protein families and pattern databases; Classification of proteins of known three dimensional structure: CATH & SCOP-Concept of molecular modeling -homology modeling and threading.**[T1]**	
UNIT V:	**(08 hrs)**
BIOINFORMATICS IN DRUG DESIGN: Process of drug discovery -drug design and virtual screening -structure and ligand-based ligand design -docking -scoring -small molecular libraries -lead optimization –pharma cophore. **[T1]**	

COURSE OUTCOMES:

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

CO1:	To understand scope of Bioinformatics and of popular bioinformatics database.
CO2:	Analyze sequence based algorithms and searches.
CO3:	Analyze tools and Applications of the Bioinformatics
CO4:	To Design and structure of the Bioinformatics.

MAPPING OF COs TO POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	3	3	3	3	-	-	-	-	-	-	-	-	3
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO4	3	-	3	-	-	-	-	-	-	-	-	-	3	-

TEXT BOOKS:

1.	S.C. Rastogi & others, "Bioinformatics- Concepts, Skills, and Applications", CBS Publishing, 2003.
2.	2. Andreas D Baxevanis& B F Francis, "Bioinformatics- A practical guide to analysis of Genes &Proteins", John Wiley, 2000
3.	3. T K Attwood, D J parry-Smith," Introduction to Bioinformatics", Pearson Education, 1st Edition, 11th Reprint 2005.

REFERENCE BOOKS:

1.	1. C S V Murthy," Bioinformatics", Himalaya Publishing House, 1st Edition 2003..
2.	2. David.Mount "Bioinformatics sequence and genome analysis", Cold spring harbor lab. press, 2004.
3.	3. S. Ignacimuthu, S. J., "Basic Bioinformatics', Narosa Publishing house.

BLOCKCHAIN TECHNOLOGIES
(Professional Elective-V)

Subject Code: UGIT7T0422		L	T	P	C
IV Year / I Semester		3	0	0	3

PRE-REQUISITES:	
➢ The prerequisites to learn about blockchain technology are important to identify whether you are ready for blockchain concepts.	
COURSE OBJECTIVE:	
➢ To understand blockchain technology and Cryptocurrency works	
SYLLABUS:	
UNIT I:	**(08 hrs)**
Basics of Blockchain: Introduction to the blockchain, basic ideas behind blockchain, how it is changing the landscape of digitalization, introduction to cryptographic concepts required, Blockchain or distributed trust, Currency, Cryptocurrency, how Cryptocurrency works, financial services, and Bitcoin prediction markets.	
UNIT II:	**(08 hrs)**
Hashing, public key cryptosystems, private vs. public blockchain and use cases, Hash Puzzles, Extensibility of Blockchain concepts, Digital Identity verification, Blockchain Neutrality, Digital art, Blockchain Environment	
UNIT III:	**(08 hrs)**
Introduction to Bitcoin, Bitcoin Blockchain and scripts, Use cases of Bitcoin Blockchain, scripting language in micropayment, escrow etc Downside of Bitcoin mining, Introduction to Blockchain Science, Grid coin, Folding coin, Blockchain Genomics, Bitcoin MOOCs.	
UNIT IV:	**(10 hrs)**
Ethereum continued, IOTA, the real need for mining, consensus, Byzantine Generals Problem, and Consensus as a distributed coordination problem, Coming to private or permissioned blockchains, Introduction to Hyper ledger, Currency, Token, Campus coin, Coin drop as a strategy for Public adoption, Currency Multiplicity, Demurrage currency	
UNIT V:	**(08 hrs)**
Technical challenges, Business model challenges, Scandals and Public perception, Government Regulations, Uses of Blockchain in E-Governance, Land Registration, Medical Information Systems.	

COURSE OUTCOMES:

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

CO1:	Demonstrate the blockchain basics, Cryptocurrency
CO2:	To compare and contrast the use of different private vs. public blockchains and use cases
CO3:	Design an innovative Bitcoin Blockchain and scripts, blockchain Science on various coins
CO4:	Classify Permission Blockchain and use cases – Hyper ledger, Corda
CO5:	Make Use of Block-chain in E-Governance, Land Registration, Medical Information Systems and others

MAPPING OF COs TO POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	3	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	3	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	3	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	3	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	3	-	-	-	-	-	-	-	-

TEXT BOOKS:

1.	Blockchain Blueprint for Economy by Melanie Swan

REFERENCE BOOKS:

1.	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).
2.	Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
3.	Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
4.	DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger," Yellow paper 2014.
5.	Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum smart contracts
6.	Blockchain Basics: A Non-Technical Introduction in 25 Steps 1st Edition, by Daniel Drescher

SOFT COMPUTING
(Professional Elective-I)

Subject Code: UGAI7T0922		L	T	P	C
IV Year / I Semester		3	0	0	3

PRE-REQUISITES:
➢ Basic knowledge in Mathematics and Artificial Intelligence.
COURSE OBJECTIVE:
➢ The main objective of the course is to expose the students to soft computing, various types of soft computing techniques and applications of soft computing.
SYLLABUS:

UNIT I:	(06 hrs)

UNIT I: Introduction to Soft Computing
Introduction of soft computing, soft computing vs. hard computing- various types of soft computing techniques- Requirements of Soft computing - applications of soft computing.

UNIT II:	(08 hrs)

Fuzzy Logic Introduction: Basic Concepts of Fuzzy Logic, Fuzzy Sets and Crisp Sets, Fuzzy Set Theory and Operations, Properties of Fuzzy Sets, Fuzzy and Crisp Relations, Fuzzy to Crisp Conversion.

UNIT III:	(14 hrs)

Fuzzy Membership and Rules: Membership Functions, Interference in Fuzzy Logic, Fuzzy If-Then Rules, Fuzzy Implications and Fuzzy Algorithms, Fuzzyfications and Defuzzificataions, Fuzzy Controller, Industrial Applications.

Genetic Algorithms: Basic Concepts, Working Principle, Procedures of GA, Flow Chart of GA, Genetic Representations, (Encoding) Initialization and Selection, Genetic Operators, Mutation, Generational Cycle, Applications.

UNIT IV:	(08 hrs)

Multi-objective Optimization Problem Solving
Concept of multi-objective optimization problems (MOOPs) and issues of solving them,Multi-Objective Evolutionary Algorithm (MOEA),Non-Pareto approaches to solve MOOPs,Pareto-based approaches to solve MOOPs,Some applications with MOEAs.

UNIT V:	(06 hrs)

Swarm Intelligence
What is swarm intelligence? Various animal behavior which have been used as examples, ant colony optimization, swarm intelligence in bees, flocks of birds, shoals of fish, ant-based routing, particle swarm optimization

COURSE OUTCOMES:

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

CO1:	Identify and describe soft computing techniques and their roles in building intelligent machines
CO2:	Apply suitable soft computing techniques for various applications.
CO3:	Evaluate and compare solutions by various soft computing approaches for a given Problem
CO4:	Develop application on different soft computing techniques

MAPPING OF COs TO POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	2
CO3	-	3	-	3	-	-	-	-	-	-	-	-	-	2
CO4	-	-	3	-	-	-	-	-	-	-	-	-	-	2

TEXT BOOKS:

1.	S. Rajsekaran, G.A.Vijayalakshmi Pai ,Neural Networks,Fuzzy Logic and Genetic Algorithm:Synthesis and Applications, , Prentice Hall of India.
2.	N.P Padhy ,Artificial Intelligence and Intelligent Systems, Oxford University Press.
3.	S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd.,2nd Edition, 2011.

REFERENCE BOOKS:

1.	Timothy J.Ross ,Fuzzy Logic with Engineering Applications, McGraw-Hill.
2.	Davis E.Goldberg, Genetic Algorithms: Search, Optimization and Machine Learning, , Addison Wesley, N.Y.

NETWORK AND GRAPH ANALYSIS
(Professional Elective-V)

Subject Code: UGAI7T1022		L	T	P	C
IV Year / I Semester		3	0	0	3

PRE-REQUISITES:
➢ Python programming, Probability and Statistics, Machine Learning.
COURSE OBJECTIVE:
➢ To introduce the emergence of online social networks and large-scale data availability in social sciences.   ➢ To introduce the analysis of massive networks which provide many computational, algorithmic, and modeling challenges.   ➢ Identify the algorithms for the World Wide Web; prediction and recommendation in online social networks; representation learning for large networks; etc.
SYLLABUS:

UNIT I:	(08 hrs)

INTRODUCTION and NETWORK MEASURES:

Introduction, Applications, Preliminaries, Three Levels of SNA, Historical Development, Graph Visualization Tools.

NETWORK MEASURES: Network Basics, Node Centrality, Assortativity, Transitive and Reciprocity. Similarity, Degeneracy

UNIT II:	(08 hrs)

NETWORK GROWTH MODELS and LINK ANALYSIS:

NETWORK GROWTH MODELS: Properties of real world networks, Random network model, Ring Lattice Network Model, Watts Strogatz model. Preferential Attachment model. Price's model, Local-world network growth model.

LINK ANALYSIS: Applications, Signed networks, Strong and weak Ties. Link analysis and algorithms. Page Rank. Personalized Page Rank, Divrank. Simrank. PathSim.

UNIT III:	(08 hrs)

COMMUNITY STRUCTURE IN NETWORKS and LINK PREDICTION:

COMMUNITY STRUCTURE IN NETWORKS: Applications, Types of communities. Community detection methods, Disjoint community detection, overlapping community detection, local community detection, community detection vs community search, evaluation.

LINK PREDICTION: Applications, temporal changes in a network, Problem definition, Evaluating link prediction networks, Heuristic Models, probabilistic Models, Supervised Random walk, Information- theoretic model.

UNIT IV:	(10 hrs)

CASCADE BEHAVIOR AND NETWORK EFFECTS and ANOMALY DETECTION IN STATIC NETWORKS:

CASCADE BEHAVIOR AND NETWORK EFFECTS: Preliminaries. Cascade model, case study, Probabilistic cascades, epidemic models, Independent cascade models,

Cascade prediction. **ANOMALY DETECTION IN STATIC NETWORKS:** Outliers vs Network-based anomalies, challenges. Anomaly detection in static and dynamic networks.	
UNIT V:	**(08 hrs)**
GRAPH REPRESENTATION LEARNING, APPLICATION AND CASE STUDIES: **GRAPH REPRESENTATION LEARNING:** Machine learning pipelines, Intuition behind representation learning, benefits, criteria of GRL, GRL pipelines. Representation learning methods. **APPLICATION AND CASE STUDIES:** Malicious activities on OSNs. Sockpuppets in OSNS. Modeling the spread of COVID 19, Recommendation System.	

COURSE OUTCOMES:

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

CO1:	Describe the levels of SNA and network measures.(L2)
CO2:	Outline various network growth models and different rank methods.(L2)
CO3:	Illustrate different community structures and link prediction models. (L2)
CO4:	Explain cascade behavior in networks. (L2)
CO5:	Predict and recommend in online social networks (L3)

MAPPING OF COs TO POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	3	-	-	-	-	-	-	-	-	-	-	-

TEXT BOOKS:

1.	Social Network Analysis. Tanmoy Chakraborty, Wiley, 2021

REFERENCE BOOKS:

1.	Network Science, Albert-Lazzlo Barabasi
2.	Social Network Analysis: Methods and Applications, Stanley Wasserman, Katherine Faus

TEXT BOOKS:

1.	https://onlinecourses.nptel.ac.in/noc22_cs117/preview

SPRING BOOT
(Job Oriented Elective-III)

Subject Code: UGAI7T1122		L	T	P	C
IV Year / I Semester		2	0	2	3

PRE-REQUISITES:
➤ A good working knowledge on web application development using any of the popular IDEs like Eclipse or IntelliJ. ➤ Experience using Java and build tools such as Maven or Gradle.
COURSE OBJECTIVE:
➤ Build a Java application using Spring Initializer from scratch ➤ Understand how to use Spring data as an application backend ➤ Create RESTful services with Spring Boot
SYLLABUS:

UNIT I:	(08 hrs)
Spring Framework 5: Architecture, Design principles and Patterns, A simple Spring web application. **Introduction to Spring Boot:** Spring boot configuration, features, Spring boot application model. **[T1]**	

UNIT II:	(08 hrs)
Spring boot Framework: Spring Initializer, Spring Boot CLI, Spring Boot Properties, Spring Boot Annotations, Spring Boot Dependency Manager, Spring Boot Starters. **Spring boot application design:** Creating maven web project, configuring pm.xml file, Creating REST resources, creating the application class, deploy the spring boot application. **[T3]**	

UNIT III:	(07 hrs)
Web applications with Spring Boot: Spring boot MVC auto-configuration, Spring boot web ToDo App: design, running and testing, ToDo Client App design, overriding defaults. **[T1]**	

UNIT IV:	(08 hrs)
Data Access with Spring Boot: Spring data with JDBC, Spring Data with JPA, Spring data REST with Spring boot, MongoDB with Spring Boot. **[T1]**	

UNIT V:	(08 hrs)
Security with Spring Boot:, Using security with JDBC. **[T1]** **Spring Boot Actuator:** Actuator setting in Spring boot application, Custom Actuator Endpoints, Spring boot Actuator Health. Spring security, applying basic security with default Login page **[T1]**	

EXPERIMENTS:

1. Write a program to create a simple Spring Boot application that prints a message.
2. Write a program to demonstrate RESTful Web Services with spring boot
3. Demonstrate the integration of JDBC with spring boot.
4. Demonstrate the integration of JPA with spring boot.
5. Demonstrate the integration of MongoDB with spring boot.
6. Demonstrate to use the Actuator end points to monitor the Spring boot application
7. Design a Login page by applying basic security configuration to spring boot

COURSE OUTCOMES:

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

CO1:	Design Spring Core and maven building blocks for Spring Boot. **[L3]**
CO2:	Understand the Spring Boot's Web capabilities including REST web services. **[L2]**
CO3:	Design database centric spring boot applications by integrating JDBC API. **[L4]**
CO4:	Manipulate the settings of Actuator endpoints to monitor and manage applications. **[L3]**
CO5:	Apply Spring Security to secure Web and REST endpoints in the cloud.**[L3]**

MAPPING OF COs TO POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-		-	3	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-		-	3	-	-	-	-	-	-	-	-	-	-
CO5		-	3	-	-	-	-	-	-	-	-	-	-	-

TEXT BOOKS:

1.	Felipe Gutierrez, Pro Spring Boot 2, II Edition, A Press.

REFERENCE BOOKS:

1.	Packt, Greg L. Turnquist, Learning Spring Boot 2.0, II Edition
2.	Jens Boje, Spring Boot 2: How to Get Started and Build a Microservice - Third Edition, CodeBoje

3.	Craig walls, Spring Boot in Action, Manning publisher.
	https://dzone.com/articles/introducing-spring-boot
	https://spring.io/

ONLINE COURSES AND REFERENCES:

1. Building scalable Java micro services with spring bid and spring cloud offered by Google Cloud – Coursera.
2. Master micro Services with Spring Boot & spring cloud by in 2 minutes official – udamy.com.

AUTONOMOUS SYSTEMS
(JOB ORIENTED ELECTIVE-III)

Subject Code: UGAI7T1222		L	T	P	C
IV Year / I Semester		2	0	2	3

PRE-REQUISITES:
➢ **Programming & Algorithms:** Proficiency in a high-level programming language (like Python, Java, or C++), coupled with an understanding of basic AI concepts and foundational algorithms. ➢ **Mathematical Background:** Knowledge of linear algebra, probability, statistics, and logic to support understanding of agent algorithms and behavior. ➢ **Basic Robotics & Systems Understanding:** Familiarity with fundamental robotics components, control systems, and a grasp of how components interact within broader systems.
COURSE OBJECTIVE:
➢ Understand the foundational concepts and latest trends in autonomous agents and robotics. ➢ Gain proficiency in programming methodologies for single and multi-agent systems. ➢ Analyze challenges and advancements in autonomous communication and coordination.
SYLLABUS:

UNIT I:	(09 hrs)

INTRODUCTION TO AUTONOMOUS SYSTEM: Definitions: Autonomous Agent, Environment, Intelligent Agents. **Evolutions in Agent Architecture:** Deliberative, Reactive, and Hybrid Agents.

Robot and its States: Transition from traditional to autonomous robots.

Mobile Robotics: Current trends and challenges.

Control Architectures: Modern methods and algorithms.

Deliberative vs. Reactive: Pros and Cons.

UNIT II:	(09 hrs)

AUTONOMOUS AGENT BEHAVIOUR AND REASONING

Practical Reasoning: Real-world scenarios and applications.

Planning: Evolution from block-world to real-world applications.

Action Representation: Formalisms and applications.

Commitment and Intention: Modern understandings and reconsiderations.

UNIT III:	(09 hrs)
PROGRAMMING AUTONOMOUS AGENTS	
Agent Programming Languages: Recent developments.	
Introduction to AgentSpeak and BDI Logics: Advanced concepts.	
Architecture of Modern AgentSpeak Systems.	
Multi-agent System Programming: Challenges and solutions.	
UNIT IV:	**(09 hrs)**
ADVANCED AGENT PROGRAMMING WITH JASON	
Jason Language Evolution: New features and functions.	
Real-world Applications: Mars rover, drones, and more.	
Perception, Belief, and Communication in Jason.	
Advanced Topics: Plan execution, handling failures, intention management.	
UNIT V:	**(10 hrs)**
COMMUNICATION AND COORDINATION IN AUTONOMOUS SYSTEMS	
Advanced Communication Techniques in Jason.	
Semantic Understanding and Protocol Development.	
Role of Agents in Communication: Active, Initiator, Responder.	
Challenges in Autonomous Communication: Handling non-responsive agents, misunderstandings.	

COURSE OUTCOMES:

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

CO1:	Master the selection, identification, and behavior analysis of advanced autonomous agents.
CO2:	Develop and program agents tailored to specific real-world applications using modern tools like Jason.
CO3:	Understand and implement cutting-edge communication methods and protocols in autonomous systems.

MAPPING OF COs TO POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3	-	-	-	-	2	3	-	-	2	3	3
CO2	3	2	3	3	-	-	2	3	3	-	-	3	3	3
CO3	3	3	2	3	-	-	-	3	2	-	-	2	2	3

TEXT BOOKS:

1.	"Advanced Multi-Agent Systems: Concepts and Applications" - Michael Wooldridge, John Wiley & Sons publication, 2023.
2.	"Autonomous Mobile Robots: Challenges and Solutions" - Roland Siegwart, Illah Reza Nourbakhsh, MIT Press Publications, 2022.

REFERENCE BOOKS:

1.	"Programming in AgentSpeak using Jason: Advanced Topics" - Rafael H. Bordnin, Jomi Fred Hubner, Michael Wooldridge, Wiley publications, 2022.
2.	"Modern Robotics Programming with AI Techniques" - Wei Lu, Apress/Springer publications, 2023.

IoT and Cloud Technologies
(Job Oriented - Elective)

Subject Code: UGAI7T1322		L	T	P	C
IV Year / I Semester		2	0	2	3

PRE-REQUISITES:
• Familiarity with Computer Networks, Database and Python Programming
COURSE OBJECTIVE:
• To make the students understand the concepts of Cloud Technologies & Internet of Things, and to obtain and analyse data from IoT devices.
SYLLABUS:

UNIT I :	(07 hrs)

INTRODUCTION TO CLOUD:
Types of Computing - Clustered - Parallel - Distributed – Grid - Edge, Cloud - Characteristics - Service Models - Deployment Models – Cloud Architecture - Benefits and Limitations, Virtualization Types, Virtualization Tools and Mechanisms – Cloud Migration.

UNIT II:	(08 hrs)

CLOUD SERVICES:
Infrastructure as a Service: Introduction to IaaS – Compute Service – Storage Service – Network Service – Security Service, **Platform as a Service:** Introduction to PaaS – Analytics Service - Database Service – Deployment & Deployment Service - AWS PaaS – **Software as a Service** – Introduction – Email Service – Content delivery service – Salesforce, Cloud Simulators – CloudSim and GreenCloud.

UNIT III :	(14 hrs)

CLOUD MANAGEMENT & SECURITY:
Distributed management of virtual machines - provisioning of virtualized resource - Multi-Tenancy, Cloud Security - Challenges – Security Mechanisms – Data Security, Access Control, Virtualization Security, Network Security, and Platform related Security, SLA.

FUNDAMENTALS OF IOT:
An overview - IoT Ecosystem – IoT Decision Framework – IoT Architecture – Common Applications - Smart Objects in IoT – IoT Devices – IoT Platform - Communication Protocols, Network Protocols – Session Protocols – MQTT, SMQTT, CoAP, DDS – IoT Application Level Protocols.

UNIT V:	(08 hrs)

IoT OSI Model:
Modified OSI Model for IoT/M2M systems, ETSI M2M Domains, Message Communication Protocols for connected devices CoAP-SMS, CoAP-MQ, XMPP – Wireless Communication Technologies - Near Field Communication – RFID, Bluetooth, BR/EDR and ZigBee, WiFi, RF transceiver and RF Modules – Data enrichment, data consolidation & Device Management Gateway.

UNIT V - IoT SECURITY & IIoT	**(08 hrs)**
Securing IoT: Introduction - Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment. Introduction Industrial IoT - IIOT architecture - Basic technologies - Applications and challenges.	

Lab Experiments

Cloud Computing

1. Understand Virtualization - Install Virtual Box and create VM(Linux) for MVC model
2. Understand the working of AWS - Create AWS-Instance Creation, AWS-S3-ObjStorage - Web Container
3. Understand the working of Openstack OS-InstanceCreateWithVol, OS-Swift-ObjStorage, OS-LoadBalancer-Manual

IoT Lab Exercises

Experiment 1:
   a. Exploring the features and components of an Arduino Board and IDE
   b. Using ArduinoIDE write a program to blink LED at timely intervals at specific time intervel.
   c. Read the values of Temperature and Humidity form the environment and if temperature is above 300C then blink red LED otherwise green LED.
   d. Display the values of Temperature and Humidity to LCD Screen.

Experiment 2:
   a. Using IR Sensor find if there is any obstacle and display the distance on Serial Monitor.
   b. Using Soil Moisture Sensor read the moisture level in soil and display them on a Serial Monitor.
   c. Develop a Real Time Heart Rate monitoring system and display them on Serial Plotter.

Experiment 3:
   a. To perform programming for Interfacing NodeMCU to Cloud Thingsboard/Thingspeak.
   b. To perform programming for sending DHT Temperature sensor data to cloud.
   c. Upload the data of Temperature and Heart Rate to Cloud and show the graphical representation of the heart rate.

Experiment 4:
   a. To perform programming for control home appliance using NodeMCU controller and cloud.

Experiment 5:
   a. Explore the features and components of a Raspberry Pi.
   b. Glow an LED using a Raspberry Pi.

Experiment 6:
      a. Read the Values Temperature and Humidity form the environment and setting a threshold value blink an LED using Raspberry Pi.

Text Book
1. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.
2. Erl Thomas & Mahmood Zaigham, 2013, Cloud Computing: Concepts, Technology & Architecture, 1st Edition, Kindle Edition
3. Iqbal, Muhammad Azhar, Sajjad Hussain, Huanlai Xing, and Muhammad Ali Imran. Enabling the Internet of Things: Fundamentals, Design and Applications. John Wiley & Sons, 2020.
4. Cloud Computing - Implementation, Management; Security, John W.Rittinghouse, James F. Ransome, CRC Press

Reference Book
1. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, 1st Edition, Apress, 2017
2. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.
3. Monika Mangla , Suneeta Satpathy, Bhagirathi Nayak & Sachi Nandan Mohanty, Integration of Cloud Computing with Internet of Things: Foundations, Analytics and Applications (Advances in Learning Analytics for Intelligent Cloud-IoT Systems), 2021

SECURE CODING TECHNIQUES
(JOB ORIENTED ELECTIVE–IV)

Subject Code: UGAI7T1422		L	T	P	C
IV Year / I Semester		2	0	2	3

PRE-REQUISITES:
➢ Concepts related to the basic principles and practices of programming, Data Structures, Software development.
COURSE OBJECTIVE:
➢ Students having successfully completed this course will understand the basic principles and practices of secure computing and writing secure software, including: security threats, secure software design, authentication, authorization, access control, buffer-overflow attacks, type safety, layered networking architectures, basic network protocols, firewalls, intrusion-detection systems, web applications, databases and information management, SQL queries, SQL injection attacks and defenses, XSS, symmetric cryptography, asymmetric cryptography, and password management.

SYLLABUS:	
UNIT I:	**(08 hrs)**
Security Design Principles: Security Is Holistic: Physical Security Technological Security Policies and Procedures Authentication Authorization Access Control Lists (ACLs) Access Control Models the Bell-LaPadula Model Confidentiality Message/Data Integrity Accountability Availability	
UNIT II:	**(08 hrs)**
Secure Systems Design: Understanding Threats Defacement Infiltration Phishing Pharming Insider Threats Click Fraud Denial-of-Service (DoS Data Theft and Data Loss. Designing-In Security Windows 98.	
UNIT III:	**(09 hrs)**
Secure Programming Techniques: Worms and Other Malware Buffer Overflows Safe String Libraries Additional Approaches Heap-Based Overflows. Client-State Manipulation Using HTTP POST Instead of GET SQL Injection Attack Scenario Solutions Password Security Additional Password Security Techniques	
UNIT IV:	**(09 hrs)**
Cross-Domain Security in Web Applications: Interaction Between Web Pages from Different Domains, Attack Patterns, Preventing XSRF, Preventing XSSI, Preventing XSS	

UNIT V:	(08 hrs)
Symmetric Key Cryptography: Introduction to Encryption, Stream Ciphers, Steganography, Asymmetric Key Cryptography, Key Management and Exchange, MACs and Signatures	

COURSE OUTCOMES:

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

CO1:	Explain the basic principles and practices of secure computing and writing secure software
CO2:	Analyze, evaluate, and explain security vulnerabilities (including buffer overflows, SQL injections, and XSS) in software designs and implementations
CO3:	Synthesize alternative designs and implementations that incorporate mitigations for observed vulnerabilities
CO4:	Apply knowledge of information management and computer networking and communications while performing software-security assessments and designing and implementing secure code.
CO5:	Explain the basic principles and practices of secure computing and writing secure software

MAPPING OF COs TO POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	3	-	-	-	-	-	-	-	-	-	-

TEXT BOOKS:

1.	Foundations of Security. Neil Daswani, Christoph Kern, and Anita Kesavan. Apress, 2007 (1st ed). ISBN-10: 1590597842; ISBN-13: 978-1590597842.

MANAGEMENT SCIENCE

Subject Code:UGMB7T0122		L	T	P	C
IV Year / I Semester		3	0	0	3

PRE-REQUISITES:
➢ General awareness about Principles of Management. ➢ To have an insight about Production and Operations Management. ➢ To be able to acquire knowledge about Human Resource Management, Marketing, Strategic Management.
COURSE OBJECTIVE:
1. To create awareness about different Managerial concepts like Management, Production, Marketing, Human Resource and Strategic Management. 2. To make the students equip with knowledge on techniques of PERT and CPM in project management.
SYLLABUS:

UNIT I:	(08 hrs)
Introduction to Management: Concept and importance of Management, Functions of management, Evaluation of Management thought, Fayol's principles of Management, Maslow's need hierarchy & Herzberg's two factor theory of Motivation, Decision making process, Designing organizational structure, Principles of Organization, Types of organization structures.	
UNIT II:	**(08 hrs)**
Operations Management: Plant Location Principles and types of plant Layout , Work study, Materials Management: Objectives - Need for inventory control- Inventory control techniques EOQ , ABC, HML, SDE, VED and FSN analysis	
UNIT III:	**(12 hrs)**
Human Resources Management (HRM): Concepts of HRM, Basic functions of HR manager, Job Evaluation and Merit Rating, Performance Appraisal, Methods of Performance appraisal Concepts Compensation. **Marketing Management:** Functions of marketing, Marketing Mix, Marketing strategies based on Product life cycle, Channels of distribution (Place), Promotional Mix.	
UNIT IV:	**(10 hrs)**
Project Management (PERT/CPM): Network analysis, Program Evaluation and Review Technique (PERT), Critical path method (CPM) - Identifying critical path, Difference between PERT & CPM (simple problems).	

UNIT V:	(08 hrs)
Strategic Management: Mission, Goals, objectives, policy, strategy, Environmental scanning, SWOT analysis, Steps in strategy formulation and implementation Generic strategy alternatives.	

COURSE OUTCOMES:

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

COs	Description	Blooms Level
CO 1	Understand the fundamentals of Management with specific insight as its function and role	Understanding
CO 2	Learn the concepts of production, Management of human Resources and Management of Marketing activities along with business environment	Understanding
CO 3	Apply the problem solving skills to demonstrate logical solution to real life problems	Applying
CO 4	Create the awareness of business strategies to deal with the dynamic business environment	Creating

MAPPING OF COs TO POs:

POs/COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO2	-	-	-	-	2	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	2	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	2	-	-	-

TEXT BOOKS:

1.	Dr. Arya Sri, "Management Science", TMH 2011.
2.	L.M. Prasad, "Principles & Practices of Management" Sultan chand & Sons, 2007.

REFERENCE BOOKS:

1.	K. Aswathappa and K. Sridhara Bhat, "Production and Operations Management", Himalaya Publishing House, 2010.
2.	Philip Kotler, Kevin Keller, Mairead Brady, Malcolm Goodman, Torben Hansen, "Marketing Management" Pearson Education Limited, 2016.

BIG DATA: Apache Spark
(Common to CSE(AI&DS) and CSE(AI&ML))

Subject Code: UGAI7K1522		L	T	P	C
IV Year / I Semester		1	0	2	2

PRE-REQUISITES:
➢ The student should have knowledge of high level programming languages and SQL for analyzing the data.

COURSE OBJECTIVE:
➢ The core objective of this course is to get a comprehensive understanding of large volumes of data, including structured, unstructured, text, social media, video, audio, and image.
➢ Mastering technologies used to store, manipulate, analyze, and derive insights using statistics, Machine Learning algorithms, and Big Data tools..

SYLLABUS:	
UNIT I:	**(4 hrs)**
Overview of Big Data and Spark: Big Data Problem, Spark Introduction, Basic Architecture, Language APIs, Data Frames, Transformations and Actions; Spark's toolset. **Structured APIs:** Overview – Structured Spark Types, Structured API Execution; Basic Structured Operations **[T1]**	
UNIT II:	**(05 hrs)**
Data Frame: Data Frame Transformations; Spark SQL – How to Run Spark SQL Queries, Tables; Datasets – Creating Datasets. **Low-Level APIs:** Resilient Distributed Datasets – Overview, Creating RDDs, Transformations; Advanced RDDs – Key-Value Basics. **[T1]**	
UNIT III:	**(05 hrs)**
Production Applications: How Spark Runs on a Cluster – The Architecture of a Spark Application; **Developing Spark Applications**: Writing and Launching Applications; Deploying Cluster to run Spark Applications, Monitoring Landscape. **[T1]**	
UNIT IV:	**(05 hrs)**
Streaming: Stream Processing Fundamentals – Use Cases, Advantages and Challenges, Spark's Streaming APIs; Structured Streaming – Basics and Core Concepts. **[T1]**	
UNIT V:	**(05 hrs)**
Advanced Analytics and Machine Learning: Overview – A Sort Primer on Advanced Analytics, Spark's Toolkit, High-Level MLib Concepts; Preprocessing and Feature Engineering – Feature Selection; Classification – Types, Models, Decision	

Trees, Random Forest and Gradien-Boosted Trees, Naïve Bayes and Evaluation Metrics. **[T1]**

List of Experiments:
1. Perform setting up and Installation of Apache Spark.
2. Create and implement various operations on spark Data Frames.
3. Implement RDD transformations in RDD programming with the help of examples.
4. Implement actions in RDD programming with the help of examples.
5. Write a Spark program to count the number of words in a text document.
6. Write a Spark program to count number of occurrences of each character in a text document.
7. Build a distributed stream data processing application using Spark to show trending Twitter hashtags.
8. Develop a supervised machine learning application using MLlib API.
9. Build and evaluate a machine Learning model with Spark ML.
10. Predict the labels from the feature vectors of a sample dataset using the Logistic Regression algorithm.

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

CO1:	Analyze various components of Spark framework. **[L4]**
CO2:	Develop SQL statements on very large data sets using Apache Spark SQL and the Apache Spark Data Frame API. **[L3]**
CO3:	Create Apache Spark applications on a Hadoop cluster. **[L6]**
CO4:	Evaluate machine learning algorithms to solve real time problems. **[L5]**

MAPPING OF COs TO POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	-	-	-	-	-	3	-
CO2	3	3	3	3	3	-	-	-	-	-	-	-	3	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	-
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3

TEXT BOOKS:

1.	Spark: The Definitive Guide, Bill Chambers, Matei Zaharia, O'Reilly, 2018.

REFERENCE BOOKS:

1.	Big Data Analytics with Spark, Mohammed Guller, Apress Media, 2015.
2.	Scala and Spark for Big Data Analytics, Md. Rezaul Karim, Sridhar Alla, Packt Publishing, 2017.
3.	Big Data Processing Using Spark in Cloud, Mamta Mittal, Valentina E. Balas, Springer, 2019.
4.	SPARK: Big Data Cluster Computing in Production, Ilya Ganelin, Ema Orhian, Wiley, 2016.

Coursera Courses:
1. Big Data Specialization -- Offered by UC San Diego.
2. Introduction to Data Analytics – Offered by IBM.