

**IV Year - I Semester**

S.No	Category	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	PE	UGAI7T0121 UGAI7T0221 UGAI7T0321 UGAI7T0421	<b>Professional Elective –III:</b> a) Reinforcement Learning b) Adhoc & Sensor Networks c) Social Media Analytics d) Software Testing Methodologies	3	-	-	3	30	70	100
2	PE	UGAI7T0521 UGAI7T0621 UGAI7T0721 UGAI7T0821	<b>Professional Elective –IV:</b> a) Human Computer Interaction b) Cyber Security and Cyber Laws c) Web Intelligence d) Applied Data Mining	3	-	-	3	30	70	100
3	PE	UGAI7T0921 UGAI7T1021 UGAI7T1121 UGAI7T1221	<b>Professional Elective –V:</b> a) E-Commerce & Digital Marketing b) Bio-Metrics c) Block Chain Technologies d) Drone Technologies	3	-	-	3	30	70	100
4	OE/JOE	UGAI7T1321 UGAI7T1421 UGAI7T1521	<b>Job Oriented Elective II:</b> a) Ethical Hacking b) NoSQL databases c) IoT and Cloud Technologies	2	-	2	3	30	70	100
5	OE/JOE	UGAI7T1621 UGAI7T1721 UGAI7T1821	<b>Job Oriented Elective III:</b> a) High Performance Computing b) Scala Programming c) Big Data Analytics	2	-	2	3	30	70	100
6	HSSE	UGMB7T0121	Management Science	3	-	-	3	30	70	100
7	SAC/SSC	UGAI7K1921	Data Visualization Lab	1	-	2	2	50	-	50
8	Internship	UGAI7I2021	Industrial/Research Internship (after third year)	-	-	-	3	50	-	50
<b>Total</b>				<b>17</b>	<b>0</b>	<b>6</b>	<b>23</b>	<b>280</b>	<b>420</b>	<b>700</b>
<b>Honors/Minor Course (4 Credits)</b>										

**IV Year - II Semester**

S.No	Category	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	Major Project	UGAI8J0121	Major Project & Internship (6 Months)	-	-	20	10	100	100	200
2	Seminar	UGAI8S0221	Seminar	-	2	-	2	50	-	50
<b>Total</b>				<b>0</b>	<b>2</b>	<b>20</b>	<b>12</b>	<b>150</b>	<b>100</b>	<b>250</b>

**L – Lectures, T – Tutorials, P – Practicals, C – Credits, IM – Internal Marks, EM – External Marks, TM – Total Marks**

**BS - Basic Science, HSS - Humanities & Social Science, ES - Engineering Science, MC - Mandatory Course, PC - Professional Core, SOC - Skill Oriented Course, SAC – Skill Advanced Course, SSC – Soft Skill Course, OE/JOE - Open Elective/Job Oriented Elective, PE - Professional Elective, HSSE - Humanities & Social Science Elective**

# **Syllabus**

## **IV B.Tech I SEM**

**REINFORCEMENT LEARNING  
(PROFESSIONAL ELECTIVE–III)**

<b>Subject Code: UGAI7T0121</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>IV Year / I Semester</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

<b>PRE-REQUISITES:</b>	
<ul style="list-style-type: none"> <li>➤ Theory of Probability</li> <li>➤ Applied Statistics</li> <li>➤ Machine learning foundation</li> </ul>	
<b>COURSE OBJECTIVE:</b>	
<ul style="list-style-type: none"> <li>➤ Able to identify the decision problems</li> <li>➤ To understand the dynamic programming polices</li> <li>➤ To understand the policy evaluation and controls</li> <li>➤ To understand the value prediction methods and controls</li> </ul>	
<b>SYLLABUS:</b>	
<b>UNIT I:</b>	<b>(9 hrs)</b>
<b>REINFORCEMENT PROBLEM:</b> Introduction, Elements of RL, History of RL, Evaluative feedback, Goals and rewards, Returns, Markovian Decision Problem (MDP), Value functions, Optimality Criterion in MDPs.	
<b>UNIT II:</b>	<b>(8 hrs)</b>
<b>DYNAMIC PROGRAMMING(DP):</b> Policy Evaluation, Policy Improvement, Value Iteration, asynchronous DP, Efficiency of DP.	
<b>UNIT III:</b>	<b>(7 hrs)</b>
<b>MONTE CARLO METHODS:</b> Policy Evaluation, Policy Improvement, On-policy and off, policy Monte Carlo controls, Incremental implementation.	
<b>UNIT IV:</b>	<b>(8 hrs)</b>
<b>TEMPORAL DIFFERENCE LEARNING(TD):</b> TD-prediction, Optimality of TD, Sarsa, Q-Learning, R- Learning, Actor, Critic Model, Unifying Monte Carlo and TD, Traces, Games.	
<b>UNIT V:</b>	<b>(9 hrs)</b>
<b>FUNCTION APPROXIMATION:</b> Value prediction and control, Gradient Descent methods, Linear methods, Artificial Neural Network based approximation.	
<b>UNIT VI:</b>	<b>(7 hrs)</b>
<b>PLANNING AND LEARNING:</b> 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.	<a href="http://cse.iitkgp.ac.in/~adas/courses/rl_aut2021/syllabus.html">http://cse.iitkgp.ac.in/~adas/courses/rl_aut2021/syllabus.html</a>
2.	<a href="http://www.cse.iitm.ac.in/~ravi/courses/Reinforcement%20Learning.html">http://www.cse.iitm.ac.in/~ravi/courses/Reinforcement%20Learning.html</a>
3.	<a href="https://sdean.website/cs4789.html">https://sdean.website/cs4789.html</a>

**ADHOC & SENSOR NETWORKS  
(PROFESSIONAL ELECTIVE–III)**

<b>Subject Code: UGAI7T0221</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>IV Year / I Semester</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**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: INTRODUCTION**

**(8 hrs)**

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: MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS**

**(8 hrs)**

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: ROUTING PROTOCOLS AND TRANSPORT LAYER IN AD HOC WIRELESS NETWORKS**

**(8 hrs)**

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.

**UNIT IV: WIRELESS SENSOR NETWORKS (WSNS) AND MAC PROTOCOLS**

**(9 hrs)**

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: WSN ROUTING, LOCALIZATION & QOS**

**(8 hrs)**

Issues in WSN routing – OLSR- Localization – Indoor and Sensor Network Localization-absolute and relative localization, triangulation-QOS in WSN-Energy Efficient Design

**UNIT VI: SENSOR NETWORK PLATFORMS AND TOOLS**

**(7 hrs)**

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:

<b>CO1:</b>	Explain the concepts, network architectures and applications of ad hoc and wireless sensor networks
<b>CO2:</b>	Analyze the protocol design issues of ad hoc and sensor networks
<b>CO3:</b>	Design routing protocols for ad hoc and wireless sensor networks with respect to some protocol design issues
<b>CO4:</b>	Evaluate the QoS related performance measurements of ad hoc and sensor networks
<b>CO5:</b>	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	1	-	-	-	-	-	-	-	3	-	-
CO3	3	2	2	1	-	-	-	-	-	-	-	3	-	-
CO4	3	2	2	1	-	-	-	-	-	-	-	3	-	-
CO5	3	2	2	1	1	-	-	-	-	-	-	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.

**SOCIAL MEDIA ANALYTICS  
(PROFESSIONAL ELECTIVE–III)**

<b>Subject Code: UGAI7T0321</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>IV Year / I Semester</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

<b>PRE-REQUISITES:</b>	
➤ Basic programming skills (in Python), Social Media Insights.	
<b>COURSE OBJECTIVE:</b>	
<ul style="list-style-type: none"> <li>➤ To understand the role of social media data and analytics in helping organizations achieve their goals and understand their publics;</li> <li>➤ To identify and select key performance indicators to accurately measure the success of social media efforts;</li> <li>➤ To analyze social media data using native analytics (e.g. Facebook, Twitter, Instagram) and social media measurement tools.</li> <li>➤ To draw meaningful insights and provide actionable and strategic recommendations based on thorough social media data analysis;</li> <li>➤ To develop social media measurement plans and analytics reports, and communicate findings and recommendations effectively</li> </ul>	
<b>SYLLABUS:</b>	
<b>UNIT I: INTRODUCTION TO SOCIAL MEDIA ANALYTICS</b>	<b>(06 hrs)</b>
Social media landscape, Need for SMA; SMA in Small organizations; SMA in large organizations; Application of SMA in different areas.	
<b>UNIT II: NETWORK FUNDAMENTALS AND MODELS</b>	<b>(08 hrs)</b>
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	
<b>UNIT III: CONNECTIONS &amp; WEB ANALYTICS TOOLS</b>	<b>(08 hrs)</b>
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	
<b>UNIT IV: SOCIAL ANALYTICS (FACEBOOK, INSTAGRAM, TWITTER)</b>	<b>(06 hrs)</b>
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.	
<b>UNIT V: PROCESSING AND VISUALIZING DATA</b>	<b>(07 hrs)</b>
Processing and Visualizing Data, Influence Maximization, Link Prediction, Collective Classification, Applications in Advertising and Game Analytics.	
<b>UNIT VI: CASE STUDY IMPLEMENTATION</b>	<b>(06 hrs)</b>
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)**

<b>Subject Code: UGAI7T0421</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>IV Year / I Semester</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

<b>PRE-REQUISITES:</b>	
<ul style="list-style-type: none"> <li>➤ Basic concepts of Programming, software engineering and analytical skills.</li> </ul>	
<b>COURSE OBJECTIVE:</b>	
<p>This course enables the learners to have a higher level knowledge related to software testing of a product in IT industry.</p> <ul style="list-style-type: none"> <li>➤ 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 &amp; testing tools.</li> <li>➤ Learners will get exposure to various real time testing practices testing different types of software through this course.</li> </ul>	
<b>SYLLABUS:</b>	
<b>UNIT I:</b>	<b>(7 hrs)</b>
<b>SOFTWARE TESTING:</b>	
Introduction, Evolution, Myths & Facts, Goals, Psychology, Definition, Model for testing, Effective Vs Exhaustive Software Testing.	
<b>Software Testing Terminology and Methodology:</b> Software Testing Terminology, Software Testing Life Cycle, Software Testing Methodology. <b>[T1]</b>	
<b>UNIT II:</b>	<b>(8 hrs)</b>
<b>VERIFICATION AND VALIDATION:</b>	
Verification & Validation Activities, Verification, Verification of Requirements, High level and low level designs, how to verify code, Validation. <b>[T2]</b>	
<b>Dynamic Testing, I: Black Box testing techniques:</b> Boundary Value Analysis, Equivalence class Testing, State Table based testing, Decision table based testing, Cause-Effect Graphing based testing, Error guessing. <b>[T1]</b>	
<b>UNIT III:</b>	<b>(7 hrs)</b>
<b>DYNAMIC TESTING II:</b>	
<b>White-Box Testing:</b> need, Logic coverage criteria, Basis path testing, Graph matrices, Loop testing, data flow testing	
<b>Static Testing:</b> inspections, Structured Walkthroughs, Technical reviews. <b>[T1]</b>	
<b>UNIT IV:</b>	<b>(7 hrs)</b>
<b>VALIDATION ACTIVITIES:</b>	
Unit testing, Integration Testing, Function testing, system testing, acceptance testing.	
<b>Regression testing:</b> Progressives Vs regressive testing, Objectives of regression testing, when regression testing done? Regression testing types, Regression testing	

techniques. [T1]	
<b>UNIT V:</b>	<b>(6 hrs)</b>
<b>AUTOMATION AND TESTING TOOLS:</b> Need for automation, categorization of testing tools, selection of testing tools, Cost incurred, Guidelines for automated testing, overview of some commercial testing tools.	
<b>UNIT VI:</b>	<b>(6 hrs)</b>
<b>Testing Web based Systems:</b> 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 <b>(L2)</b>
CO2:	Apply modern software testing processes in relation to software Development and project management. <b>(L3)</b>
CO3:	Analyze different types of verification & validation techniques to ensure the Functioning of a software system. <b>(L4)</b>
CO4:	Create and execute test cases for object oriented and web based Projects. <b>(L6)</b>
CO5:	Evaluate different testing tools and their Working mechanisms <b>(L5)</b>

### 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	-	-	-	-	-	-	-	-	-	-	-

### 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)**

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

<b>PRE-REQUISITES:</b>	
<ul style="list-style-type: none"> <li>➤ Basic concepts of system analysis and design and exposure to various user interface designs related to web and mobile.</li> </ul>	
<b>COURSE OBJECTIVE:</b>	
Upon successful completion of this course, students should be able to:	
<ul style="list-style-type: none"> <li>➤ Design clear, easy-to-understand and use interfaces and screens for graphical and Web systems.</li> <li>➤ Describe and apply core theories, models and methodologies from the field of HCI.</li> </ul>	
<b>SYLLABUS:</b>	
<b>UNIT I</b>	<b>(8 hrs)</b>
<p><b>The User Interface – An Introduction and Overview:</b> Importance of User Interface, Defining the User Interface, importance of Good Design, Benefits of Good Design, A brief history of the Human-Computer Interface.</p> <p><b>Characteristics of Graphical and Web User Interfaces:</b> 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.</p>	
<b>UNIT II</b>	<b>(8 hrs)</b>
<p><b>The User Interface Design process:</b> 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.</p> <p><b>Understand the Business Function:</b> Business Definition and Requirements Analysis, Determining Basic Business Functions, Design Standards or Style Guides, System Training and Documentation Needs.</p>	
<b>UNIT III</b>	<b>(9 hrs)</b>
<p><b>Develop System Menus and Navigation Schemes:</b> Structures of Menus, Functions of Menus, Content of Menus, Formatting of Menus, Phrasing the Menu, Selecting Menu Choices, Navigating Menus, Kinds of Graphical Menus.</p>	
<b>UNIT IV</b>	<b>(9 hrs)</b>
<p><b>Select the Proper Kinds of Windows:</b> Window Characteristics, Components of a Window, Window Presentation Styles, Types of Windows, Window Management, Organizing Window Functions, Window Operations, Web Systems</p>	

<b>UNIT V</b>	<b>(8 hrs)</b>
<b>Select the Proper Device-Based Controls:</b> Characteristics of Device-Based Controls, Selecting the Proper Device-Based Controls.	
<b>Choose the Proper Screen-Based Controls:</b> Operable Controls, Text Entry/Read-Only Controls, Selection Controls, Combination Entry/Selection Controls, Other Operable Controls, Custom Controls, Presentation Controls, Selecting the Proper Controls.	
<b>UNIT IV:</b>	<b>(7 hrs)</b>
<b>Components:</b> Words, Sentences, Messages and Text, Text for Web Pages.	
<b>Create Meaningful Graphics, Icons and Images:</b> Icons, Multimedia.	
<b>Choose the Proper Colors:</b> 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.	1. Wilbert O Galitz, "The Essential Guide To User Interface Design", Wiley DreamaTech.
2.	Ben Shneidermann, "Designing The User Interface", 3 <sup>rd</sup> 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.

**CYBER SECURITY and CYBER LAWS  
(Professional Elective-IV)**

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

<b>COURSE OBJECTIVE:</b>	
<ul style="list-style-type: none"> <li>➤ To understand various types of cyber-attacks and cyber-crimes</li> <li>➤ To learn threats and risks within context of the cyber security</li> <li>➤ To have an overview of the cyber laws &amp; concepts of cyber forensics</li> <li>➤ To study the defensive techniques against these attacks.</li> </ul>	
<b>SYLLABUS:</b>	
<b>UNIT I:</b>	<b>(08 hrs)</b>
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.	
<b>UNIT II:</b>	<b>(08 hrs)</b>
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	
<b>UNIT III:</b>	<b>(08 hrs)</b>
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.	
<b>UNIT IV:</b>	<b>(10 hrs)</b>
Cyber Security: Organizational Implications: Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations.	
<b>UNIT V:</b>	<b>(08 hrs)</b>
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	

<b>UNIT VI:</b>	<b>(06 hrs)</b>
<b>Examples and Mini-Cases Examples:</b> 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)**

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

<b>PRE-REQUISITES:</b>	
➤ The student must have a solid background in mathematics, algorithms, and data structures.	
<b>COURSE OBJECTIVE:</b>	
➤ 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.	
<b>SYLLABUS:</b>	
<b>UNIT I: INTRODUCTION TO WEB</b>	<b>(8 hrs)</b>
Introduction to Internet, web, blogs, tweets, wikis, grid, and cloud. Collaborative mapping, Components of typical web, Characteristics and benefits of the Web.	
<b>UNIT II: WEB INTELLIGENCE</b>	<b>(8 hrs)</b>
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.	
<b>UNIT III: WEB INFORMATION RETRIEVAL</b>	<b>(9 hrs)</b>
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.	
<b>UNIT IV: WEB MINING</b>	<b>(9 hrs)</b>
Introduction to data mining: Classification & clustering, Pattern recognition, Introduction to web mining, Evolution, Process, Web content mining, Web usage mining, Web structure mining.	
<b>UNIT V: INTELLIGENT WEB ALGORITHMS</b>	<b>(8 hrs)</b>
The intelligent-algorithm lifecycle, Classes of intelligent algorithm, Recommendation engines based on users, items, and content.	
<b>UNIT IV: WEB ANALYTICS</b>	<b>(7 hrs)</b>
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	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	2	3	3	-	-	-	2	-	-	3	2	-
CO3	3	3	2	3	3	-	-	-	2	-	-	3	2	-
CO4	3	3	2	3	3	-	-	-	2	-	-	3	2	-

**TEXT BOOKS:**

1.	Priti Srinivas Sajja, Rajendra Akerkar, Intelligent Technologies for Web Applications - CRC Press - Taylor & Francis Group.
2.	Douglas G. McIlwraith, Haralambos Marmanis, 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.



**APPLIED DATA MINING  
(PROFESSIONAL ELECTIVE–IV)**

<b>Subject Code: UGAI7T0821</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>IV Year / I Semester</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

<b>PRE-REQUISITES:</b>	
➤ Basic knowledge in Data Science and Statistics.	
<b>COURSE OBJECTIVE:</b>	
➤ This course enables students to extract knowledge from big datasets by applying supervised and unsupervised data mining methods using software tools	
<b>SYLLABUS:</b>	
<b>UNIT I: ORGANISATION OF THE DATA</b>	<b>(8 hrs)</b>
From the data warehouse to the data marts, The data warehouse, The data webhouse, Data marts, Classification of the data, The data matrix, Binarisation of the data matrix, Frequency distributions, Univariate distributions, Multivariate distributions, Transformation of the data, Other data structures	
<b>UNIT II: EXPLORATORY DATA ANALYSIS</b>	<b>(8 hrs)</b>
Univariate exploratory analysis, Bivariate exploratory analysis, Multivariate exploratory analysis of quantitative data, Multivariate exploratory analysis of qualitative data, Reduction of dimensionality	
<b>UNIT III: COMPUTATIONAL DATA MINING</b>	<b>(9 hrs)</b>
Measures of distance, Cluster analysis, Linear regression, Logistic regression, Tree models, Neural networks, Nearest-neighbour models .	
<b>UNIT IV: STATISTICAL DATA MINING</b>	<b>(9 hrs)</b>
Uncertainty measures and inference, Non-parametric modeling, The normal linear model , Generalised linear models, Log-linear models, Graphical models.	
<b>UNIT V: EVALUATION OF DATA MINING METHODS</b>	<b>(8 hrs)</b>
Criteria based on statistical tests:Distance between statistical models, Discrepancy of a statistical model, The Kullback–Leibler discrepancy. Criteria based on scoring functions, Bayesian criteria, Computational criteria, Criteria based on loss functions.	
<b>UNIT IV: BUSINESS CASES</b>	<b>(7 hrs)</b>
Market basket analysis: Objectives of the analysis, Description of the data, Exploratory data analysis, Model building, Log-linear models, Association rules. Web clickstream analysis: Objectives of the analysis, Description of the data, Exploratory data analysis, Model building, Sequence rules, Link analysis, Probabilistic expert systems, Markov chains.	

**COURSE OUTCOMES:**

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

CO1:	Understand how data can be organized and analysed to apply data mining techniques.
CO2:	Understand various computational and statistical techniques for data mining and their applications.
CO3:	Evaluate different data mining models.
CO4:	Apply data mining methods in different business cases.

**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	-	-	-	2	2	-	3	2	-
CO2	3	3	3	3	3	-	-	-	2	2	-	3	2	-
CO3	3	3	3	3	3	-	-	-	2	2	-	3	2	-
CO4	3	3	3	3	3	-	-	-	2	2	-	3	2	-

**TEXT BOOKS:**

1.	Applied Data Mining, Statistical Methods for Business and Industry, PAOLO GIUDICI, , Wiley–Blackwell; 2nd Edition.
2.	Data Mining: Concepts and Techniques, Han, Jiawei, Kamber, Michelle, and Pei, Jian, , 3rd ed. By. Elsevier, 2012. ISBN 978-0-12-381479-1.

**REFERENCE BOOKS:**

1.	Data Mining - Concepts and Techniques, Jiawei Han, Jian Pei & Michcline Kamber, Morgan Kauffman Publishers.
2.	Data Mining and Data Warehousing Principles and Practical Techniques, Parteek Bhatia, 1 <sup>st</sup> edition, Cambridge University Press.

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

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

<b>PRE-REQUISITES:</b>	
<ul style="list-style-type: none"> <li>➤ Knowledge on traditional commerce and business processes</li> <li>➤ Basics of internet and online related transactions</li> </ul>	
<b>COURSE OBJECTIVE:</b>	
<ul style="list-style-type: none"> <li>➤ Basic concepts of e-business and e-commerce, including presentation and discussion of the strategies and technologies involved</li> <li>➤ 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</li> <li>➤ Concepts of business strategies, and technologies involved in the design and deployment of business and Digital Marketing on the internet and World Wide Web.</li> </ul>	
<b>SYLLABUS:</b>	
<b>UNIT I: ELECTRONIC COMMERCE</b>	<b>(8 hrs)</b>
Frame work, anatomy of E-Commerce applications, E-Commerce Consumer applications, E-Commerce organization applications, Consumer Oriented Electronic commerce, Mercantile Process models	
<b>UNIT II: ELECTRONIC PAYMENT SYSTEMS</b>	<b>(8 hrs)</b>
Smart Cards, Credit Cards, Risks in Electronic Payment systems.	
<b>UNIT III: INTER ORGANIZATIONAL COMMERCE</b>	<b>(8 hrs)</b>
EDI, EDI Implementation, Value added networks, Intra Organizational Commerce - work Flow, Automation Customization and internal Commerce, Supply chain Management.	
<b>UNIT IV: CORPORATE DIGITAL LIBRARY</b>	<b>(9 hrs)</b>
Document Library, digital Document types, corporate Data Warehouses, Advertising and Marketing - Information based marketing, Advertising on Internet, on-line marketing.	
<b>UNIT V: INTRODUCTION TO DIGITAL MARKETING</b>	<b>(8 hrs)</b>
Origin of Digital Marketing, traditional Vs Digital Marketing, internet users, Digital Marketing strategy, Digital marketing Advertisement in India.	
<b>UNIT VI: DIGITAL MARKETING STRATEGIES</b>	<b>(7 hrs)</b>
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:

<b>CO1:</b>	Comprehend the increasing significance of E- Commerce and its applications in Business and Various Sectors
<b>CO2:</b>	To identify various Payment, Security, Privacy and Legal Issues.
<b>CO3:</b>	To develop skills of students in relation with application of IT in E-Commerce.
<b>CO4:</b>	To explore the students to the latest trends in marketing.
<b>CO5:</b>	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.	-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

**BIOMETRICS**  
**(PROFESSIONAL ELECTIVE–V)**

<b>Subject Code: UGAI7T1021</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>IV Year / I Semester</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

<b>PRE-REQUISITES:</b>	
<ul style="list-style-type: none"> <li>➤ Knowledge on Biometric authentication process</li> <li>➤ Awareness on different biometric devices</li> </ul>	
<b>COURSE OBJECTIVE:</b>	
<ul style="list-style-type: none"> <li>➤ Understand the Biometric technology including the definition, terminologies used, parameters and basic features.</li> <li>➤ Learn the principle, process, hardware used and issues for the different biometric methods like finger, facial, iris, voice, hand, signature, keystroke, AFIS and retina.</li> <li>➤ Know the different biometric applications.</li> <li>➤ Know the difference between physiological and behavioural biometrics.</li> </ul>	
<b>SYLLABUS:</b>	
<b>UNIT I</b>	<b>(06 hrs)</b>
<p><b>Introduction – Why Biometrics?</b> - Benefits of biometrics versus Traditional Authentication methods, Benefits of biometrics in identification Systems</p> <p><b>Key Biometric Terms and Processes</b> - Definitions, Verification and identification, Logical versus Physical Access, how biometric matching works, <b>Accuracy in biometric systems</b>– False match rate, False non-match rate, Failure to enroll rate, Derived metrics. <b>[T1]</b>.</p>	
<b>UNIT II</b>	<b>(8 hrs)</b>
<p><b>Finger scan</b> – Components, how finger scan technology works, competing finger Scan technologies, Finger scan Deployments, Finger scan Strengths, Finger scan weaknesses. <b>[T1]</b></p> <p><b>Facial Scan</b> – Components, how facial scan technology works, competing facial Scan technologies, Facial scan Deployments, Facial scan Strengths, Facial scan weaknesses. <b>[T1]</b></p>	
<b>UNIT III</b>	<b>(9 hrs)</b>
<p><b>Iris Scan</b> - Components, how it works, Deployments, Iris scan Strengths, Iris scan weaknesses. <b>[T1]</b></p> <p><b>Voice Scan</b> - Components, how it works, Deployments, Voice scan Strengths, Voice scan weaknesses. <b>[T1]</b></p>	
<b>UNIT IV</b>	<b>(9 hrs)</b>
<p><b>Other physiological biometrics</b> – Hand Scan, Retina Scan, Automatic Fingerprint Identification Systems (AFIS)</p>	

<b>Other Leading Behavioral Biometrics</b> – Signature scan, keystroke scan. <b>[T1]</b>	
<b>UNIT V</b>	<b>(8 hrs)</b>
<b>Categorizing Biometrics Applications</b> – Defining the Seven Biometric Applications, Introduction to IBG’s Biometric Solution Matrix	
<b>Assessing the Privacy Risks of Biometrics</b> – Bio Privacy Technology Risk Ratings	
<b>Biometric standards</b> – Why Standards? Application Programming Interfaces. <b>[T1]</b>	
<b>UNIT VI:</b>	<b>(8 hrs)</b>
<b>Recommended Biometric for Network Security</b> – Finger Biometrics, Face Biometrics, Voice Biometrics, Iris Biometrics, the Choice of a Biometric for Network Access	
<b>An Introduction to Statistical Measures of Biometrics</b> – FAR, FRR, FTE, EER, and What Measure is Most Important?	
<b>The Biometric Transaction</b> – Securing and Trusting a Biometric Transaction, Trusted Biometric Devices, and non-trusted biometric devices, Matching Location. <b>[T2]</b>	

**COURSE OUTCOMES:**

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

CO1:	Identify various biometric techniques and standards. <b>[L3]</b>
CO2:	Categorizes biometric applications and technologies to real time
CO3:	Problems. <b>[L4]</b>
CO4:	Describe various biometric mechanisms. <b>[L2]</b>

**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	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	3	-	-	-	-	-	-	-	-	-	-	-

**TEXT BOOKS:**

1.	Biometrics–Identity Verification in a Networked World, Samir Nanavati, Michael Thieme, Raj Nanavati, A Wiley Tech Brief.
2.	Biometrics for Network Security, Paul Reid, Pearson Education.

**REFERENCE BOOKS:**

1.	Biometrics- The Ultimate Reference, John D. Woodward, Jr. Wiley Dreamtech
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2.	Woodward, J.D. and Orlans, Nicholas M., Biometrics, McGraw Hill
3.	Implementing Biometric Security”, John Chirillo, Scott Blaul, Wiley

**ONLINE COURSES / REFERENCES:**

1.	“Biometrics-An introductory course about understanding the different types and uses of biometrics” Created by Art of Service – Udemey course
2.	“Biometrics”- offered by IIT Kanpur – NPTEL Course
3.	“Usable Security” offered by University of Maryland – Coursera course
4.	<a href="https://blog.mantratec.com/category/biometric-technology">https://blog.mantratec.com/category/biometric-technology</a>
5.	<a href="https://www.bayometric.com/biometric-blog/">https://www.bayometric.com/biometric-blog/</a>
6.	<a href="https://www.aware.com/blog/">https://www.aware.com/blog/</a>

**BLOCKCHAIN TECHNOLOGIES**  
**(Professional Elective-V)**

<b>Subject Code: UGAI7T1121</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>IV Year / I Semester</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

<b>PRE-REQUISITES:</b>	
➤ The prerequisites to learn about blockchain technology are important to identify whether you are ready for blockchain concepts.	
<b>COURSE OBJECTIVE:</b>	
➤ To give students the understanding of emerging abstract models for Blockchain Technology and to familiarize them with the functional/operational aspects of cryptocurrency eco-system.	
<b>SYLLABUS:</b>	
<b>UNIT I:</b>	<b>(08 hrs)</b>
<b>Basics of Blockchain:</b> Introduction, Concept of Blockchain, History, Definition of Blockchain, Fundamentals of Blockchain, Characteristics of Blockchain, Consensus in Trust-Building Exercise, Public, Private, and Hybrid Blockchains, Distributed Ledger Technologies, DLT Decentralized Applications and Databases, Architecture of Blockchain, Transactions, Chaining Blocks, Value Proposition of Blockchain Technology.	
<b>UNIT II:</b>	<b>(08 hrs)</b>
<b>Architecture of Blockchain:</b> Architecture of Blockchain, Transactions, Chaining Blocks, Value Proposition of Blockchain Technology. <b>Consensus:</b> Introduction, Consensus Approach, Consensus Algorithms, Byzantine Agreement Methods.	
<b>UNIT III:</b>	<b>(08 hrs)</b>
<b>Blockchain Components:</b> Introduction, Ethereum, History, Ethereum Virtual Machine, Working of Ethereum, Ethereum Clients, Ethereum Key Pairs, Ethereum Addresses, Ethereum Wallets, Ethereum Transactions, Ethereum Languages, Ethereum Development Tools.	
<b>UNIT IV:</b>	<b>(10 hrs)</b>
<b>Smart Contracts:</b> Introduction, Smart Contracts, Absolute and Immutable, Contractual Confidentiality, Law Implementation and Settlement, Characteristics, Internet of Things, <b>Bitcoin:</b> Introduction, Working of Bitcoin, Merkle Trees, Bitcoin Block Structure, Bitcoin Address, Bitcoin Transactions, Bitcoin Network, Bitcoin Wallets, Bitcoin Payments, Bitcoin Clients, Bitcoin Supply	
<b>UNIT V:</b>	<b>(08 hrs)</b>
<b>Blockchain and Allied Technologies:</b> Blockchain and Cloud Computing,	



Characteristics of Blockchain Cloud, Blockchain and Artificial Intelligence, Blockchain and IoT, Blockchain and Machine Learning, Blockchain and Robotic Process Automation

**UNIT VI:** (06 hrs)

**Introduction to Augmented Reality:** What Is Augmented Reality - Defining augmented reality, history of augmented reality, The Relationship Between Augmented Reality and Other Technologies-Media, Technologies, Other Ideas Related to the Spectrum Between Real and Virtual Worlds, applications of augmented reality Augmented Reality Concepts- How Does Augmented Reality Work? Concepts Related to Augmented Reality, Ingredients of an Augmented Reality Experience.

**COURSE OUTCOMES:**

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

CO1:	Apply and explore the working of Blockchain technology Architecture and components. (Apply)
CO2:	Analyze the working of Smart Contracts. (Analyze)
CO3:	Analyze and evaluate Crypto currency. (Evaluate)
CO4:	Apply the learning of solidity and de-centralized apps on Ethereum. (Apply)

**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	-	-	3	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	3	-	-	-	-	-	-	-	-
CO4	-	-	-	3	-	-	-	-	-	-	-	-	-	-

**TEXT BOOKS:**

1.	Blockchain Technology: Concepts and Applications.Kumar Saurabh, Ashutosh Saxena,Wiley.
2.	Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India; First edition (12 October 2016), ISBN-10: 9332578494.
3.	Allan Fowler-AR Game Development  , 1st Edition, A press Publications, 2018, ISBN 978- 1484236178 2

**REFERENCE BOOKS:**

1.	Blockchain Technology, Chandramouli Subramanian, Asha A George, Abhilash K A and Meena Karthikeyan, Universities Press
2.	Blockchain Basics: A Non-Technical Introduction in 25 Steps by Daniel Drescher, Apress.
3.	Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016.

**DRONE TECHNOLOGIES  
(Professional Elective-V)**

<b>Subject Code: UGAI7T1221</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>IV Year / I Semester</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

<b>PRE-REQUISITES:</b>	
➤ Basic knowledge on electrical and electronics	
<b>COURSE OBJECTIVE:</b>	
<ul style="list-style-type: none"> <li>➤ To understand the basics of Unmanned Aerial Vehicles (Drones) and its various applications.</li> <li>➤ To learn fundamental concepts of electrical and electronics required for the drone.</li> <li>➤ The students will be introduced to the safety and operational considerations during building and flying the drone.</li> </ul>	
<b>SYLLABUS:</b>	
<b>UNIT I:</b>	<b>(06 hrs)</b>
<b>Introduction to Drones:</b> Definitions, History of UAVs, Classification of UAVs, Applications of Drones, safety & operational considerations. <b>[T2,T3]</b>	
<b>UNIT II:</b>	<b>(08 hrs)</b>
<b>Basic Electrical and Electronics:</b> <b>Electrical:</b> Voltage, Current, Power, Speed, Torque, series and parallel connection sources. <b>[T1]</b> <b>Electronics:</b> Basics of Diodes, Transistors and FET's (definitions, V-I Characteristics and Switching behavior), Concept of Relays, LEDs. <b>[T1]</b>	
<b>UNIT III:</b>	<b>(09 hrs)</b>
<b>Concepts of Flight:</b> Aerodynamics, Flight Performance, Stability and Control <b>[T3,T4]</b>	
<b>UNIT IV:</b>	<b>(09 hrs)</b>
<b>Components and Specifications-1:</b> <b>Flight Controller:</b> Basics of Microcontrollers (Definition, types and Applications), Modes of Communications, (IR and RF Transmitter, Receiver.) <b>[T2,T4]</b> <b>Battery:</b> Types, Selection, Charge-Discharge states, diode bridge rectifier (AC-DC)-5V, 12V, Battery charger. <b>[T2,T4]</b>	
<b>UNIT V:</b>	<b>(08 hrs)</b>
<b>Components and Specifications-2:</b> <b>Propeller System:</b> Propellers, types of propellers, selection of propellers. <b>[T4]</b> <b>BLDC Motors:</b> Principles of operation, Construction. <b>[T4]</b> <b>ESC (Motor Driver):</b> PWM, Speed Control. <b>[T4]</b>	

<b>UNIT VI:</b>	<b>(07 hrs)</b>
<b>Payload and Case Studies:</b>	
<b>Impact of Payloads:</b> Types of Payloads and their application sensors, Case Studies. <b>[T3,T4]</b>	

**COURSE OUTCOMES:**

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

CO1:	Explore various considerations for building a drone like electrical, electronics, aerodynamics, safety and operations aspects. <b>[L2]</b>
CO2:	Differentiate between various components used for building application specific drones. <b>[L4]</b>
CO3:	Apply the concepts of electrical, electronic and aerodynamics for developing drone solutions. <b>[L3]</b>
CO4:	Create a working prototype in teams, involving design, assembling, calibrating and testing using appropriate hardware components and software tools. <b>[L5]</b>

**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	-	-	-	-	-	-	-	-	-	-	-	3
CO3	3	-	2	-	-	-	-	-	-	-	-	-	3	-
CO4	-	-	3	-	3	-	-	-	3	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

**TEXT BOOKS:**

1.	Basic Electrical and Electronics Engineering by S.K. Bhattacharya 2011, Pearson Education
2.	DIY Drones for the Evil Genius: Design, Build, and Customize Your Own Drones by Fitz Tepper, Ian Cinnamon, and Romi Kadri, Tata McGraw-Hill, 2016
3.	Unmanned Aircraft System, UAVS Design, Development and Deployment, Reg Austin - Wiley
4.	Make: Getting Started with Drones by Terry Kilby & Belinda Kilby, SPD

## REFERENCE BOOKS:

1.	Basic Electrical and Electronics Engineering by S.K. Bhattacharya 2011, Pearson Education
2.	DIY Drones for the Evil Genius: Design, Build, and Customize Your Own Drones by Fitz Tepper, Ian Cinnamon, and Romi Kadri, Tata McGraw-Hill, 2016
3.	Unmanned Aircraft System, UAVS Design, Development and Deployment, Reg Austin - Wiley
4.	Make: Getting Started with Drones by Terry Kilby & Belinda Kilby, SPD

## ONLINE RESOURCES:

1. <http://www.faa.gov/>
2. [http://www.faa.gov/regulations\\_policies/handbooks\\_manuals/aviation/phak/](http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/phak/)
3. [http://www.faa.gov/documentLibrary/media/Advisory\\_Circular/AC\\_107-2pdf](http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_107-2pdf)
4. <http://dronetraininghq.com/>
5. <http://www.precisionhawk.com/lancaster>
6. <https://3dr.com/>
7. <http://www.dji.com/>
8. <https://oscarliang.com/build-a-quadcopter-beginners-tutorial-1/>
9. <https://blog.owenson.me/build-your-own-quadcopter-flight-controller/>
10. <http://andrew.gibiansky.com/blog/physics/quadcopter-dynamics/>
11. <http://blog.owenson.me/build-your-own-quadcopter-flight-controller/>

## ONLINE COURSES:

- Make an Open Source Drone in Udemy  
[https://www.udemy.com/course/make\\_a\\_drone/](https://www.udemy.com/course/make_a_drone/)

**ETHICAL HACKING**  
**(Job Oriented Elective II)**

<b>Subject Code: UGAI7T1321</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>IV Year / I Semester</b>		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

<b>PRE-REQUISITES:</b>	
➤ Familiarity with Computer Networks and Information Security	
<b>COURSE OBJECTIVE:</b>	
➤ This course introduces the concepts of Ethical Hacking and gives the students the opportunity to learn about different tools and techniques in hacking and security. This makes students to understand how perimeter defenses work, escalate privileges and lead them to know about scanning and attacking of networks. Students will also learn about Intrusion Detection, Policy Creation, Social Engineering, DDoS Attacks, Buffer Overflows and Virus Creation	
<b>SYLLABUS:</b>	
<b>UNIT I:</b>	<b>(09 hrs)</b>
<b>INTRODUCTION:</b> Hacking (Effects, Types, Purpose, advantages and disadvantages), Types of Hackers, Types of Cybercrimes, Ethical Hacking, Types of Data Stolen from the Organizations and its protection, Elements of Information Security (Confidentiality, Integrity, Availability, Authentication, Non – repudiation and Access control), Information Security Challenges, Penetration Testing (Objectives, Types, preliminary knowledge of Process), Role of Security Penetration Tester, Benefits of a Penetration Testing Methodology, Penetration Testing Methodology, Networking and Computer Attacks and its protection.	
<b>UNIT II:</b>	<b>(07 hrs)</b>
<b>Malicious Software:</b> Protection and detection of malicious software (Virus, Macro virus, Worms, Trojan programs, Spyware & Adware), Protection against from all Malware, Intruder Attacks on Networks and Computers (including Proxy and Packet Filtering, Denial of Service, Sniffer.), Addressing Physical Security, Key Loggers and its types, Back Doors.	
<b>UNIT III:</b>	<b>(09 hrs)</b>
<b>Pre – Attack Phase:</b> Foot Printing: Web Tools for Foot Printing (Purpose, Types, Techniques), Conducting Competitive Intelligence and Techniques, Google Hacking, Scanning (Types and Methodologies), Steps of Scanning, Types of port scanning, Scanning Tools: NMAP, Angry IP Scanner, Advanced IP Scanner, Types of Pings, Enumeration and its different tools. Social Engineering: Tap nabbing, Shoulder Surfing, Dumpster Driving, Piggybacking.	

<b>UNIT IV:</b>	<b>(08 hrs)</b>
<b>Data Security:</b> Physical Security - Attacks and Protection, Steganography – Methods, Attacks and Measures, Cryptography – Methods and Types of Attacks, Wireless Hacking, Windows Hacking, Linux Hacking.	
<b>UNIT V:</b>	<b>(09 hrs)</b>
<b>Network Protection System:</b> Routers, Firewalls & Honeypots, Web Filtering, Vulnerability, Penetration, Testing, Session Hijacking, Web Servers, SQL Injection, Cross Site Scripting, Exploit Writing, Buffer Overflow, Reverse Engineering, E-mail Hacking, Bluetooth Hacking, Mobile Phone Hacking.	
<b>UNIT VI:</b>	<b>(08 hrs)</b>
<b>Ethical Hacking Laws and Tests:</b> Legal, Professional and Ethical Issues, Ethical Responsibilities, Professional Integrity, Host Reconnaissance, Session Hijacking, Hacking Web servers, Databases, Password Cracking, Methodical Penetration Testing. IT acts & amendments in India,(aadhar bill, privacy bill etc)	

### Experiments:

- 1) OWASP-10, Cookie/Session based vulnerabilities - Session Fixation, Session Hijacking, Insecure Cookie Attributes
- 2) Familiarity of KaliLinux,
- 3) Injection attacks - Cross Site Scripting (XSS), SQL Injection, HTML Injection, CSS Injection, XML injection, OS Command Injection
- 4) Remote code execution
- 5) local file inclusion
- 6) remote file inclusion
- 7) Insecure file upload
- 8) Path Traversal / Directory Listing
- 9) Cache Misconfiguration
- 10)Brute force attacks
- 11)Denial of Service
- 12)Distributed Denial of Service

**COURSE OUTCOMES:**

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

CO1:	Interpret several types of hacking, elements and challenges in information security, penetration testing methodology for data protection
CO2:	Learn techniques to detect and protect networks and computers from malicious software's by using Foot Printing and Scanning Tools.
CO3:	Summarize data protection techniques and network protection systems.
CO4:	Choose relevant legal and ethical hacking laws to apply on Hackers and Intruders.
CO5:	Analyse the vulnerabilities of the target system

**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	2	2	-	3	-	-
CO2	3	3	-	-	3	-	-	3	2	2	-	3	-	-
CO3	3	3	-	-	-	-	-	3	2	2	-	3	-	-
CO4	3	3	-	-	3	3	-	3	2	2	-	3	-	-
CO5	-	-	3	-	3	-	-	-	-	-	-	-	-	-

**TEXT BOOKS:**

1.	Michael T. Simpson, Kent Backman, James E Corley, Hand-On Ethical Hacking and Network Defense, Second Edition, CENGAGE Learning
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**REFERENCE BOOKS:**

1.	Manthandesai, Basics of Ethical hacking, Hacking for beginners, Hacking Tech.
2.	Patrick Engebretson, The Basics of Hacking and Penetration Testing Ethical Hacking and Penetration Testing Made Easy, Syngress –Elsevier.



**NoSQL DATABASES**  
**(Job Oriented Elective II)**

<b>Subject Code: UGAI7T1421</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>IV Year / I Semester</b>		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

<b>PRE-REQUISITES:</b>	
➤ The students should have knowledge on Database Management Systems.	
<b>COURSE OBJECTIVE:</b>	
➤ The course is intended to familiarize with various NoSQL Databases to handle structured, semi-structured and unstructured data..	
<b>SYLLABUS:</b>	
<b>UNIT I:</b>	<b>(08 hrs)</b>
<b>Introduction:</b> Early Database Management Systems, Relational Database Revolution, Motivations for NoSQL Databases, Four Types of NoSQL Databases - Key-Value Databases, Document Databases, Column Family Databases, Graph Databases	
<b>UNIT II:</b>	<b>(09 hrs)</b>
<b>Key-Value Databases:</b> From Arrays to Key-Value Databases, Essential Features of Key-Value Databases, Keys: More Than Meaningless Identifiers, Values: Storing Just About Any Data You Want, Key-Value Database Data Modeling Terms, Key-Value Architecture Terms, Key-Value Implementation Terms, Key Design and Partitioning, Designing Structured Values, Limitations of Key-Value Databases.	
<b>UNIT III:</b>	<b>(08 hrs)</b>
<b>Document Databases:</b> What is a Document?, Avoid Explicit Schema Definitions, Basic Operations on Document Databases, Document and Collection Terms, Types of Partitions, Data Modeling and Query Processing, Designing for Document Databases.	
<b>UNIT IV:</b>	<b>(10 hrs)</b>
<b>Column Family Databases:</b> Column Family Database Features, Architectures Used in Column Family Databases, When to Use Column Family Databases, Basic Components of Column Family Databases, Implementing Column Family Databases, Internal Structures and Configuration Parameters, Clusters and Partitions, Processes and Protocols, Designing for Column Family Databases.	
<b>UNIT V:</b>	<b>(08 hrs)</b>
<b>Graph Databases:</b> What Is a Graph?, Graphs and Network Modeling, Advantages of Graph Databases, Elements of Graphs, Operations on Graphs, Properties of Graphs and Nodes, Types of Graphs, Designing for Graph Databases.	

<b>UNIT VI:</b>	<b>(06 hrs)</b>
<b>Guidelines for Selecting a NoSQL Database:</b> Selecting Key-Value Databases, Selecting Document Databases, Selecting Column Family Databases, Selecting Graph Databases, Using NoSQL and Relational Databases together, List of NoSQL Databases.	

### Experiments:

1. Installation and setup of MongoDB Client and Server
2. Demonstrate the mongo Shell environment and Create database with collections and documents in JSON format
3. Demonstrate the commands of MongoDB – Insert, Query, Update, Delete, Projection, Index
4. Demonstrate various MongoDB queries such as displaying all the records, displaying selected records with conditions, sort, and aggregates.
5. Demonstrate how the operations like comparison and logical query operators - \$gt, \$gte, \$lt, \$lte, \$in, #nin, \$ne, \$and, \$or, \$not, \$nor are performed in MongoDB
6. Demonstrate how to Perform the operations on MongoDB database using element, array based and evaluation query operators -\$exists, \$type, \$mod, \$regex, \$where
7. Demonstrate how to handle datasets in MongoDB and Import various collections and apply some queries to get specified output.
8. Demonstrate the CRUD Operations on Google Firebase

### COURSE OUTCOMES:

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

CO1:	Understand the need of NoSQL Databases and compare different NoSQL Databases such as Key-Value, Document, Column Family and Graph Databases.
CO2:	Demonstrate competency in designing Key-Value and Document databases.
CO3:	Demonstrate competency in designing Column Family and Graph databases.
CO4:	Choose NoSQL databases for a specific application.

### **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	3	-	3	-	-	-	-	-	-	3	3	-
CO4	3	3	3	-	3	-	-	-	-	-	-	3	3	-

### **TEXT BOOKS:**

1.	NoSQL for Mere Mortals, Dan Sullivan, Addison Wesley.
2.	NoSQL For Dummies, Adam Fowler, John Wiley & Sons Inc.

### **REFERENCE BOOKS:**

1.	Next-Generation Databases, Guy Harrison, Apress.
2.	Professional NoSQL, Shashank Tiwari, Wrox Press
3.	NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Pramod J Sadalage, Martin Fowler, Addison Wesley.

**IoT and Cloud Technologies  
(Job Oriented - Elective)**

<b>Subject Code: UGAI7T1521</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>IV Year / I Semester</b>		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

<b>PRE-REQUISITES:</b>	
<ul style="list-style-type: none"> <li>Familiarity with Computer Networks, Database and Python Programming</li> </ul>	
<b>COURSE OBJECTIVE:</b>	
<ul style="list-style-type: none"> <li>To make the students understand the concepts of Cloud Technologies &amp; Internet of Things, and to obtain and analyse data from IoT devices.</li> </ul>	
<b>SYLLABUS:</b>	
<b>UNIT I : INTRODUCTION TO CLOUD</b>	<b>(07 hrs)</b>
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.	
<b>UNIT II: CLOUD SERVICES</b>	<b>(08 hrs)</b>
<b>Infrastructure as a Service:</b> Introduction to IaaS – Compute Service – Storage Service – Network Service – Security Service, <b>Platform as a Service:</b> Introduction to PaaS – Analytics Service - Database Service – Deployment & Deployment Service - AWS PaaS – <b>Software as a Service</b> – Introduction – Email Service – Content delivery service – Salesforce, Cloud Simulators – CloudSim and GreenCloud.	
<b>UNIT III : CLOUD MANAGEMENT &amp; SECURITY</b>	<b>(08 hrs)</b>
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.	
<b>UNIT IV: FUNDAMENTALS OF IOT</b>	<b>(09 hrs)</b>
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.	
<b>UNIT V: IoT OSI Model</b>	<b>(08 hrs)</b>
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.	
<b>UNIT VI - IoT SECURITY &amp; IIoT</b>	<b>(08 hrs)</b>
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 interval.
- 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

## HIGH PERFORMANCE COMPUTING (Job Oriented Elective II)

<b>Subject Code: UGAI7T1621</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>IV Year / I Semester</b>		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

<b>PRE-REQUISITES:</b>	
➤ A basic understanding of modern computer architecture.	
<b>COURSE OBJECTIVE:</b>	
➤ The objective of this course is to provide insights about the concepts of parallel computing, modern processors.	
<b>SYLLABUS:</b>	
<b>UNIT I:</b>	<b>(8 hrs)</b>
<b>Modern processors:</b> Stored-program computer architecture, General-purpose cache-based microprocessor architecture, Performance metrics and benchmarks, Transistors galore: Moore's Law, Pipelining, Superscalarity, SIMD, Memory hierarchies, Cache, Cache mapping, Prefetch, Multicore processors, Multithreaded processors, Vector processors.	
<b>UNIT II:</b>	<b>(8 hrs)</b>
<b>Basic optimization techniques for serial code:</b> Scalar profiling, Function- and line-based runtime profiling, Hardware performance counters, Manual instrumentation, Common sense optimizations, The role of compilers, General optimization options, Inlining, Aliasing, Computational accuracy, Register optimizations, Using compiler logs.	
<b>UNIT III:</b>	<b>(10 hrs)</b>
<b>Data access optimization:</b> Balance analysis and lightspeed estimates, Bandwidth-based performance modeling, The STREAM benchmarks, Storage order, Case study: The Jacobi algorithm, Case study: Dense matrix transpose, Algorithm classification and access optimizations	
<b>UNIT IV:</b>	<b>(8 hrs)</b>
<b>Parallel computers:</b> Taxonomy of parallel computing paradigms, Shared-memory computers, Cache coherence, Distributed-memory computers, Hierarchical (hybrid) systems, Networks.	
<b>UNIT V:</b>	<b>(8 hrs)</b>
<b>Basics of parallelization:</b> Why parallelize?, Parallelism, Data parallelism, Functional parallelism, Parallel scalability, Factors that limit parallel execution, Scalability metrics, Simple scalability laws, Parallel efficiency, Serial performance versus strong scalability, Refined performance models, Choosing the right scaling baseline.	
<b>UNIT VI:</b>	<b>(8 hrs)</b>
<b>Shared-memory parallel programming with OpenMP:</b> Short introduction to	

OpenMP, Parallel execution, Data scoping, OpenMP worksharing for loops, Synchronization, Reductions, Loop scheduling, Tasking, Miscellaneous, Efficient OpenMP programming.

### COURSE OUTCOMES:

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

CO1:	Understand the role of High Performance computing in science and engineering.
CO2:	Analyze how Data access optimization can be done in High Performance computing.
CO3:	Understand the popular parallel programming paradigms.
CO4:	Analyze an existing program for OpenMP and MPI parallelization possibilities.

### 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	2	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	2	2	-	-	-	-	-	-	3	-	-

### TEXT BOOKS:

1.	Georg Hager and Gerhard Wellein. Introduction to High Performance Computing for Scientists and Engineers (1st ed.). CRC Press, Chapman; Hall/CRC Computational Science, India, 2010.
2.	Charles severance, Kevin Dowd, High Performance Computing, OpenStax CNX
3.	Taylor, Francis, High Performance Computing A Chapter Sampler, CRS PRESS.

### REFERENCE BOOKS:

1.	Thomas Sterling, Matthew Anderson, Maciej Brodowicz, High performance computing : modern systems and practices.
2.	John L. Hennessy and David A. Patterson. Computer Architecture: A Quantitative Approach (5th ed.). Elsevier India Pvt. Ltd. 2011.
3.	David B. Kirk and Wen-mei W. Hwu. Programming Massively Parallel Processors: A Hands-On Approach (1st ed.). Elsevier India Pvt. Ltd. 2010.
4.	Michael T. Heath. Scientific Computing: An Introductory Survey (2nd ed.). McGraw Hill Education (India) Private Limited, 2011
5.	Vipin Kumar , Ananth Grama , Anshul Gupta , George Karypis. Introduction to Parallel Computing (2nd ed.). Pearson India . 2003.



**SCALA PROGRAMMING**  
**(Job Oriented Elective III)**

<b>Subject Code: UGAI7T1721</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>IV Year / I Semester</b>		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

<b>PRE-REQUISITES:</b>	
➤ Basic programming knowledge	
<b>COURSE OBJECTIVE:</b>	
➤ The objective of this course is to provide insights in Scala Programming. This course also focuses on various concepts such as lists, tuples, sets, maps, control structures, classes and packages in Scala.	
<b>SYLLABUS:</b>	
<b>UNIT I</b>	<b>(7 hrs)</b>
Introduction to Scala: A Scalable Language, First Steps in Scala, Next Steps in Scala- Steps in Scala- Parameterize arrays with Use list- Use tuples- Use sets and maps- Learn to recognize the Read lines from a file, Classes and objects-Classes, fields, and methods-Semicolon inference- Singleton objects-Scala application.	
<b>UNIT II</b>	<b>(7 hrs)</b>
Types and operations: Basic types, Literals, Operators are methods, Arithmetic operations, Relational and logical operations, Bitwise operations, Object equality, Operator precedence and associativity.	
<b>UNIT III</b>	<b>(7 hrs)</b>
Functional Objects: Constructing a Rational- Reimplementing the to String method- Checking preconditions-Adding fields-Self references- Auxiliary constructors- Private fields and methods- Defining operators- Identifiers in Scala-Method overloading Implicit conversions.	
<b>UNIT IV</b>	<b>(9 hrs)</b>
Control structures and function: If expressions, While loops, For expressions, Exception handling, Match expressions, break and continue, Variable scope, Functions and Closure Methods -Local functions- First- class functions- Closures-Repeated parameters-Tail recursion , Control Abstraction.	
<b>UNIT V</b>	<b>(8 hrs)</b>
Composition and Inheritance: Abstract classes - Defining parameterless methods- Extending classes- Overriding methods and fields -. Defining parametric fields- Invoking superclass constructors - Using override modifier-Polymorphism and dynamic binding-Using composition and inheritance.	
<b>UNIT VI</b>	<b>(8 hrs)</b>
Packages and list: Packages, Imports, Assertions, Unit Testing, Case Classes and Pattern Matching, List literals, The List type, Constructing lists, Operations on lists, List patterns, Collections, Stateful Objects, Type Parameterization, Abstract Members, Implicit Conversions and Parameters.	

**EXPERIMENTS:**

1.	Setting up Scala
2.	Develop Scala programs to understand comments, types, operations and conversions
3.	Develop Scala programs to understand variables, functions and loops
4.	Develop Scala programs to understand the built-in control structures in Scala
5.	Develop Scala programs to understand lists, tuples, sets and maps
6.	Handling packages and imports in scala
7.	Develop Scala program to perform pattern matching
8.	Implementing Algorithms in Scala
9.	Scraping Websites using Scala

**COURSE OUTCOMES:**

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

<b>CO1:</b>	Understand introductory concept of Scala language
<b>CO2:</b>	Implement different operation performed in Scala
<b>CO3:</b>	Understand several functions and properties of Scala
<b>CO4:</b>	Understand packages available in Scala programming

**MAPPING OF COs TO POs:**

<b>POs/ COs</b>	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
<b>CO1</b>	3	3	3	3	3	-	-	-	2	2	-	3	-	3
<b>CO2</b>	3	3	3	3	3	-	-	-	2	2	-	3	-	3
<b>CO3</b>	3	3	3	3	3	-	-	-	2	2	-	3	-	3
<b>CO4</b>	3	3	3	3	3	-	-	-	2	2	-	3	-	3

**TEXT BOOKS:**

1.	Odersky, Spoon & Venners, Artima , Programming in Scala— (4th edition).
2.	Chiusano & Bjarnason, Manning , Functional Programming in Scala.

**REFERENCE BOOKS:**

1.	Dean Wampler and Alex Payne , Programming Scala: Scalability = Functional Programming + Objects, "O'Reilly Media, Inc.", 2014.
2.	Cay S. Horstmann, Scala for the Impatient, Addison-Wesley Professional; first edition, 2012.

**BIG DATA ANALYTICS**  
**(JOB ORIENTED ELECTIVE-III)**

<b>Subject Code: UGAI7T1821</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>IV Year / I Semester</b>		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

<b>PRE-REQUISITES:</b>	
➤ The student should have knowledge of high level programming languages and SQL for analyzing the data.	
<b>COURSE OBJECTIVE:</b>	
➤ 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, analyse, and derive insights using statistics, Machine Learning algorithms, and Big Data tools..	
<b>SYLLABUS:</b>	
<b>UNIT I:</b>	<b>(07 hrs)</b>
<b>Overview of Big Data and Spark:</b> Big Data Problem, Spark Introduction, Basic Architecture, Language APIs, DataFrames, Transformations and Actions; Spark's toolset. <b>[T1]</b>	
<b>UNIT II:</b>	<b>(08 hrs)</b>
<b>Structured APIs:</b> Overview – Structured Spark Types, Structured API Execution; Basic Structured Operations – DataFrame Transformations; Spark SQL – How to Run Spark SQL Queries, Tables; Datasets – Creating Datasets . <b>[T1]</b>	
<b>UNIT III:</b>	<b>(07 hrs)</b>
<b>Low-Level APIs:</b> Resilient Distributed Datasets – Overview, Creating RDDs;; Advanced RDDs – Key-Value Basics. <b>[T1]</b>	
<b>UNIT IV:</b>	<b>(07 hrs)</b>
<b>Production Applications:</b> 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. <b>[T1]</b>	
<b>UNIT V:</b>	<b>(08 hrs)</b>
<b>Streaming:</b> Stream Processing Fundamentals – Use Cases, Advantages and Challenges, Spark's Streaming APIs; Structured Streaming – Basics and Core Concepts. <b>[T1]</b>	
<b>UNIT VI:</b>	<b>(07 hrs)</b>
<b>Advanced Analytics and Machine Learning:</b> Overview – A Sort Primer on Advanced Analytics, Spark's Toolkit, High-Level MLib Concepts; Preprocessing and	



**TEXT BOOKS:**

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

**Courseera Courses:**

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

## MANAGEMENT SCIENCE

<b>Subject Code: UGMB7T0121</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>IV Year / I Semester</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

<b>PRE-REQUISITES:</b>	
<ul style="list-style-type: none"> <li>➤ General awareness about Principles of Management.</li> <li>➤ To have an insight about Production and Operations Management.</li> <li>➤ To be able to acquire knowledge about Human Resource Management, Marketing, Strategic Management.</li> </ul>	
<b>COURSE OBJECTIVE:</b>	
<ul style="list-style-type: none"> <li>➤ To create awareness about different Managerial concepts like Management, Production, Marketing, Human Resource and Strategic Management.</li> <li>➤ To make the students equip with knowledge on techniques of PERT and CPM in project management.</li> </ul>	
<b>SYLLABUS:</b>	
<b>UNIT I:</b>	<b>(08 hrs)</b>
<b>Introduction to Management :</b> 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.	
<b>UNIT II:</b>	<b>(08 hrs)</b>
<b>Operations Management:</b> 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.	
<b>UNIT III:</b>	<b>(08 hrs)</b>
<b>Human Resources Management (HRM):</b> Concepts of HRM, Basic functions of HR manager, Job Evaluation and Merit Rating, Performance Appraisal, Methods of Performance appraisal Concepts Compensation.	
<b>UNIT IV:</b>	<b>(08 hrs)</b>
<b>Marketing Management:</b> Functions of marketing, Marketing Mix, Marketing strategies based on Product life cycle, Channels of distribution (Place), Promotional Mix.	
<b>UNIT V:</b>	<b>(10 hrs)</b>
<b>Project Management (PERT/CPM):</b> Network analysis, Program Evaluation and Review Technique (PERT), Critical path method (CPM) - Identifying critical path, Difference between PERT & CPM (simple problems).	

<b>UNIT VI:</b>	<b>(08 hrs)</b>
<b>Strategic Management:</b> 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:

CO1:	Understand the fundamentals of Management with specific insight as its function and role
CO2:	Learn the concepts of production, Management of human Resources and Management of Marketing activities along with business environment
CO3:	Apply the problem solving skills to demonstrate logical solution to real life problems
CO4:	Create the awareness of business strategies to deal with the dynamic business environment

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

### REFERENCE BOOKS:

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

## DATA VISUALIZATION

<b>Subject Code: UGAI7K1921</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>IV Year / I Semester</b>		<b>1</b>	<b>0</b>	<b>2</b>	<b>2</b>

### **PRE-REQUISITES:**

- Basic knowledge in databases, graphs and statistics

### **COURSE OBJECTIVE:**

All students will learn how to:

- Use all the basic functionality to visualize their data
- Connect to various data sources
- Build a variety of basic charts
- Combine insights into a useable dashboard
- Share and publish visualizations
- Create complex calculations and dynamic parameters
- Build a dashboard with powerful interactivity
- Produce complex chart types
- Real time log analysis and visualization using Splunk
- Apply advanced formatting and data visualization best practices

### **Experiments**

1.	Installing Tableau visualization software in PC
2.	Connect to and Prepare data <ol style="list-style-type: none"> <li>a. Connect to your data</li> <li>b. Modelling the data(Joins and Relationships)</li> <li>c. Setup data source</li> <li>d. Mange Data Sources</li> </ol>
3.	Organize Data and Customize fields in the Data Pane
4.	Build data views from scratch <ol style="list-style-type: none"> <li>a. Add visual details by dragging fields to the views</li> <li>b. Filter and sort data</li> <li>c. Showcase insights</li> </ol>
5.	Add Interactivity using filters and actions for the visualization
6.	Build Common Chart types for the selected dataset <ol style="list-style-type: none"> <li>a. Bar Chart</li> <li>b. Box Plot</li> <li>c. Area Chart</li> <li>d. Histogram</li> <li>e. Line Chart</li> <li>f. Scatter Plot</li> <li>g. Text Table</li> <li>h. Treemap</li> </ol>



	i. Heat map
7.	Create Maps for the Geographic Data
8.	Analyze the data <ul style="list-style-type: none"> <li>a. Create Groups</li> <li>b. Create Sets</li> <li>c. Create Calculated Fields</li> <li>d. Spot Trends</li> <li>e. Calculate Percentages</li> <li>f. Find Clusters in Data</li> </ul>
9.	Creating a Dashboards for the selected data source <ul style="list-style-type: none"> <li>a. Combining multiple views</li> <li>b. Linking the views</li> <li>c. Filtering based on one view</li> </ul>
10.	Creating Story for the selected data source <ul style="list-style-type: none"> <li>a. Steps</li> <li>b. Highlights</li> <li>c. Tell a story</li> </ul>
11.	Create a visualization and publish in tableau public

### **COURSE OUTCOMES:**

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

CO1:	Understand best practices in data visualization and storytelling to communicate accessible and meaningful insights.
CO2:	Create meaningful data visualizations, gaining experience with the iterative process of data storytelling.
CO3:	Gain experience with presenting data insights through visualizations

### **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	3	-	-	3	-
CO2	3	3	3	-	3	-	-	3	3	3	-	-	3	-
CO3	3	3	3	-	3	-	-	3	3	3	-	-	3	-

**TEXT BOOKS:**

1.	Dykes, Brent. "Data Storytelling: The Essential Data Science Skill Everyone Needs." Forbes.com. March 31, 2016.
2.	Ryan, Lindy. "Storyboarding Frame-by-Frame" in Visual Data Storytelling with Tableau. Boston, MA: Pearson Education, 2018.

**REFERENCES:**

1.	<a href="https://help.tableau.com/current/pro/desktop/en-us/default.htm">https://help.tableau.com/current/pro/desktop/en-us/default.htm</a>
2.	<a href="https://www.datacamp.com/community/tutorials/data-visualisation-tableau">https://www.datacamp.com/community/tutorials/data-visualisation-tableau</a>
3.	<a href="http://Dear-Data.com">http://Dear-Data.com</a>
4.	<a href="http://Dear-Data-Two.com">http://Dear-Data-Two.com</a>