



(An Autonomous Institution - AFFILIATED TO ANNA UNIVERSITY, CHENNAI)

S.P.G.Chidambara Nadar - C.Nagammal Campus

S.P.G.C. Nagar, K.Vellakulam – 625 701 (Near VIRUDHUNAGAR).

**B.Tech. INFORMATION TECHNOLOGY
REGULATIONS – 2021
AUTONOMOUS SYLLABUS
CHOICE BASED CREDIT SYSTEM
V AND VI SEMESTER CURRICULUM AND SYLLABI**

VISION:

To make the department of Information Technology the unique of its kind in the field of Research and Development activities in this part of world

MISSION:

To impart highly innovative and technical knowledge in the field of Information Technology to the urban and unreachable rural student folks through Total Quality Education.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

- PEO 1:** Technical Knowledge : Graduates will be able to identify, analyze and create solutions for real life, industrial and societal needs by applying the principles and practices of Information Technology.
- PEO 2:** Teamwork & Ethics : Graduates will be able to collaborate effectively and ethically in a multi-disciplinary team as a member &/ as a leader.
- PEO 3:** Lifelong Learning : Graduates will be able to adopt the contemporary technologies in the field of Information Technology to provide solutions for challenging environments.

PROGRAM OUTCOMES:

After going through the four years of study, the B.Tech. Information Technology graduates will have the ability to

POs	Graduate Attribute	Programme Outcome
1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	Problem analysis	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	Design/Development of solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
5	Modern tool usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
6	The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO1 : Demonstrate technical and interpersonal skills to design and develop IT enabled solutions to meet the real time industrial and societal needs

PSO2 : Exhibit an ability to adapt to the evolutionary changes in computing

REGULATIONS - 2021
CHOICE BASED CREDIT SYSTEM
B.Tech. INFORMATION TECHNOLOGY
V AND VI SEMESTER CURRICULUM
SEMESTER V

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	IT2301	Algorithms Design and Analysis	PC	3	3	0	0	3
2	IT2302	Artificial Intelligent Systems	PC	3	3	0	0	3
3	IT2303	Computer Networks	PC	3	3	0	0	3
4	IT2304	Full Stack Web Development	PC	3	3	0	0	3
5	PE1	Professional Elective – I	PE	3	3	0	0	3
6	PE2	Professional Elective – II	PE	3	3	0	0	3
PRACTICALS								
7	IT2305	Full Stack Web Development Laboratory	PC	4	0	0	4	2
8	IT2306	Networks Laboratory	PC	4	0	0	4	2
9	EM2351	Professional Communication	EM	2	0	0	2	1
10	EM2301	Internship**	EM	0	0	0	0	1
TOTAL				28	18	0	10	24

** - Credits earned by the students through Internship will be given in the final consolidated mark statement.

SEMESTER VI

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	IT2351	Principles of Cryptography [#]	PC	4	2	0	2	3
2	OE1	Open Elective I*	OE	3	3	0	0	3
3	PE3	Professional Elective – III	PE	3	3	0	0	3
4	PE4	Professional Elective – IV [#]	PE	4	2	0	2	3
5	PE5	Professional Elective – V	PE	3	3	0	0	3
6	PE6	Professional Elective – VI [#]	PE	4	2	0	2	3
PRACTICALS								
7	IT2352	Android Application Development Laboratory	PC	4	0	0	4	2
TOTAL				25	15	0	10	20

[#] - Theory cum Laboratory Course

* - Course from the Curriculum of other UG programmes.

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 1: NETWORKS AND SECURITY	VERTICAL 2: PRODUCT DEVELOPMENT	VERTICAL 3: DATA SCIENCE
Network Security Essentials	Software Architecture and UML Design	Computer Vision and Image Processing [#]
Cloud Computing [#]	Agile Methodologies	Data Science for Engineers
Internet of Things: Principles and Paradigm [#]	Essentials of .NET Framework [#]	Big Data Analytics [#]
Software Defined Networks [#]	Virtual Reality Systems	Machine Learning Algorithms [#]
Cyber Forensics Investigation	Game Design and Development [#]	Natural Language Processing
DevOps Frameworks	Web Application Development using Django Framework [#]	Recommender Systems
Blockchain Technologies and its Applications	User Interface and User Experience Design	Data Visualization Techniques [#]

- Theory cum Laboratory Courses

VERTICAL 1: NETWORKS AND SECURITY

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1	VIT311	Network Security Essentials	PE	3	3	0	0	3
2	VIT312	Cloud Computing [#]	PE	4	2	0	2	3
3	VIT313	Internet of Things: Principles and Paradigm [#]	PE	4	2	0	2	3
4	VIT314	Software Defined Networks [#]	PE	4	2	0	2	3
5	VIT315	Cyber Forensics Investigation	PE	3	3	0	0	3
6	VIT316	DevOps Frameworks	PE	3	3	0	0	3
7	VIT317	Blockchain Technologies and its Applications	PE	3	3	0	0	3

- Theory cum Laboratory Courses

VERTICAL 2: PRODUCT DEVELOPMENT

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1	VIT321	Software Architecture and UML Design	PE	3	3	0	0	3
2	VIT322	Agile Methodologies	PE	3	3	0	0	3
3	VIT323	Essentials of .NET Framework [#]	PE	4	2	0	2	3
4	VIT324	Virtual Reality Systems	PE	3	3	0	0	3
5	VIT325	Game Design and Development [#]	PE	4	2	0	2	3
6	VIT326	Web Application Development using Django Framework [#]	PE	4	2	0	2	3
7	VIT327	User Interface and User Experience Design	PE	3	3	0	0	3

- Theory cum Laboratory Courses

VERTICAL 3: DATA SCIENCE

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	VIT331	Computer Vision and Image Processing [#]	PE	4	2	0	2	3
2	VIT332	Data Science for Engineers	PE	3	3	0	0	3
3	VIT333	Big Data Analytics [#]	PE	4	2	0	2	3
4	VIT334	Machine Learning Algorithms [#]	PE	4	2	0	2	3
5	VIT335	Natural Language Processing	PE	3	3	0	0	3
6	VIT336	Recommender Systems	PE	3	3	0	0	3
7	VIT337	Data Visualization Techniques [#]	PE	4	2	0	2	3

- Theory cum Laboratory Courses

VERTICALS FOR MINOR DEGREE – BUSINESS DATA ANALYTICS

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	MBD001	Management Information System	OE	3	3	0	0	3
2	MBD002	Introduction to Business Analytics	OE	3	3	0	0	3
3	MBD003	Big Data Analytics for Business	OE	3	3	0	0	3
4	MBD004	Machine Learning for Business Analytics	OE	3	3	0	0	3
5	MBD005	Data Visualization for Business Analytics	OE	3	3	0	0	3
6	MBD006	Marketing Analytics	OE	3	3	0	0	3
7	MBD007	Human Resource Analytics	OE	3	3	0	0	3

Course Code	Course Name	L	T	P	C
IT2301	ALGORITHMS DESIGN AND ANALYSIS	3	0	0	3

Category: Professional Core

a. Preamble

This course enables to apply the knowledge of computing and mathematics to algorithm design. This course identifies the efficiency of algorithm for various algorithm techniques. This course familiarize the iterative improvement techniques and to understand the limitations of algorithm power.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Identify the time and space complexity of computational problems.	K3
CO2	Utilize Bruteforce and Divide & Conquer techniques for sorting and searching problems.	K3
CO3	Apply Greedy and Dynamic Programming techniques for graph and combinatorial problems.	K3
CO4	Identify the roles of iterative improvement technique to solve optimization problems.	K3
CO5	Apply Backtracking, Branch & Bound and Approximation techniques to solve NP-Complete and NP-Hard problems.	K3

c. Course Syllabus

Total : 45 Periods

INTRODUCTION

9

Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types – Performance Analysis - Space and Time Complexity - Growth of Function - Big-Oh, Omega, Theta Notation - Asymptotic Notations and its Properties - Recurrent Equations and the Master Theorem - Mathematical Analysis for Recursive and Non-Recursive Algorithms.

BRUTE FORCE AND DIVIDE-AND-CONQUER

9

Brute Force: String Matching - Closest-Pair and Convex-Hull Problems Exhaustive Search: Traveling Salesman Problem - Knapsack Problem - Assignment Problem Divide and Conquer Methodology: Merge Sort - Quick Sort - Binary Search - Strassen's Matrix Multiplication - Closest Pair Problem.

GREEDY TECHNIQUE AND DYNAMIC PROGRAMMING

9

Greedy Technique: Fractional Knapsack Problem - Minimum Cost Spanning Tree - Prim's Algorithm - Kruskal's Algorithm - Dijkstra's Algorithm - Huffman Trees
Dynamic Programming: Principle of Optimality - Computing a Binomial Coefficient - Warshall's and Floyd Algorithm - Optimal Binary Search Trees - 0/1 Knapsack Problem.

ITERATIVE IMPROVEMENT 9

Simplex Method - Jacobi Method - Gauss-Seidel Method - Maximum-Flow Problem - Maximum Matching in Bipartite Graphs - Stable Marriage Problem.

COPING WITH THE LIMITATIONS OF ALGORITHM POWER 9

Lower-Bound Arguments: Decision Trees - P, NP and NP-Complete Problems
Backtracking: N-Queens Problem - Hamiltonian Circuit Problem - Subset Sum Problem
Branch and Bound: Assignment Problem - Knapsack Problem
Approximation Algorithms for NP - Hard Problems: Traveling Salesman Problem

d. Activities

- Quiz
- Case Study

e. Learning Resources

Text Books

1. Anany Levitin, *Introduction to the Design and Analysis of Algorithms*, 3rd edition, Pearson Education, 2012.
2. Ellis Horowitz, Sartaj Sahni & Sanguthevar Rajasekaran, *Computer Algorithms/ C++*, 2nd edition, Universities Press, 2007.

Reference Books

1. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest & Clifford Stein, *Introduction to Algorithms*, 3rd edition, PHI Learning Private Limited, 2012.
2. Alfred V Aho, John E Hopcroft & Jeffrey D Ullman, *Data Structures and Algorithms*, Pearson Education, Reprint, 2006.

Course Code	Course Name	L	T	P	C
IT2302	ARTIFICIAL INTELLIGENT SYSTEMS	3	0	0	3

Category: Professional Core

a. Preamble

This course enables the students to understand the fundamental concepts of artificial intelligence. It helps the students to solve problems through various searching techniques. This course familiarizes the knowledge representation and reasoning in solving problems. It enables the students to understand the software agents in artificial intelligence and to know the different types of decision making and learning systems.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Summarize the fundamental concepts of artificial intelligence.	K2
CO2	Select an appropriate search algorithm for solving real-time problems.	K3
CO3	Apply knowledge representation and reasoning in solving artificial intelligence problems.	K3
CO4	Illustrate the architecture of software agents and its properties.	K2
CO5	Outline the different types of algorithms in decision making and learning.	K2

c. Course Syllabus

Total : 45 Periods

INTRODUCTION 9

Introduction – Foundation and History of Artificial Intelligence – Benefits and Risk of AI – Agent and Environments – Good Behavior: The Concept of Rationality – Nature of Environments – Structure of Agents.

PROBLEM SOLVING METHODS 9

Problem Solving Methods – Search Strategies – Uninformed – Informed – Heuristics – Local Search Algorithms and Optimization Problems – Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation – Backtracking Search – Game Playing – Optimal Decisions in Games – Alpha – Beta Pruning – Stochastic Games.

KNOWLEDGE REPRESENTATION AND REASONING 9

Knowledge Reasoning: Knowledge Based Agents – Propositional Logic: Syntax and Semantics – Inference in Propositional Logic – First Order Predicate Logic: Prolog Programming – Unification – Forward Chaining – Backward Chaining – Resolution – Knowledge Representation: Ontological Engineering – Categories and Objects – Events – Mental Events and Mental Objects – Reasoning Systems for Categories – Reasoning with Default Information.

SOFTWARE AGENTS 9

Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems.

DECISION MAKING AND LEARNING 9

Decision Networks – Markov Decision Processes – Learning from Examples – Reinforcement learning – Case Study: Natural Language Processing.

d. Activities

- Quiz
- Problem Solving

e. Learning Resources

Text Books

1. Stuart Russell, Peter Norvig, *Artificial Intelligence – A Modern Approach*, 3rd Edition, Pearson Education / Prentice Hall of India, 2010.
2. Kevin Night and Elaine Rich, Nair B., *Artificial Intelligence (SIE)*, Mc Graw Hill-2008.

Reference Books

1. Nils J. Nilsson, *Artificial Intelligence: A new Synthesis*, Harcourt Asia Pvt. Ltd., 2000.
2. Janakiraman, K. Sarukesi, *Foundations of Artificial Intelligence and Expert Systems*, Macmillan Series in Computer Science, 2000.
3. W. Patterson, *Introduction to Artificial Intelligence and Expert Systems*, Prentice Hall of India, 2003.

Course Code	Course Name	L	T	P	C
IT2303	COMPUTER NETWORKS	3	0	0	3

Category: Professional Core

a. Preamble

This course enables to infer the importance of computer networks. Apply error checking and error correction mechanisms in data Link layer. Make use of various routing protocols. Distinguish the functionalities of TCP & UDP protocols in the transport layer. Summarize the functionalities and real time usage of various application layer protocols.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Infer the importance of computer networks with OSI and TCP/IP architectures.	K2
CO2	Utilize an appropriate error checking and error correction mechanisms in data Link layer for error free data transmission.	K3
CO3	Outline the various routing protocols and their strategies in the network layer.	K2
CO4	Compare the functionalities of TCP & UDP protocols in the transport layer during data transmission.	K2
CO5	Summarize the functionalities of various application layer protocols and their real time usage.	K2

c. Course Syllabus

Total : 45 Periods

PHYSICAL LAYER

8

Introduction: OSI, TCP/IP architecture, Addressing – Networking: Topology, Types – Devices: Hubs, Bridges, Switches, Routers and Gateways – Transmission Media: Guided Media, Unguided Media – Performance: Bandwidth, Throughput, Latency (Delay), Jitter.

DATALINK LAYER

10

Error Detection and Correction: Introduction, Block Coding, Cyclic Codes and Checksum – Data Link Control: Framing, Flow Control and Error Control, Noiseless Channels and Noisy Channels, HDLC, PPP – MAC: Random Access Aloha, Controlled Access, Channelization – Ethernet, IEEE 802.11, Bluetooth – Link Layer Addressing: ARP.

NETWORK LAYER **9**

IP address: IPv4 and IPv6 – Packet switching – Routing: Distance Vector – RIP, Link State - OSPF, Multicast, DHCP, ICMP.

TRANSPORT LAYER **9**

Process to Process Delivery – User Datagram Protocol – Transmission Control Protocol – SCTP – Service: Congestion Control, Quality of Service.

APPLICATION LAYER **9**

Protocols: HTTP, DNS, SMTP, MIME, POP, FTP, TELNET, SSH, SNMP

d. Activities

- Quiz
- Crossword puzzle
- Model making

e. Learning Resources

Text Book

1. Behrouz A. Forouzan, *Data Communications and Networking*, Fifth Edition TMH, 2017.

Reference Books

1. Larry L. Peterson, Bruce S. Davie, *Computer Networks: A Systems Approach*, Fifth Edition, Morgan Kaufmann Publishers Inc., 2011.
2. William Stallings, *Data and Computer Communications*, Tenth Edition, Pearson Education, 2014.
3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, *Computer Networks: An Open Source Approach*, McGraw Hill, 2012

Course Code	Course Name	L	T	P	C
IT2304	FULL STACK WEB DEVELOPMENT	3	0	0	3

Category: Professional Core

a. Preamble

This course enables the students to understand new methods of development in web applications and programming languages. Prepare mock-ups and storyboards for a web development project using jQuery. Understand the platform design choice that led to NodeJS. Create first docker file and review NodeJS. Learn the administration activities such as backup, recovery, data import/export.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Develop a front end for website using jQuery.	K3
CO2	Build a single page web application using AngularJS.	K3
CO3	Create a user interface for web applications using ReactJS.	K3
CO4	Utilize the features of NodeJS and ExpressJS for creating a website.	K3
CO5	Interpret the given scenario and write an appropriate schema using MongoDB.	K2

c. Course Syllabus

Total : 45 Periods

INTRODUCTION AND CLIENT SIDE SCRIPTING USING JQUERY 8

Overview of Web application development using HTML, CSS and JavaScript – Introduction to jQuery – Selecting elements using jQuery – jQuery utilities – Effects – Events – jQuery plugins – AJAX & Data formats.

SINGLE PAGE WEB APPLICATION USING ANGULAR JS 8

Introduction – Modules and Dependency Injection – Scope as a Data Model – Templates to Views – Directives – Services.

USER INTERFACE CREATION USING REACT JS 8

Introduction – Components – JSX – State management – Event Handling – Routing – Creating a Dynamic UI – Integration with Other Libraries – React Server Integration & Deployment.

NODE JS and EXPRESS JS

12

Node.js: Introduction – Using Events, Listeners, Timers and Callback – Handling Data I/O – Accessing the File System – HTTP Services – Socket Services – Scaling Applications using Multiple Processors. Express.js: Implementing Express in NodeJS – Defining a route – Handling Routes – Route and Query Parameters – Middleware – Session management.

MONGODB – DOCUMENT ORIENTED DATABASE

9

Understanding NoSQL and MongoDB – Getting Started with MongoDB – Getting Started with MongoDB and NodeJS – Manipulating MongoDB Documents from NodeJS – Accessing MongoDB Document from NodeJS – Structured Schema and Validation – Advanced Concepts.

d. Activities

- Quiz
- Crossword puzzle

e. Learning Resources

Text Books

1. Cody Lindley, *jQuery Cookbook: Solutions & Examples for jQuery Developers (Animal Guide)*, 1st Edition, O'Reilly, November 2009.
2. Brad Dayley, *Node.js, MongoDB, and AngularJS Web Development*, Addison – Wesley, 2014.
3. Alex Banks, Eve Porcello, *Learning React: Modern Patterns for Developing React Apps*, 2nd Edition, O'Reilly, June 2020.

Reference Books

1. Felipe Coury, Ari Lerner, Carlos Taborda, *ng-book: The Complete Guide to Angular*, Kindle Edition, February 2018.
2. Amit Phaltankar, Juned Ahsan, Michael Harrison, Liviu Nedov, *MongoDB Fundamentals: A hands-on guide to using MongoDB and Atlas in the real world*, Packt Publishing Ltd., December 2020.

Course Code	Course Name	L	T	P	C
IT2305	FULL STACK WEB DEVELOPMENT LABORATORY	0	0	4	2

Category: Professional Core

a. Preamble

This course enables the students develop a web application using jQuery, AngularJS, ReactJS, NodeJS, ExpressJS and MongoDB.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Develop a front end for a simple web application.	K3
CO2	Build a web application and validate the page with client side scripting.	K3
CO3	Create a single page web application using AngularJS.	K3
CO4	Develop a web application using ReatJS and NodeJS.	K3
CO5	Create a web application to connect front end with back end using MongoDB.	K3

c. Course Syllabus

Total : 60 Periods

LIST OF EXPERIMENTS

1. Create a website for your Department using HTML5, CSS3 and JavaScript.
2. Create a simple webpage for star rating system using jQuery.
3. Develop a registration form using jQuery.
4. Create a conversion application using AngularJS.
5. Create a CGPA calculator using AngularJS.
6. Develop a voting application using ReactJS.
7. Create a blog using ReactJS.
8. Create a chat application using NodeJS.
9. Create a web application with attractive front end and perform CRUD operations using MongoDB.
10. Develop and deploy the full stack web application.

d. Learning Resources

References

1. Cody Lindley, *jQuery Cookbook: Solutions & Examples for jQuery Developers (Animal Guide)*, 1st Edition, O'Reilly, November 2009.
2. Brad Dayley, *Node.js, MongoDB, and AngularJS Web Development*, Addison – Wesley, 2014.
3. Alex Banks, Eve Porcello, *Learning React: Modern Patterns for Developing React Apps*, 2nd Edition, O'Reilly, June 2020.
4. <https://www.w3schools.com/jquery/>
5. <https://www.w3schools.com/angular/default.asp>
6. <https://www.w3schools.com/REACT/DEFAULT.ASP>
7. <https://www.javatpoint.com/expressjs-tutorial>
8. <https://www.w3schools.com/mongodb/>

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, HDD 500 GB, 4 GB RAM)	30
2.	Printer	1
3.	Software: a. Visual Studio or Equivalent b. NoSQL c. MongoDB	Open Source

Course Code	Course Name	L	T	P	C
IT2306	NETWORKS LABORATORY	0	0	4	2

Category: Professional Core

a. Preamble

This course enables the students to learn and use network commands. Understand socket programming. Familiarize with the implementation and analysis of various network protocols. Make use of simulation tools to analyze the performance of various network protocols.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Utilize the basic networking commands for capturing packets in live networks.	K3
CO2	Implement bit stuffing and error correction algorithms in a client/server environment.	K3
CO3	Analyse the performance of network routing protocols and transport layer services through simulation tools.	K3
CO4	Simulate the application protocols using TCP.	K3
CO5	Implement the application protocols using UDP.	K3

c. Course Syllabus

Total : 60 Periods

LIST OF EXPERIMENTS

1. Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and traceroute PDUs using wireshark and examine.
2. Study on Network Simulator.
3. Implementation of bit stuffing concept.
4. Implementation of error correction mechanism (like CRC).
5. Implementation of subnetting concepts.
6. Performance evaluation of Distance Vector/ Link State Routing algorithm using simulation tool.
7. Implementation of ARP/RARP protocols.
8. Write a HTTP web client program to download a web page using TCP sockets.
9. Applications using TCP sockets like:

- a) Echo client and echo server
 - b) Chat
 - c) File Transfer
10. Implementation of DNS using UDP sockets.
 11. Simulation of Congestion Control Algorithms using NS.
 12. Performance Evaluation of TCP/UDP using Simulation tool.

d. Learning Resources

References

1. Larry L. Peterson, Bruce S. Davie, *Computer Networks: A Systems Approach*, Fifth Edition, Morgan Kaufmann Publishers Inc., 2011.
2. Behrouz A. Forouzan, *Data Communications and Networking*, Fifth Edition TMH, 2013.
3. <https://ns2projects.org/ns2-tutorial-for-beginners/>
4. <https://www.netacad.com/courses/packet-tracer/introduction-packet-tracer>

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, HDD 500 GB, 4 GB RAM)	30
2.	Printer	1
3.	Software: For capturing packets: Wireshark Simulation Tools Preferred: NS-2, CISCO Packet Tracer, or equivalent Language preferred: C, Java, Python	Open Source

Course Code	Course Name	L	T	P	C
EM2351	PROFESSIONAL COMMUNICATION	0	0	2	1

Category: Employability Enhancement Course

a. Preamble

The course aims to:

- Enhance the Employability and Career Skills of students.
- Orient the students towards grooming as a professional.
- Make them Employable Graduates.
- Develop their confidence and help them attend interviews successfully.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Apply hard and soft skills to enhance their employability	K3
CO2	Utilize adequate presentation skills to present a PPT	K3
CO3	Demonstrate the proper usage of grammar in GD	K3
CO4	Make use of the acquired skills while attending interviews	K3
CO5	Develop adequate Soft Skills required for the workplace	K3

c. Course Syllabus

Total : 30 Periods

SOFT SKILLS 6

Introduction to Soft Skills– Hard skills & soft skills – employability and career Skills— Grooming as a professional with values—Time Management—General awareness of Current Affairs.

EFFECTIVE PRESENTATIONS 6

Self-Introduction-organizing the material – Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice— presenting the visuals effectively – 5 minute presentations.

GROUP DISCUSSION 6

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics – brainstorming the topic -- questioning and clarifying –GD strategies-activities to improve GD skills.

INTERVIEW ETIQUETTE **6**

Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview – FAQs related to job interviews.

CAREER PLAN **6**

Recognizing differences between groups and teams- managing time-managing stress- networking professionally- respecting social protocols-understanding career management- developing a long-term career plan-making career changes.

d. Activities

Students shall be trained in Individual Presentation, Group Discussion and Mock Interview.

e. Learning Resources

Reference Books

1. Butterfield, *Jeff Soft Skills for Everyone*, Cengage Learning, New Delhi, 2015.
 2. E. Suresh Kumar et al., *Communication for Professional Success*, Orient Blackswan: Hyderabad, 2015.
 3. *Interact English Lab Manual for Undergraduate Students*, Orient BlackSwan, Hyderabad, 2016.
 4. Raman, Meenakshi and Sangeeta Sharma, *Professional Communication*, Oxford University Press: Oxford, 2014.
 5. S. Hariharan et al., *Soft Skills*, MJP Publishers, Chennai, 2010.
- WEB SOURCES

Course Code	Course Name	L	T	P	C
EM2301	INTERNSHIP	0	0	0	1

Category: Employability Enhancement Course

a. Preamble

To enable the students to

- Get connected with industry/ laboratory/research institute.
- Get practical knowledge on production process in the industry and develop skills to solve industry related problems.
- Develop skills to carry out research in the research institutes/laboratories.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Validate system-level processes, techniques, manufacturing and production processes in the industry/research facilities of the laboratory/research institute.	K5
CO2	Analyse the solutions of industry/research problems.	K4
CO3	Document system specifications, design methodologies, process parameters, testing parameters and results.	K2
CO4	Comprehend the process followed in the industry/research institute in the form of presentation .	K2
CO5	Demonstrate the technical knowledge observed in the industry/research institute with the courses studied.	K2

c. Course Instruction

The students individually undergo training in reputed industry/ research institutes / laboratories for the specified duration. After completion of the training, a detailed report should be submitted within ten days from the commencement of next semester. The evaluation will be done as per the Regulations. Credits shall be awarded to the students who satisfy the clauses for industrial training/ internship of the Regulation concerned.

Course Code	Course Name	L	T	P	C
IT2351	PRINCIPLES OF CRYPTOGRAPHY	2	0	2	3

Category: Professional Core

a. Preamble

This course enables the student to learn the fundamental concepts and techniques in cryptography. This course helps the students to acquire the knowledge on basic group, ring and number theory. Illustrate the symmetric cryptosystem with respect to block ciphers and stream ciphers. Explore the Asymmetric cryptosystems. Understand the various message authentication principals and data integrity algorithms.

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Select an appropriate classical symmetric cryptosystem to provide security to data.	K3
CO2	Apply the mathematical concepts for solving number theory problems.	K3
CO3	Illustrate the working of symmetric block and stream ciphers.	K2
CO4	Choose an appropriate asymmetric cryptosystem and key management to ensure a secure transmission for a real world scenario.	K3
CO5	Utilize the hash functions and digital signatures to provide authentication and integrity to a cryptosystem.	K3

Course Outcome (Lab)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Choose appropriate classical symmetric cryptosystem to provide data confidentiality.	K3
CO2	Utilize the concepts of modern symmetric cryptosystem to enhance data security.	K3
CO3	Implement asymmetric cryptosystem to enhance data security and authentication.	K3
CO4	Apply the key exchange algorithm to securely exchange symmetric keys.	K3
CO5	Select an appropriate hash algorithm and digital signature to provide integrity and authentication.	K3

c. Course Syllabus

Total : 60 Periods

CLASSICAL CRYPTOSYSTEM 6

Introduction: OSI Security Architecture, Symmetric cryptosystem, Asymmetric cryptosystem – Classical symmetric techniques: Substitution: Playfair cipher, Hill cipher, Vigenere cipher, Autokey cipher, One time pad, Transposition: Rail fence, Row columnar transposition.

MATHEMATICAL BACKGROUND 6

Mathematics for Symmetric model: Algebraic structures, Modular arithmetic, Congruence and matrices, Groups, Rings, Fields, Finite fields, Euclid's algorithm – Mathematics for asymmetric model: Primes, Primality Testing, Factorization, Fermat's and Euler's Theorem, Euler's totient function, Chinese Remainder Theorem, Exponentiation and logarithm.

MODERN SYMMETRIC CRYPTOSYSTEM 6

Mode of operations: Electronics codebook, Cipher block chaining, Cipher feedback, Output feedback, Counter – Block Ciphers: Block cipher design principles, Data Encryption

Standard (DES), Advanced Encryption Standard (AES) – Stream ciphers: Stream cipher design principles, RC4.

ASYMMETRIC CRYPTOSYSTEM 6

Asymmetric cryptosystem: RSA – Key distribution – Diffie Hellman – ElGammal cryptosystem – Elliptic curve cryptosystem.

INTEGRITY AND AUTHENTICATION 6

Authentication requirements – Authentication function – Message Authentication Code (MAC) – Hash function – Secure Hash Algorithm (SHA) – HMAC and CMAC – Digital signature – DSS.

PRACTICAL EXERCISES 30

Periods

LIST OF EXPERIMENTS

1. Implementation of Classical Substitution Crypto Algorithms to provide Confidentiality
 - a. Implementation of Playfair Cipher
 - b. Implementation of Vigenere Cipher
 - c. Implementation of Hill Cipher
2. Implementation of Classical Transposition Crypto Algorithms to provide Confidentiality
 - a. Implementation of Row - Columnar Transformation
 - b. Implementation of Rail fence
3. Implementation of Modern Private Key Cryptosystem Algorithms to provide Confidentiality
 - a. Apply DES algorithm for practical applications
 - b. Apply AES algorithm for practical applications
4. Implementation of Public Key Cryptosystem to provide Confidentiality and Authentication
 - a. Implement RSA Algorithm
5. Implement the Diffie-Hellman Key Exchange algorithm
6. Implementation of Cryptographic Algorithms to provide Data Integrity and Authentication
 - a. Calculate the message digest of a text using the SHA algorithm.
 - b. Implement the SIGNATURE SCHEME - Digital Signature Standard.

d. Learning Resources

Text Book

1. William Stallings, *Cryptography and network Security*, 7th edition Pearson,2017.

Reference Books

1. Behrouz A.Foruzan, *Cryptography and Network Security*, Tata McGraw Hill 2017.
2. C K Shyamala, N Harini and Dr. T R Padmanabhan, *Cryptography andNetwork Security*, Wiley India Pvt. Ltd.
3. Wade Trappe, Lawrence C Washington, *Introduction to Cryptography with coding theory*, 2nd edition, Pearson, 2007
4. Charles P. Pfleeger, Shari Lawrence Pfleeger, *Security in computing*, Prentice Hall of India, 3rd Edition, 2006
5. Charlie Kaufman, Radia Perlman, and Mike Speciner, *Network Security: PRIVATE Communication in a PUBLIC World*, Prentice Hall, ISBN 0-13- 046019-2

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, HDD 500 GB, 4 GB RAM)	30
2.	Printer	1
3.	Software: Language: C / Java / Python	Open Source

Course Code	Course Name	L	T	P	C
IT2352	ANDROID APPLICATION DEVELOPMENT LABORATORY	0	0	4	2

Category: Professional Core

a. Preamble

This course enables the students to learn and create Android Mobile Application Development. Build the simple android mobile applications using GUI components. Develop the mobile android mobile applications using graphical primitives and event driven concepts. Make use of file concept in SQLite database. Use notification manager and location tracking concepts in android mobile application development. Construct the real time mobile application to integrate cloud database.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Build simple android mobile applications using GUI components.	K3
CO2	Develop android mobile applications using Graphical Primitives and Event Driven Concepts.	K3
CO3	Develop file concepts and inbuilt/SQLite database for developing android mobile applications.	K3
CO4	Utilize notification and location tracking concepts in android mobile application development.	K3
CO5	Construct real time android mobile applications to integrate cloud database.	K3

c. Course Syllabus

Total : 60 Periods

LIST OF EXPERIMENTS

1. Develop an android application that uses GUI components, Styles

2. Develop an android application that uses Layout Managers and event listeners
3. Develop an android application to draw basic graphical primitives on the screen
4. Create an Animation using Multithreading
5. Develop an android application that makes use of database (SQLite)
6. Implement an android application that writes data to the SD card
7. Develop an android application that makes use of Notification Manager
8. Develop a native android application that uses GPS location information
9. Develop an android mobile application to send an E-mail
10. Develop an android mobile application with regional language support
11. Develop an android mobile application to retrieve and process data from cloud storage
12. Develop a societal/Institutional/Industrial needed application in android studio and upload in Google play-store account

d. Learning Resources

Reference Book

1. John Horton, *Android Programming for Beginners*, 2nd Edition, Packt Publishing, 2018.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Quantity Required
1.	Personal Computers (8 GB RAM)	30
2.	Printer	1
3.	Software: Framework preferred: Android Studio Language preferred: Java / Kotlin	Open Source

Course Code	Course Name	L	T	P	C
VIT311	NETWORK SECURITY ESSENTIALS	3	0	0	3

Category: Professional Elective

a. Preamble

This course enables the students to understand the basics of network security and the various types of attacks. This course helps the students to summarize the types of mutual authentication mechanisms. This course demonstrates the security mechanisms to protect the system from malicious attack. This course describes the security mechanism in wireless LAN and cloud. This course elaborates the various security features in various TCP/IP layers.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Summarize the basics of network security and types of attacks.	K2
CO2	Outline the various mutual authentication mechanisms.	K2
CO3	Infer the security mechanisms for protecting the system from unauthorized access and malicious software.	K2
CO4	Demonstrate the security concepts in wireless LAN and cloud.	K2
CO5	Discuss various real time practices that provide Email security, network security and system security.	K2

c. Course Syllabus

Total : 45 Periods

INTRODUCTION TO NETWORK SECURITY 9

Overview of Network Security – Security services – attacks – Security Issues in TCP/IP suite – Sniffing – Spoofing – Buffer overflow – ARP poisoning – ICMP Exploits – IP address spoofing – IP fragment attack – routing exploits –UDP exploits – TCP exploits.

COMMUNICATION SECURITY 9

Introduction – Perfect secrecy – Overview of cryptosystem – Remote User Authentication Principles – Symmetric Key Distribution Using Symmetric Encryption – Kerberos – Key

Distribution Using Asymmetric Encryption- X.509 Certificates – Public-Key Infrastructure – Federated Identity Management.

SYSTEM SECURITY 9

Intruders – Intrusion Detection – Password Management – Malicious software: Trapdoor, Trojan horses, Logic bombs, Viruses, Worms, etc. – Firewalls: The Need for Firewalls – Firewall Characteristics and Access Policy – Types of Firewalls-Firewall Basing –Firewall Location and Configurations.

WIRELESS LAN AND CLOUD SECURITY 9

Wireless LAN Security: Introduction to wireless network security – Risks and Threats of Wireless networks – Mobile Device Security –IEEE 802.11i Wireless LAN Security.

Cloud Security: Cloud Computing – Cloud Security Risks and Countermeasures – Data Protection in the Cloud – Cloud Security as a Service

SECURITY APPLICATIONS 9

IP Security – AH and ESP – SSL/TLS – SSH – Web Security – HTTPS – DNS Security – Electronic Mail Security (PGP - S/MIME).

d. Activities

- Quiz
- Crossword puzzles
- Seminars

e. Learning Resources

Text Books

1. William Stallings, *Network Security Essentials: Applications and Standards*, Sixth Edition, Pearson Education, 2016.
2. Yang Xiao, Yi Pan, *Security in Distributed and Networking Systems*, World Scientific, 2007.

Reference Books

1. Dr. Wenliang Du, *Computer & Internet Security: A Hands-on Approach*, 2nd Edition, 2019.
2. Charlie Kaufman, Radia Perlman, and Mike Speciner, *Network Security: PRIVATE Communication in a PUBLIC World*, Prentice Hall, ISBN 0-13- 046019-2.

Course Code	Course Name	L	T	P	C
VIT312	CLOUD COMPUTING	2	0	2	3

Category: Professional Elective

a. Preamble

This course enables the students to understand the basics of cloud computing. This course helps the students to learn the evolution of cloud from the existing technologies. This course familiarizes the lead players in cloud. This course makes the students to have knowledge on the various issues in cloud computing. This course disseminates various cloud platforms.

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Outline the evolution of cloud computing and its characteristics	K2
CO2	Summarize the basic concepts and implementation levels of virtualization	K2
CO3	Illustrate the architecture, services and delivery models of compute and storage cloud	K2
CO4	Identify the core issues of resource management and security in cloud computing	K2
CO5	Demonstrate the features of various cloud platforms	K2

Course Outcome (Lab)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Create and manage a virtual machine instance in a virtualized environment	K3
CO2	Deploy a web application in a PaaS environment	K3
CO3	Apply a resource scheduling algorithm in cloud environment	K3
CO4	Construct a Hadoop framework to store and process large datasets	K3
CO5	Use MapReduce program to perform parallel processing	K3

c. Course Syllabus

Total : 60 Periods

INTRODUCTION 6

Cloud Computing Basics: Introduction to Cloud Computing – Definition of Cloud – Roots of Cloud Computing – Cloud Characteristics – Elasticity in Cloud – On-Demand Provisioning – Pros and Cons of Cloud Computing

CLOUD ENABLING TECHNOLOGIES 6

Web Services and SOA: Introduction to Web Service and Service Oriented Architecture – SOAP – REST – Virtualization: Basics of Virtualization – Full and Para Virtualization – Implementation Levels of Virtualization – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices

CLOUD ARCHITECTURE, SERVICES AND STORAGE 6

Cloud Architecture: NIST Cloud Computing Reference Architecture – Architectural Design Challenges – Cloud Services: Public, Private and Hybrid Clouds – IaaS – PaaS – SaaS – Cloud Storage: Storage-as-a-Service – Advantages of Cloud Storage.

CLOUD RESOURCE MANAGEMENT AND SECURITY 6

Resource Management: Inter Cloud Resource Management – Resource Provisioning and Methods – Security: Cloud Security Overview – Cloud Security Challenges – Security Architecture Design – Virtual Machine Security – Application Security – Data Security – IAM.

CLOUD PLATFORMS 6

Cloud Platforms: Hadoop – MapReduce – Google App Engine (GAE) – Microsoft Azure – OpenStack – Heroku – Amazon Web Services.

Periods**LIST OF EXPERIMENTS**

1. Installation of Guest OS using Virtual box / VMware.
2. Installation of C compiler in the Virtual Machine.
3. Implement PaaS using Amazon Web Services.
4. Simulate a VM allocation algorithm using CloudSim.
5. Installation of Single Node Hadoop Cluster.
6. Implement MapReduce concept for an application.
7. Create Virtual Machine in OpenStack Cloud Platform.

d. Activities

- Quiz
- Debate
- Chart Preparation
- Seminar

e. Learning Resources**Text Books**

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, *Distributed and Cloud Computing, From Parallel Processing to the Internet of Things*, Morgan Kaufmann Publishers, 2012.
2. Rittinghouse, John W, and James F. Ransome, *Cloud Computing: Implementation, Management and Security*, CRC Press, 2017.

Reference Books

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, *Mastering Cloud Computing*, Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, *Cloud Computing - A Practical Approach*, Tata Mcgraw Hill, 2009.
3. George Reese, *Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)*, O'Reilly, 2009.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, HDD 500 GB, 4 GB RAM)	30
2.	Printer	1
3.	Software: <ul style="list-style-type: none"> a. Eucalyptus or Open Stack or Cloudsim or equivalent b. Git bash c. Oracle or VMWare d. DevStack C / Java / Python 	Open Source

Course Code	Course Name	L	T	P	C
VIT313	INTERNET OF THINGS: PRINCIPLES AND PARADIGM	2	0	2	3

Category: Professional Elective

a. Preamble

The aim of the Internet of things course is to understand IoT architectures and smart objects for real world application. The course is organized to learn about various IoT-related protocols. This course helps the students to build simple IoT Systems using Arduino and Raspberry Pi. Students will be able to understand the cloud related to IoT and to develop IoT infrastructure for real time applications

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Outline the components of IoT architecture and functional blocks.	K2
CO2	Summarize the various protocols in IoT.	K2
CO3	Build simple IoT system using Raspberry Pi/Arduino.	K2
CO4	Recognize the integration of sensors and actuators using Arduino.	K2
CO5	Summarize the applications of IoT in real time scenario.	K2

Course Outcome (Lab)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Apply the basic Arduino functions.	K3
CO2	Utilize various sensors to develop IoT applications.	K3
CO3	Build IoT systems using Arduino.	K3
CO4	Utilize Raspberry PI processor for developing IoT applications.	K3
CO5	Develop real time smart IoT Applications.	K3

c. Course Syllabus

Total : 60 Periods

INTRODUCTION TO IoT 6

Evolution of Internet of Things - IoT Enabling Technologies - IoT Levels - IoT Architectures - OneM2M, IoT World Forum (IoTWF)- Fog, Edge and Cloud in IoT - Functional Blocks of an IoT Ecosystem.

IoT PROTOCOLS 6

IoT Access Technologies: Physical and MAC Layers, Topology and Security of IEEE 802.15.4 and LoRaWAN Network Layer: IP Versions, Constrained Nodes and Constrained Networks Application Layer Protocols: CoAP and MQTT

DEVELOPMENT WITH ARDUINO, RASPBERRY PI 6

Arduino: Board Details, IDE Programming: Structure, Variables and constants, Data types, Operators, Control statements, Loops - Logical Design using Raspberry PI

INTEGRATION WITH ARDUINO 6

Sensors: Temperature sensor, Detecting motion using PIR sensor, Measuring distance using infrared and ultrasonic sensor

Actuators: Controlling motors with transistors, Controlling speed with Pulse Width Modulation(PWM), Servo motor, Stepper motor

CASE STUDIES AND REAL-WORLD APPLICATIONS 6

Cloud for IoT - Smart Grid - Smart Agriculture - Smart and Connected Cities: Smart Lighting, Smart Parking, Smart Traffic Control.

PRACTICAL EXERCISES 30

Periods

LIST OF EXPERIMENTS

1. Arduino program to demonstrate basic functions and data types.
2. Arduino program to demonstrate conditional and looping statements.
3. Utilize the following sensors to monitor its values in real time using Arduino.
 - (i) Temperature sensor
 - (ii) PIR sensor
 - (iii) Infrared sensor
 - (iv) Ultrasonic sensor

4. Implementation of IoT based control of an LED using Arduino
5. Implement the following using Raspberry Pi.
 - (i) LED Blinking.
 - (ii) Sensing temperature and humidity.
6. Implementation of IoT based real time application using Arduino/Raspberry Pi.

d. Learning Resources

Text Books

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, *IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things*, Cisco Press, 2017
2. SudipMisra, Anandarup Mukherjee, Arijit Roy, *Introduction to IoT*, New Delhi: Cambridge University Press, 2020.

Reference Books

1. Kamal Raj, *Internet of Things - Architecture and Design Principles*, New Delhi:McGraw Hill Education India, 2017
2. MayurRamgir, *Internet of Things- Architecture, Implementation, and Security*, New Delhi:Pearson Education, 2019

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, HDD 500 GB, 4 GB RAM)	30
2.	Printer	1
3.	Software: Language: Embedded C, Python	Open Source

Course Code	Course Name	L	T	P	C
VIT314	SOFTWARE DEFINED NETWORKS	2	0	2	4

Category: Professional Elective

a. Preamble

This course enables the students to understand the basics of Software Defined Network. This course helps the students to interpret the working of interface between low level and high level layers in SDN. This course demonstrates the data center in SDN. This course enables the students to experience the topology and framework of SDN. This course outlines the applications of SDN.

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Summarize the fundamental concepts of Software Defined Network.	K2
CO2	Outline the programmatic interface for building SDN controllers.	K2
CO3	Illustrate the integration of a constellation of networking resources.	K2
CO4	Interpret the various network topology using SDN framework	K2
CO5	Extend the knowledge of SDN for real time scenarios.	K2

Course Outcome (Lab)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Utilize the appropriate commands to simulate the software defined network	K3
CO2	Develop a network topology for the given scenario	K3
CO3	Install and use Open Network Operating System (ONOS) controllers	K3
CO4	Visualize the network topology using ONOS GUI	K3
CO5	Create the SDN environment using various SDN frameworks	K3

c. Course Syllabus

Total : 60 Periods

INTRODUCTION TO SOFTWARE DEFINED NETWORK 6

History of Software Defined Networking (SDN) – Modern Data Center – Traditional Switch Architecture – Why SDN – Evolution of SDN – How SDN Works – Centralized and Distributed Control and Data Planes.

INTERFACE AND CONTROLLER 6

Interface: Openflow – Controller: VMWare – Mininet - NOX/POX – Big Switch Networks/Floodlight – Layer 3 Centric: L3VPN – Path Computation Element Server – Plexxi: Plexxi Affinity – Network Programmability: Management Interface – Modern Programmatic Interfaces – Modern Orchestration.

DATA CENTERS 6

Multitenant and Virtualized Multitenant Data Center – SDN Solutions for the Data Center Network – VLANs – EVPN – VxLAN – NVGRE.

TOPOLOGY AND FRAMEWORK **6**

Network Topology: Traditional Methods – LLDP – BGP – TE/LS – ALTO – I2RS – Framework: Build Code First – The Juniper SDN Framework(s) – Open Daylight Controller/Framework – Policy.

TECHNOLOGY **6**

Use Cases Bandwidth Scheduling, Manipulation, Calendaring: Bandwidth Calendaring – Big Data and Application Hyper – Virtualization for Instant CSPF – Expanding Technology, Use Cases for Data Center Overlays, Big Data, Network Function Virtualization: Data Center Orchestration – Puppet – Network Function Virtualization – Optimized Big Data, Use Cases for Input Traffic Monitoring, Classification and Triggered Action: Firewall as Service – Network Access Control Replacement – Virtual Firewall – Feed Back and Optimization – Intrusion Detection/Threat Mitigation.

PRACTICAL EXERCISES **30**

Periods

LIST OF EXPERIMENTS

1. Configuration of Mininet and basic Mininet Commands Execution.
2. Classic Topologies simulation with Mininet.
3. Custom Topologies creation with Mininet and Python API.
4. Configuration of ONOS controller with ONOS GUI.
5. Configuration of ONOS controller with ONOS CLI.
6. Visualization of Network Topologies using ONOS GUI.
7. Creating SDN environment with OpenDaylight, Mininet, PuTTY and Xming.

d. Learning Resources

Text Books

1. Thomas D. Nandau, Ken Gray, *Software Defined Networks*, First Edition, O’Reilly Media Inc., 2013.
2. Goransson Paul, Chuck Black, Timothy Culver, *Software Defined Networks: A Comprehensive Approach*, Morgan Kaufmann, 2016.

Reference Books

1. Siamak Azodolmolky, *Software Defined Networking with Open Flow*, Packet Publishing, 2013.
2. Vivek Tiwari, *SDN and Open Flow for Beginners*, Amazon Digital Services, Inc., 2013.
3. Patricia A. Morreale, James M. Anderson, *Software Defined Networking: Design and Deployment*, CRC Press, 2014
4. FEI HU, *Network Innovation through OpenFlow and SDN: Principles and Design*, CRC Press, Taylor & Francis Group, 2014.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, HDD 500 GB, 4 GB RAM)	30
2.	Printer	1
3.	Software: Mininet, ONOS Controller, Open Daylight Controller, Python	Open Source

Course Code	Course Name	L	T	P	C
VIT315	CYBER FORENSICS INVESTIGATION	3	0	0	3

Category: Professional Elective

a. Preamble

This course outlines the basics of Cyber Forensics along with preparation of incident response. This course imparts the knowledge of data acquisition and duplications. This course helps the students to gain knowledge in e-mail and social media investigation. This

course demonstrates the procedures in mobile device forensics and cloud forensics. This course motivates the students to work with cyber forensics tools.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Outline the basics of Cyber Forensics along with preparation of incident response.	K2
CO2	Interpret the procedures for data acquisition and duplications in cyber investigation.	K2
CO3	Infer the crime through e-mail investigation.	K2
CO4	Demonstrate the process of investigation in mobile device forensics and cloud forensics.	K2
CO5	Illustrate the investigation procedure through various cyber forensics tools.	K2

c. Course Syllabus

Total : 45 Periods

INTRODUCTION TO CYBER FORENSICS 9

Introduction to Cyber Forensics – Types of Cyber Forensics technology – Incident and incident response process – Preparation for IR: Preparing individual hosts – Preparing a network – Establishing appropriate policies and procedures – Creating a response toolkit – Establishing an incident response team – Overview of the initial response phase – Conducting interviews.

ACQUISITION AND DUPLICATION 9

Data Acquisition: Understanding storage formats for digital evident – Determining the best acquisition method – Contingency planning for image acquisitions – Using acquisition tools, Validating Data acquisitions – Performing RAID data acquisitions – Using remote network acquisition tools – Using other forensics acquisition tools.

Forensics Duplication: Forensics duplicates as admissible evidence – Forensics duplication tool requirements – Creating a forensics duplicate of a hard drive – Creating a qualified forensics duplicate of a hard drive.

E-MAIL INVESTIGATION 7

Exploring the Role of E-mail in Investigations – Exploring the Roles of the Client and Server in E-mail – Investigating E-mail Crimes and Violation – Understanding E-mail Servers – Using Specialized E-mail Forensics Tools – Applying Digital Forensics to Social Media.

MOBILE DEVICE AND CLOUD FORENSICS 11

Mobile Device Forensics: Understanding mobile device forensics: Mobile phone basics, Inside mobile devices – Understanding acquisition procedures for mobile devices: Mobile forensics equipment, using forensics tools – Understanding forensics in the Internet of Anything.

Cloud Forensics: Overview of cloud computing – Legal challenges in cloud forensics – Technical challenges in cloud forensics – Acquisitions in the cloud – Conducting a cloud investigation – Tools for cloud forensics.

CYBER FORENSIC TOOLS 9

Evaluating Digital Forensics Tool Needs – Digital Forensics Software Tools – Digital Forensics Hardware Tools – Validating and Testing Forensics Tools – ProDiscover (Hands-on).

d. Activities

- Case study
- Quiz
- Seminar
- Role Play

e. Learning Resources

Text Books

1. Prorise C, Mandia K, Pepe M, *Incident Response & Computer Forensics*, 2014.
2. Nelson, Phillips, Steuart, *Computer Forensics and Investigations*, Cengage Learning, Sixth Edition, 2018.

Reference Books

1. Marjie T Britz, *Computer Forensics and Cyber Crime: An Introduction*, Pearson Education, 2nd Edition, 2008.
2. Deje, Murugan, *Cyber Forensics*, Oxford University Press, 2018.

Course Code	Course Name	L	T	P	C
VIT316	DEVOPS FRAMEWORKS	3	0	0	3

Category: Professional Elective

a. Preamble

This course enables the student to understand the basics of DevOps. This course familiarizes the various GIT commands related to DevOps. This course helps student to understand the

continuous integration using Jenkin. This course focuses on containerized development using Docker and Kubernetes.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Summarize the basics of DevOps and concepts of cloud.	K2
CO2	Show the various GIT commands to work in cloud environment.	K2
CO3	Outline the continuous integration using Jenkins.	K2
CO4	Infer the need of Docker to speed up development and application deployment.	K2
CO5	Illustrate orchestrates containerized applications to run in a cluster of hosts using Kubernetes.	K2

c. Course Syllabus

Total : 45 Periods

INTRODUCTION TO DEVOPS 9

Introduction – History of Devops – Foundational Terminology and Concepts – Four Pillars of Effective Devops – DevOps delivery pipeline – Market trends and technical challenges – Tools used in DevOps – Cloud and Virtualization architecture – Cloud deployment architecture – Introduction to Amazon web services.

GIT – VERSION CONTROLLING TOOL 9

Understanding GIT – Making Commits – Undoing and Editing Commits – Branching – Tracking – Merging – Naming Commits – Viewing History – Editing History – Remote Access.

CONTINUOUS INTEGRATION USING JENKINS 9

Introduction – Master/Slave Mode – Creating Views and Jobs – Managing Views and Jobs – Advanced Automated Testing – Software Deployments and Delivery – Build Pipelines – Plugin Management.

CONTAINERIZATION DEVELOPMENT WITH DOCKER 9

Understanding Docker – Installing Docker – Docker Engine – Docker Image – Container – Docker Compose – Docker Swarm – Docker Networking – Volumes and Persistent Data – Docker Stacks – Security.

CONTAINERIZATION DEVELOPMENT WITH KUBERNETS 9

Introduction – Working with Pods – Virtual Clusters with Namespaces – Deployment – Services – Ingress – Service Discovery – Storage – Security.

d. Activities

- Demo
- Quiz
- Hands-on

e. Learning Resources

Text Books

1. Richard E. Silverman, *Git Pocket Guide*, O’Reilly Media, Inc. July 2013.
2. Jonathan McAllister, *Mastering Jenkins*, Packt Publishing, October 2015.
3. Nigel Poulton, *Docker Deep Dive: Zero to Docker in a single book*, Kindle Edition, May 2020
4. Nigel Poulton and Pushkar Joglekar, *The Kubernetes Book*, Kindle Edition, January 2023.

Reference Books

1. Scott Surovich , Marc Boorshtein, *Kubernetes and Docker - An Enterprise Guide*, Packt, ISBN: 9781839213403, November 2020.
2. Robert Kernman, *DevOps: Jenkins: The Ultimate Beginner's Guide*, Kindle Edition.

Web Resource

1. <https://www.javatpoint.com/devops>

Course Code	Course Name	L	T	P	C
VIT317	BLOCKCHAIN TECHNOLOGIES AND ITS APPLICATIONS	3	0	0	3

Category: Professional Elective

a. Preamble

This course is designed to understand blockchain's fundamental components and deals with the various cryptography primitives, consensus algorithms and design issues used in blockchain. This course provides the aspects of trading and mining using crypto currencies. This course explains the components of ethereum and programming languages for ethereum and to study the basics of hyperledger and web3.

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Demonstrate the technology components of blockchain and cryptography primitives for blockchain systems.	K2
CO2	Illustrate the various consensus algorithms work with its design issues.	K2
CO3	Summarize bitcoin and its limitations by comparing with other alternative coins.	K2
CO4	Outline the components and programming languages for ethereum.	K2
CO5	Summarize the uses of Web3 and Hyperledger development framework.	K2

c. Course Syllabus

Total : 45 Periods

INTRODUCTION TO BLOCKCHAIN AND CRYPTOGRAPY 9

History of Blockchain - Types of Blockchain - Decentralization using Blockchain - Platforms for Decentralization - Hashing in Blockchain - Linking Blocks in Blockchain - Linking Blocks using SHA256 - Block Structure - Creating Blockchain - Byzantine Failure Problem in Blockchain - Digital Signatures in Blockchain - Blockchain Wallets.

CONSENSUS ALGORITHMS 9

Proof of Work - Pure Stake Based Consensus - Proof of Stake - Leased Proof of Stake - Delegated Proof of Stake - Hybrid Form of PoS and PoW - Practical Byzantine Fault Tolerance - Ripple - Tendermint - Proof of Elapsed Time - Proof of Activity - Proof of Burn.

INTRODUCTION TO CRYPTOCURRENCY 9

Bitcoin - Digital Keys and Addresses - Transactions - Mining - Bitcoin Networks and Payments - Wallets - Alternative Coins - Theoretical Limitations - Bitcoin Limitations - Name Coin - Prime Coin - Zcash - Smart Contracts - Ricardian Contracts.

ETHEREUM 9

The Ethereum Network - Components of Ethereum Ecosystem - Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule - Solidity Language - Dapps - DAO.

WEB3 AND HYPERLEDGER 9

Introduction to Web3 - Contract Deployment - POST Requests - Development Frameworks - Hyperledger as a Protocol - The Reference Architecture - Hyperledger Fabric - Distributed Ledger - Corda.

d. Learning Resources

Text Books

1. Imran Bashir, *Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained*, Second Edition, Packet Publishing, 2018.
2. Koshik Raj, *Foundations of Blockchain*, Packt Publishers, 2019.

Reference Books

1. Arshdeep Bahga and Vijay Madiseti, *Blockchain Applications : A Hands-On Approach* VPT, 2017.
2. Andreas Antonopoulos, Satoshi Nakamoto, *Mastering Bitcoin*, O’Reilly Publishing, 2014.
3. Roger Wattenhofer, *The Science of the Blockchain*, Create Space Independent Publishing Platform, 2016.
4. S. Shukla, M. Dhawan, S. Sharma and S. Venkatesan, *Blockchain Technology: Cryptocurrency and Applications*, Oxford University Press, 2019.
5. Alex Leverington, *Ethereum Programming*, Packt Publishing Limited, 2017.

Course Code	Course Name	L	T	P	C
VIT321	SOFTWARE ARCHITECTURE AND UML DESIGN	3	0	0	3

Category: Professional Elective

a. Preamble

This course is designed to understand software architectural requirements. Be exposed to architectural styles and views. Be familiar with architectures for emerging technologies. To design with static UML diagrams. To design with the UML dynamic and implementation diagrams.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Summarize the software architecture that can be used for an application.	K2
CO2	Illustrate the design fundamentals of the software.	K2
CO3	Demonstrate the design methodologies to create good software.	K2
CO4	Construct appropriate use case and class diagrams for real world scenarios.	K3
CO5	Apply the dynamic and implementation diagrams for the given software system	K3

c. Course Syllabus

Total : 45 Periods

INTRODUCTION TO SOFTWARE ARCHITECTURE 9

Notion of Architecture - Notion of Software Architecture - Architectural Styles: Pipes and Filters - Layered Systems - Repositories - Description of Software Architecture - Visual Notation.

DESIGN FUNDAMENTALS 9

The Basic Concepts of Design - Characteristics of Design Activities - Essential Elements of Design - The Factors that affect the Design - Design Principles - Basic Rules of Software Design - Design Processes.

DESIGN METHODOLOGIES 9

Structured Design - Design Practices - Stepwise Refinement - Incremental Design - Structured System Analysis and Design - Jackson Structured Programming - Jackson System Development - Designing with Objects - User Interface Design.

USE CASE AND STATIC DIAGRAMS 9

Unified Process Model - Inception - Use Case Modelling - Relating Use Cases - Include, Extend and Generalization - Class Diagram - Elaboration - Domain Model - Finding Conceptual Classes and Description Classes - Associations – Attributes.

DYNAMIC AND IMPLEMENTATION DIAGRAMS

9

Dynamic Diagrams - UML Interaction Diagrams - System Sequence Diagram - Collaboration Diagram - State Machine Diagram and Modelling - Activity Diagram - UML Package Diagram - Component and Deployment Diagrams.

d. Activities

- Quiz
- Case Study

e. Learning Resources

Text Books

1. Hong Zhu, *Software Design Methodology from Principles to Architectural Styles*, Elsevier, 2005
2. Craig Larman, *Applying UML and Patterns: An Introduction to Object Oriented Analysis and Design and Iterative Development*, Third Edition, Pearson Education, 2012.

Reference Books

1. David Budgen, *Software Design*, Second Edition, Pearson Education, 2004.
2. Mary Shaw David Garlan, *Software Architectural Perspectives on an Emerging Discipline*, EEE, PHI 1996.
3. Mike O'Docherty, *Object-Oriented Analysis & Design: Understanding System Development with UML 2.0*, John Wiley & Sons, 2005.

Course Code	Course Name	L	T	P	C
VIT322	AGILE METHODOLOGIES	3	0	0	3

Category: Professional Elective

a. Preamble

This course enables the students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software. It is designed to understand the benefits and pitfalls of working in an agile team and to perform a detailed examination and demonstration of agile development and testing techniques.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Demonstrate the importance of agile software development practices to create high-quality software.	K2
CO2	Summarize the iterative software development processes.	K2
CO3	Outline the importance of agile management.	K2
CO4	Summarize the software process improvement by determining the requirements for a software system.	K2
CO5	Illustrate how agile approaches can be scaled up to the enterprise level.	K2

c. Course Syllabus

Total : 45 Periods

AGILE METHODOLOGY

9

Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model – Classification of Agile Methods – Agile Manifesto and Principles – Agile Team Interactions – Ethics in Agile Teams – Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values

AGILE PROCESSES

9

Lean Production: SCRUM, Crystal, Feature Driven Development, Adaptive Software Development – Extreme Programming: Method Overview, Lifecycle, Work Products, Roles and Practices.

AGILE MANAGEMENT

9

Agile Project Management – Traditional Model versus RAD model for project management – Task planning and effort tracking – The project managers new work – Agile Development Management – Agile product Management.

AGILE SOFTWARE TOOL

9

Introduction to JIRA – JIRA Version – JIRA Cloud Instance Setup – JIRA Administration: Creating a New User and Group – Permission Levels – Global Permission – Project Roles and Permissions - JIRA Schemes : Issue Types, Screens, Custom Fields, Workflow

AGILITY AND QUALITY ASSURANCE

9

Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance – Test Driven Development – Agile Approach in Global Software Development.

d. Activities

- Quiz
- Case Study

e. Learning Resources

Text Books

1. David J. Anderson and Eli Schragenheim, *Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results*, Prentice Hall, 2003.
2. Hazza and Dubinsky, *Agile Software Engineering, Series: Undergraduate Topics in Computer Science*, Springer, 2009.

Reference Books

1. Craig Larman, *Agile and Iterative Development: A Manager's Guide*, Addison-Wesley, 2004.

Web Resource

1. <https://www.udemy.com/course/the-complete-guide-to-jira-with-real-world-examples/>

Course Code	Course Name	L	T	P	C
VIT323	ESSENTIALS OF .NET FRAMEWORK	2	0	2	3

Category: Professional Elective

a. Preamble

This course enables the student to understand the basic concepts of ASP.NET framework. This course helps the students to create web applications using ASP.NET and manage the session. This course demonstrates the database connectivity using ADO.NET. This courses supports in creating a web service based applications.

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Outline the basics of ASP.NET programming.	K2
CO2	Develop web applications using ASP.NET.	K3
CO3	Utilize the features of state management to manage session and cookies.	K3
CO4	Demonstrate the database connectivity using ADO.NET.	K2
CO5	Extend the concepts of web services using ASP.NET.	K2

Course Outcome (Lab)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Apply the concepts of ASP.NET to validate the forms in the web application.	K3
CO2	Create a master web page and manage the session using ASP.NET.	K3
CO3	Develop a web application to interact with database using ADO.NET.	K3
CO4	Utilize the features of XML and AJAX for creating a web application.	K3
CO5	Build simple web application using ASP web services.	K3

c. Course Syllabus

Total : 60 Periods

INTRODUCTION TO THE .NET FRAMEWORK

6

Introduction to .NET Framework – Overview of ASP.NET Controls – Overview of ASP.NET Pages – Standard Controls – Validation Controls.

DEVELOPING ASP.NET WEBSITES 6

Designing Websites with Master Pages: Creating, Modifying Master Page Content, Loading Master Pages Dynamically – Designing Website with Themes: Adding Skins, Adding Cascading Style Sheets, Creating Global Themes – Custom Controls.

STATE MANAGEMENT 6

Cookies – Session – Profiles – View – Tracing – Debugging – Error Handling.

ADO.NET AND DATABASE CONNECTIVITY 6

Overview of ADO.NET – ADO.NET object model – SQL basics – Creating connection-Data Binding - Connected Model - Disconnected Model – Data List, Data Grid.

XML & WEB SERVICES 6

Introduction to XML – XSD – XSLT – AJAX – Creating Web Services – Consuming Web Service – Application Configuration – Deployment.

PRACTICAL EXERCISES 30

Periods

LIST OF EXPERIMENTS

1. Develop simple web applications using advanced ASP.NET Controls and validation controls.
2. Create Master Page in a web application and usage of gacutil.
3. Develop web application with session management
4. Develop web application to work with ADO.NET & CRUD
5. Develop an application to work with XML
6. Develop web application with AJAX
7. Create a web service to implement the basic calculator services

d. Learning Resources

Text Books

1. Stephen Walther, Kevin Hoffman, Nate Dudek, *ASP.NET 4.5 Unleashed*, Pearson Education, Inc, 2014.
2. J.Liberty, D.Hurwitz, *Programming ASP.NET*, Third Edition, O'REILLY, 2006.

Reference Books

1. Imar Spaanjaars, *Beginning ASP.NET 4.5.1: in C# and VB*, Kindle Edition, 2014.

2. Mathew Mac Donald, *ASP.NET complete Reference*, Tata McGraw Hill 2005.

3. Daniel Solis, *Illustrated C#*, Apress, Second Edition, 2012.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, HDD 500 GB, 4 GB RAM)	30
2.	Printer	1
3.	Software: Visual Studio, ASP.NET, MySQL	Open Source

Course Code	Course Name	L	T	P	C
VIT324	VIRTUAL REALITY SYSTEMS	3	0	0	3

Category: Professional Elective

a. Preamble

The aim of virtual reality system is to understand the basic functioning of virtual reality systems. This course provides students with an opportunity to understand the input and output devices in real time virtual environment. It also makes the students to learn various computing architectures to develop for virtual reality applications. With this new knowledge, students will be able to understand various models and applications in virtual reality systems.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Summarize the components of the virtual reality systems.	K2
CO2	Recognize the Input and output devices in real time environment.	K2
CO3	Illustrate the various computing architectures to develop for virtual reality applications.	K2
CO4	Demonstrate the various modeling in virtual reality systems.	K2
CO5	Utilize the concepts of virtual reality in real time applications.	K3

c. Course Syllabus

Total : 45 Periods

INTRODUCTION TO VIRTUAL REALITY 9

The Three I's of Virtual Reality – A Short History of Early Virtual Reality – Early Commercial VR Technology – VR Becomes an Industry – The Five Classic Components of a VR System.

INPUT AND OUTPUT DEVICES IN VR 9

Input Devices: Three-Dimensional Position Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces. Output Devices: Graphics Displays – Sound Displays – Haptic Feedback.

COMPUTING ARCHITECTURES FOR VIRTUAL REALITY 9

The Rendering Pipeline – PC Graphics Architecture – Workstation Based Architectures - Distributed VR Architectures.

VR MODELING 9

VR Object Modeling: Geometric modeling – Kinematic modeling – Physical modeling – Behavior modeling – Model Management.

APPLICATIONS OF VIRTUAL REALITY 9

Traditional applications: Medical Applications – Education, Arts, and Entertainment – Military Applications.

Emerging Applications: Manufacturing – Robotics – Information Visualization

d. Activities

- Quiz
- Crossword puzzle
- Connection

e. Learning Resources

Text Books

1. Burdeau, G.C. and P. Coiffet, *Virtual Reality Technology*, Wiley, IEEE press, 2nd edition, 2017.
2. William R. Sherman, Alan B. Craig, Morgan Kaufmann, *Understanding Virtual Reality: Interface, Application, and Design*, 1st Edition, 2002.

Reference Books

1. Guanran LIU, *Virtual Reality Technology*, Tsinghua Press, 2011.
2. John Vince, *Virtual Reality Systems*, Pearson Education Asia, 2007.
3. Adams, *Visualizations of Virtual Reality*, Tata McGraw Hill, 2000.

Course Code	Course Name	L	T	P	C
VIT325	GAME DESIGN AND DEVELOPMENT	2	0	2	3

Category: Professional Elective

a. Preamble

This course enables the students to know the basics of 2D and 3D graphics for game development. This course makes students understand the game industry and role of team. This course helps the students to understand the production cycle and the game plan. Learn and develop simple games using Pygame environment.

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Infer the concepts of 3D graphics for Game Programming.	K2
CO2	Outline the game design principles used for game programming.	K2
CO3	Demonstrate the production cycle in game design.	K2
CO4	Summarize the requirements of game and game plan for game development.	K2
CO5	Develop the game development applications using PyGame.	K3

Course Outcome (Lab)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Utilize the concepts of graphics for game programming.	K3
CO2	Build a storyboard and game script for the given application.	K3
CO3	Create the game design documents for the given scenario.	K3
CO4	Develop an animation based applications using Pygame.	K3
CO5	Implement a simple Pygame application.	K3

c. Course Syllabus

Total : 60 Periods

FUNDAMENTALS FOR GAME PROGRAMMING

6

Game – Definition – Genres of Games, Basics of 2D and 3D Graphics, Game Objects Design – 2D and 3D Transformations – Projections – Colour Models – Illumination and Shader Models – Animation – Controller based Animation.

GAME DESIGN BASICS **6**

Game Industry: Overview, Pitch Documentation, Managing the Developer-Publisher Relationship – Roles on the Team: Production, Art, Engineering, Design, Quality Assurance, Corporate.

GAME PRODUCTION **6**

Introduction – Production Cycle – Preproduction – Production – Testing – Postproduction – Effective Communication.

GAME DEVELOPMENT BASICS **6**

Introduction – Defining the Concepts – Characters, Setting, and Story – Game Requirements – Game Plan: Schedulers, Budgets, Outsourcing – Middleware.

GAME DEVELOPMENT USING PYGAME **6**

Introduction to Pygame – Pygame Basics – Tic-Tac-Toe Game – Learning About Curses by Building a Snake Game – Object Oriented Programming – Turtle Class – Snake Game UI – Tetris Game – PyOpenGL – Pymunk for Angry Bird Game – Learning Game AI.

PRACTICAL EXERCISES **30**

Periods

LIST OF EXPERIMENTS

1. Perform the basic geometric transformations like translation, scaling, zooming and rotation on 2D images.
2. Perform basic geometric transformations like translation, scaling, zooming and rotation on 3D objects
3. Implementation of colour models and shading models in Python.
4. Creation of game script in natural language and story creation.
5. Producing game level design document and detailed document.
6. Image rendering and animation.
7. Implementation of simple animations in Pygame and Processing.py
8. Pygame routines for character rendering, transformations and sound processing.

d. Learning Resources

Text Books

1. John F. Hughes, Andries Van Dam, Morgan Mc Guire ,David F. Sklar , James D. Foley, Steven K. Feiner and Kurt Akeley, *Computer Graphics: Principles and Practice*, 3rd Edition, Addison- Wesley Professional,2013
2. Heather Maxwell Chandler, and Rafael Chandler, “Fundamentals of Game Development”, Jones& Bartlett Learning, 2011.
3. Sachin Kafle, *Learning Python by Building Games: A beginner's guide to Python programming and game development*, Packt Publication, 2019.

Reference Books

1. Harrison Kinsley & Will McGugan, *Beginning Python Games Development*, 2nd Edition: With PyGame, Apress, 2015.
2. Paul Craven, *Python Arcade games*, Apress Publishers, 2016.
3. David H. Eberly, *3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics*, Second Edition, CRC Press, 2006.
4. Jung Hyun Han, *3D Graphics for Game Programming*, Chapman and Hall/CRC, 2011.
5. Al Sweigart, *Making Games with Python & Pygame*, 2012.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, HDD 500 GB, 4 GB RAM)	30
2.	Printer	1
3.	Software: Python, PyCharm, PyOpenGL, Pymunk, PyGame	Open Source

Course Code	Course Name	L	T	P	C
VIT326	WEB APPLICATION DEVELOPMENT USING DJANGO FRAMEWORK	2	0	2	3

Category: Professional Elective**a. Preamble**

The design and development of static, dynamic, and interactive web-based applications are the main topics of this course. These courses primarily concentrate on the use of Python for web development utilizing the steadily growing Django framework.

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Summarize the functionalities in Python for web development.	K2
CO2	Develop a web application framework to design and implement typical dynamic web pages and interactive web based applications.	K3
CO3	Implementing the concept of Integrating Accounts & Authentication on Django.	K3
CO4	Utilize the database concepts for database connectivity with SQLite.	K3
CO5	Create a functional website in Django and deploy Django Web Application on Cloud.	K3

Course Outcome (Lab)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Construct a web application using views and templates.	K3
CO2	Develop a web application for validating a form and sending e-mail.	K3
CO3	Build an application with the features of state management.	K3
CO4	Choose an appropriate SQL commands for database connectivity with SQLite.	K3
CO5	Create a web application and deploy on cloud.	K3

c. Course Syllabus**Total : 60 Periods****INTRODUCTION TO WEB DEVELOPMENT USING PYTHON****6**

Web Development Basics: Writing HTML, URL, Dynamic Website using CGI, Cookies, Security – Standard Markup Language Processing: Processing SGML, Processing HTML, Processing XML – Python Web Tools: Zope, Jython, Python.NET.

INTRODUCTION TO DJANGO FRAMEWORK 6

Introduction – Django Environment – Admin Interface – Creating Views – URL Mapping – Template System – Models.

AUTHENTICATION AND SESSION MANAGEMENT 6

Forms Processing – User Accounts – Customer User Model – User Authentication – Password Change and Reset – Sending E-Mails – Handling Cookies and Session.

CONNECTING SQLITE WITH DJANGO 6

Database Migrations – Fetch Data from Database – Displaying Data on Templates – Adding Condition on Data – Sending Data from URL to View – Sending Data from View to Template – Saving Objects into Database – Sorting Objects – Filtering Objects – Deleting Objects – Difference between Session and Cookie – Creating Sessions and Cookies in Django.

DEPLOYING DJANGO WEB APPLICATION ON CLOUD 6

Creating a Functional Website in Django – Four Important Pillars to Deploy – Registering on Heroku and Github – Push Project from Local System to Github – Working with Django Heroku – Working with Static Root – Handling WSGI with Gunicorn – Setting Up Database & Adding Users.

PRACTICAL EXERCISES

30

LIST OF EXPERIMENTS

1. Creating URLs and Mapping to Views.
2. Creating and working with template.
3. Creating registration form.
4. Configuring and sending e-mail using Django framework.
5. Creating session and cookies using Django.
6. Connecting database using SQLite.
7. Deploying the web application on cloud.

d. Learning Resources

Text Books

1. Martin C. Brown, *Python: The Complete Reference Paperback*, McGraw Hill Education, 4th Edition 2018.
2. William Jordon, *Python Django Web Development: The Ultimate Django web framework guide for Beginners*, Kindle Edition, 2nd Edition 2019.
3. William S. Vincent, *Django for Beginners: Build websites with Python and Django*, Kindle Edition, 2022.

Reference Books

1. Tom Aratyn, *Building Django 2.0 Web Applications: Create enterprise-grade, scalable Python web applications easily with Django 2.0*, Packt Publishing, 2nd Edition 2018.
2. Nigel George, *Build a website with Django*, GNW Independent Publishing Edition, 1st Edition 2019.
3. Ray Yao, *Django in 8 Hours: For Beginners, Learn Coding Fast*, Independently Publishing Edition, 2nd Edition 2020.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, HDD 500 GB, 4 GB RAM)	30
2.	Printer	1
3.	Software Used: Python, Visual Studio	Open Source

Course Code	Course Name	L	T	P	C
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VIT327	USER INTERFACE AND USER EXPERIENCE DESIGN	3	0	0	3
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Category: Professional Elective

a. Preamble

The aim of the UI/UX course is to provide knowledge about various processes involved in User Interface and User Experience Design. It provides deep understanding of the entire life cycle of UX design process. This course is to identify the role of UI / UX Designer and to organize user needs. It provides students with the knowledge of contextual inquiry, contextual analysis and enables the users to construct work activity affinity diagram. It also provides deep understanding of the mental, conceptual design process and Interaction design specifications.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Outline the importance of good Interface and screen design.	K2
CO2	Summarize the steps involved in UX process lifecycle.	K2
CO3	Organize ideas and data using affinity diagram.	K3
CO4	Classify design-informing model and incorporate user personas in the design.	K2
CO5	Infer the importance of mental models, conceptual model and production.	K2

c. Course Syllabus

Total : 45 Periods

INTRODUCTION TO USER INTERFACE

9

The Importance of the User Interface – Defining the User Interface – Importance of Good Design – History of the Human-Computer Interface – Interaction Styles – Graphical User Interfaces – Web User Interfaces – User Interface Design Process – Principles of Good Interface and Screen Design – Human Considerations in Interface and Screen Design.

USER EXPERIENCE PROCESS LIFECYCLE

9

Introduction of User Experience – Ubiquitous Interaction – Emerging Desire for Usability – From usability to User Experience – Emotional Impact of User Experience – User Experience needs a Business Case – Roots of usability – UX Process Life cycle – System complexity space – Scope of UX.

CONTEXTUAL INQUIRY AND ANALYSIS

9

Contextual Inquiry – User work activity data gathering – The system concept statement – User work activity data gathering – Abridged contextual inquiry process – Data-driven Vs. Model-driven Inquiry – Contextual Analysis – Organizing concepts: work roles and flow model – Creating and managing work activity notes – Construct Work Activity Affinity Diagram (WAAD) – Abridged Contextual Analysis process – History of Affinity diagrams.

DESIGN INFORMING MODEL AND IDEATION

9

Formal requirements extraction – Abridged methods for requirements extraction – Constructing Design – Informing Models – Design-informing models – User models – Usage models – Work environment models – Barrier summaries – Abridged methods for design-informing models extraction – Roots of essential use cases in software use cases – Design paradigms – Design thinking – Design perspectives – User personas – Ideation – Sketching.

MENTAL MODEL, CONCEPTUAL DESIGN AND PRODUCTION

9

Mental models – Conceptual design – Storyboards – Design influencing user behavior – Design for embodied interaction – Ubiquitous and situated interaction – Design Production – Macro view of lifecycle iterations for design – Intermediate design and Detailed design of Wireframes – Interaction design specifications – UX Targets – UX measures – UX metrics.

d. Activities

- Quiz
- Crossword puzzle
- Matching columns

e. Learning Resources

Text Books

1. Wilbert O. Galitz, *The Essential Guide to User Interface Design: An Introduction to GUI Design Principles and Techniques*, Wiley ,3rd Edition, 2007.
2. Rex Hartson and Pardha S. Pyla, *The UX Book Process and Guidelines for Ensuring a Quality User Experience*, Elsevier, 2012.

Reference Books

1. Albert Chipman, *A Complete Beginners to Pro Step by Step Guide to UX/UI Design and Mastering the Fundamentals of Web Design with Latest Tips & Techniques*, 1st Edition, 2022.
2. Jesse James Garrett, *The Elements of User Experience: User-Centered Design for the Web and Beyond*, Pearson Education ,2nd Edition, 2011.

Course Code	Course Name	L	T	P	C
VIT331	COMPUTER VISION AND IMAGE PROCESSING	2	0	2	3

Category: Professional Core Course

a. Preamble

This course is a broad introduction to computer vision and image processing. It explains the image representation, formation of Images and Filtering techniques. It categorizes the various image feature extraction techniques and also deals with texture analysis and stereopsis. It provides the various approaches used in camera calibration, segmentation and identifies the algorithms used in motion estimation and objects tracking.

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Summarize the representations and formation of images.	K2
CO2	Outline the various image feature extraction techniques.	K2
CO3	Interpret the methods required for texture analysis and stereopsis.	K2
CO4	Illustrate the various approaches used in camera calibration and segmentation.	K2
CO5	Infer the algorithms used in motion estimation and tracking objects.	K2

Course Outcome (Lab)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Experiment with linear filtering and convolution techniques for image enhancement.	K3
CO2	Implement the feature extraction techniques to extract edges and corners.	K3
CO3	Implement the various noise removal techniques for image enhancement.	K3
CO4	Choose suitable algorithms for camera calibration and segmentation.	K3
CO5	Select the appropriate algorithms for motion estimation and tracking objects.	K3

c. Course Syllabus

Total : 60 Periods

INTRODUCTION

7

Image Formation – Intrinsic and Extrinsic parameters – Basics of Geometric Camera Calibration - Modeling Brightness – Inference from Shading – Color- human perception, physics and representation- Linear Filters and Convolution

IMAGE FEATURES EXTRACTION

5

Histogram equalization – Shift Invariant Systems – Spatial Frequency and Fourier Transforms – Sampling and aliasing - Computing and representing the image gradient – Finding Corners – Building Neighborhoods with SIFT and HOG Features

TEXTURE ANALYSIS AND STEREOPSIS

6

Local Texture Representations using Filters - Pooled Texture- Representations by discovering Textons – Synthesizing Textures and Filling Holes in Images – Image Denoising – Shape from Texture – Binocular Camera Geometry and Epipolar Constraint- Binocular reconstruction – Human Stereopsis – Local methods and global methods for binocular fusion

CAMERA CALIBRATION AND SEGMENTATION

6

Internally Calibrated perspective cameras – uncalibrated weak-perspective cameras – uncalibrated perspective cameras – Image segmentation by clustering pixels – segmentation, clustering and graphs.

MODEL FITTING AND TRACKING OBJECTS

6

Hough Transform – Fitting Lines, Planes and Curved Structure – Robustness – Fitting using Probabilistic models – Motion Segmentation by parameter estimation – Model Selection- Tracking – Simple tracking Strategies – Tracking using matching – tracking linear dynamical models with kalman filters – data association – Particle filtering.

PRACTICAL EXERCISES

30

Periods

LIST OF EXPERIMENTS

1. Design of Linear Filtering
2. Image enhancement using convolution
3. Display histogram of gray scale image and color image
4. Detection of edges and corners
5. Noise removal and image sharpening
6. Segmentation using watershed transform

7. Compute camera intrinsic and extrinsic parameters
8. Object detection using template matching technique

d. Learning Resources

Text Book

1. D. A. Forsyth, J. Ponce, *Computer Vision: A Modern Approach*, PHI Learning, 2009

Reference Books

1. Milan Soanka, Vaclav Hlavac and Roger Boyle, *Digital Image Processing and Computer Vision*, Cengage Learning, 2014
2. Reinhard Klette, *Concise Computer Vision, An Introduction into theory and applications*, Springer, 2014.
3. Richard Szeliski, *Computer Vision: Algorithms and Applications*, Springer, 2nd Edition, 2022.
4. R.C. Gonzalez , R.E. Woods, *Digital Image Processing*, Pearson Education, 2007.
5. E.R.Davies, *Computer Vision Principles, Algorithms, Applications Learning* Academic Press, Fifth Edition.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, HDD 500 GB, 4 GB RAM)	30
2.	Printer	1
3.	Software: Matlab / Python	Open Source

Course Code	Course Name	L	T	P	C
VIT332	Data Science for Engineers	3	0	0	3

Category: Professional Elective

a. Preamble

This course enables the students to understand the fundamental concepts of data science and to know the different types of data sampling. It helps the students to familiarize the descriptive and inferential statistical techniques to analyze the data. It makes the students to present and interpret data using various visualization techniques.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Outline the fundamental concepts of data science	K2
CO2	Summarize the different types of data sampling	K2
CO3	Choose an appropriate descriptive statistical technique for exploratory data analysis	K3
CO4	Apply an appropriate inferential statistical technique for data analysis	K3
CO5	Interpret the data using various visualization techniques	K2

c. Course Syllabus

Total : 45 Periods

INTRODUCTION

9

Data Science: Benefits and uses – facets of data – Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation – Exploratory Data analysis – Build the model – Presenting findings and building applications.

DATA SAMPLING

9

Sampling With and Without Replacement – Simple Random Sampling – Stratified Sampling – Cluster Sampling – Systematic Sampling – Biased vs Unbiased Sampling – Sampling Error – Data Collection Methods.

DESCRIPTIVE STATISTICS

9

Introduction – Types of Data – Types of Variables – Describing Data with Tables and Graphs – Describing Data with Averages – Describing Variability – Normal Distributions and Standard (z) Scores.

INFERENCEAL STATISTICS 9

Introduction – Descriptive Statistics Vs Inferential Statistics – Populations and Samples – Statistical Hypothesis Generation and Testing – z-Test – t-Test – F-Test – Chi-Square Test.

DATA VISUALIZATION 9

Exploratory data analysis (EDA) – Types of EDA – Histogram – Box Plot – Scatter Plot – Line Plot – Bar Plot – Pair Plot – Outlier Analysis – EDA Tools – Case Study.

d. Activities

- Quiz
- Problem Solving
- Case Studies

e. Learning Resources

Text Books

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, *Introducing Data Science*, Manning Publications, 2016.
2. Robert S. Witte and John S. Witte, *Statistics*, Eleventh Edition, Wiley Publications, 2017.
3. Samir Madhavan, *Mastering python for data science*, Ingram short title, 2010.

Reference Books

1. Lillian Pierson, *Data Science For Dummies*, John Wiley & Sons, 2nd Edition, 2017.
2. Hadley Wickham, Garrett Golemund, *R for Data Science: Import, Tidy, Transform, Visualize, and Model Data*, O'Reilly Media Inc, 1st Edition, 2017.

Course Code	Course Name	L	T	P	C
VIT333	BIG DATA ANALYTICS	2	0	2	3

Category: Professional Elective

a. Preamble

The aim of the Big data analytics course is to know the fundamental concepts of Big data analytics and its applications. The course is organized to describe various techniques for Big Data Analytics. The course is focused to learn and apply different recommendation systems for large volumes of data. The course is organized to learn to use various techniques for mining data stream. The student will learn about the tools such as HIVE, HBase to process large amount of data.

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Summarize the fundamentals of Big Data Analytics.	K2
CO2	Demonstrate Hadoop and MapReduce framework to handle Big Data.	K2
CO3	Outline the different types of recommendation system for handling real time data.	K2
CO4	Elucidate the various algorithms used for mining data streams.	K2
CO5	Illustrate NO SQL database and management in data analysis.	K2

Course Outcome (Lab)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Build an appropriate recommendation system for real time data.	K3
CO2	Experiment with various algorithms for mining data streams.	K3
CO3	Apply spectral clustering algorithm for identifying communities in social media.	K3
CO4	Implement sentimental analysis for real time twitter data.	K3
CO5	Utilize NO SQL database for managing huge volume of data.	K3

c. Course Syllabus

Total : 60 Periods

INTRODUCTION TO BIG DATA

4

Introduction to Big Data : Evolution of Big data - Best Practices for Big data Analytics – Types of Data - Big data characteristics - Validating - The Promotion of the Value of Big Data – Challenges with Big data - Big Data Use Cases- Applications.

HADOOP AND MAPREDUCE FRAMEWORK **5**

A General Overview of High-Performance Architecture – Introducing Hadoop – RDBMS versus Hadoop – Hadoop Overview – HDFS (Hadoop Distributed File System) – Introduction to Map-Reduce and YARN - Map Reduce Programming Model.

RECOMMENDATION SYSTEM **6**

Recommendation System: Collaborative Recommendation – Content Based Recommendation – Knowledge Based Recommendation – Hybrid Recommendation Approaches.

STREAM MEMORY **8**

Introduction to Streams Concepts – Stream Data Model and Architecture – Stream Computing, Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating moments – Counting oneness in a Window – Decaying Window – Real time Analytics Platform(RTAP) applications – Case Studies – Real Time Sentiment Analysis, Stock Market Predictions.

NOSQL DATA MANAGEMENT FOR BIG DATA AND VISUALIZATION **7**

Using Graph Analytics for Big Data: Graph Analytics – NoSQL Databases : Schemaless Models: Increasing Flexibility for Data Manipulation – Key Value Stores – Document Stores – Tabular Stores – Object Data Stores – Graph Databases Hive – Sharding – Hbase.

PRACTICAL EXERCISES **30**

Periods

LIST OF EXPERIMENTS

1. Implement content Based Recommender System using Cosine Similarity.
2. Implement collaborative Based Recommender System using different Similarity measures.
3. Implement Bloom Filter for filter on Stream Data.
4. Implement Flajolet-Martin Algorithm for counting distinct elements in Stream Data.
5. Implement Stock Market Prediction
6. Implement Spectral Clustering.
7. Implement real time sentiment analysis – Tweets.
8. Perform crude operations using NoSQL database.

d. Learning Resources

Text Books

1. Hurwitz JS, Nugent A, Halper F, Kaufman M, *Big data for dummies*, John Wiley & Sons; 2013.
2. Alan Gates & Daniel Dai, *Pig :Data flow Scripting with Hadoop*, O'Reilly Media, 2016.
3. Jason Rutherglen, Dean Wampler, Edward Capriolo, *Programming Hive*, First edition, O'Reilly Media, 2012.

Reference Books

1. Judith Hurwitz, Alan Nugent, Dr. Fern Halper and Marcia Kaufman, *Big Data*, Wiley Publications, 2014.
2. Mark Van Rijmenam, *Think Bigger: Developing a Successful Big Data Strategy for Your Business*, Amazon, First edition, 2014.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, HDD 500 GB, 4 GB RAM)	30
2.	Printer	1
3.	Software: Language preferred: Java/Python	Open Source

Course Code	Course Name	L	T	P	C
VIT334	MACHINE LEARNING ALGORITHMS	2	0	2	3

Category: Professional Elective

a. Preamble

This course enables student to understand the learning methodologies of Machine learning. This course helps to identify appropriate learning algorithms for various types of learning tasks in various domains, clustering, classification and reinforcement.

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Summarize the basics of machine learning techniques.	K2
CO2	Choose an appropriate regression algorithm for the given scenario.	K3
CO3	Select an appropriate classification algorithm for solving real time problems.	K3
CO4	Infer the association algorithms and EM algorithm to solve real world applications.	K3
CO5	Utilize the clustering algorithms to solve the real time applications.	K3

Course Outcome (Lab)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Study the basic Python APIs for implementing machine learning algorithms.	K2
CO2	Implement the regression algorithm to find the correlation between data.	K3
CO3	Apply various classification algorithms to classify the data.	K3
CO4	Interpret the real world problems using association algorithms.	K3
CO5	Utilize an appropriate clustering algorithm to group the data.	K3

c. Course Syllabus

Total : 60 Periods

INTRODUCTION 6

Introduction to Machine Learning: Supervised, Unsupervised, Reinforcement and Semi-supervised learning – Applications – Evaluation metrics.

SUPERVISED LEARNING I 6

Linear regression – Multiple regression – Logistic regression – Support Vector Machines.

SUPERVISED LEARNING II 6

Linear Classification – Probability and Bayes learning – Naïve Bayes – Decision Tree.

UNSUPERVISED LEARNING I 6

Association – Apriori – ID3 – PCY – Market Basket Analysis – Expectation Maximization.

UNSUPERVISED LEARNING II 6

Introduction to Clustering – Partitioned Clustering – Hierarchical Clustering – Birch Algorithm – CURE Algorithm – Density based Clustering.

PRACTICAL EXERCISES 30

Periods

LIST OF EXPERIMENTS

1. Study and usage of python APIs for machine learning.
2. Implementation of Support Vector Machine (Linear and Multivariate).
3. Implementation of Bayesian classifier.
4. Implementation of Decision tree algorithm.
5. Implementation of Apriori algorithm.

6. Implementation of k-means algorithm.
7. Implementation of CURE algorithm.

d. Learning Resources

Text Books

1. Stephen Marsland, *Machine Learning - An Algorithmic Perspective*, 2nd Edition, CRC Press, 2015.
2. Ethem Alpaydin, *Introduction to Machine Learning*, PHI Learning Pvt. Ltd Third Edition, 2020, ISBN: 978-8120350786.
3. Tom Mitchell, *Machine Learning*, McGraw-Hill, First Edition, 2017, ISBN: 978-1259096952.

Reference Books

1. Peter Flach, *Machine Learning: The Art and Science of Algorithms that Make Sense of Data*, First Edition, Cambridge University Press, 2012.
2. Jason Bell, *Machine learning – Hands on for Developers and Technical Professionals*, First Edition, Wiley, 2014.
3. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar *Foundations of Machine Learning*, MIT Press, Second edition, 2018, ISBN 978-0262039406

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, HDD 500 GB, 4 GB RAM)	30
2.	Printer	1
3.	Software: Language: Python	Open Source

Course Code	Course Name	L	T	P	C
VIT335	NATURAL LANGUAGE PROCESSING	3	0	0	3

Category: Professional Elective

a. Preamble

This course enables the students to explore the fundamental concepts of Natural Language Processing. This course enables the students to know the different grammars of language modelling and learn the techniques for word level analysis. This course makes the students to understand the working of syntactic and semantic analysis. This course familiarizes with pragmatic analysis and natural language generation systems. This course enables the students to explore the applications of NLP like machine translation and information retrieval.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Outline the fundamental concepts of Natural Language Processing	K2
CO2	Illustrate the various language models and analyze the natural language	K2
CO3	Apply the syntactic and semantic analysis for the natural language text	K3
CO4	Summarize the resolution techniques for pragmatic analysis	K2
CO5	Demonstrate the machine translation and information retrieval for real-time scenarios.	K2

c. Course Syllabus

Total : 45 Periods

INTRODUCTION 9

Natural language processing – History of NLP – Early NLP Systems – Phases of Natural Language Processing – Evaluation of NLP systems – Origins and Challenges of NLP – Basic English Concepts – Language and Grammar – Processing Indian Languages

LANGUAGE MODELING AND WORD LEVEL ANALYSIS 9

Language Modeling: Various Grammar-based Language Models – Government and Binding Grammar – Lexical Functional Grammar – Paninian Framework – Statistical Language Model – Word Level Analysis: Regular Expressions – Finite-State Automata – Morphological Parsing – Spelling Error Detection and correction – Words and Word classes – Part-of Speech Tagging.

SYNTACTIC AND SEMANTIC ANALYSIS 9

Syntactic Analysis: Context-free Grammar – Constituency – Parsing – Probabilistic Parsing – Semantic Analysis: Meaning Representation – Lexical Semantics – Ambiguity – Word Sense Disambiguation.

PRAGMATIC ANALYSIS 9

Discourse Processing: Cohesion – Reference Resolution – Reference Phenomena – Pronoun Interpretation – Pronoun Resolution Algorithm – Discourse or Text Coherence – Discourse Structure – Dialogue Acts – Types of Interpretation of Dialogue Act.

APPLICATIONS 9

Machine Translation: Problems and Approaches of Machine Translation – Information Retrieval: Design Features of Information Retrieval Systems - Models and Evaluation of IR Systems.

d. Activities

- Quiz
- Case Study

e. Learning Resources

Text Books

1. Ela Kumar, *Natural Language Processing*, I.K International, New Delhi 2011
2. Tanveer Siddiqui, U.S. Tiwary, *Natural Language Processing and Information Retrieval*, Oxford University Press, 2008.
3. Daniel Jurafsky and James H Martin, *Speech and Language Processing: An introduction to Natural Language Processing*, Computational Linguistics and Speech Recognition”, Prentice Hall, 2nd Edition 2008.

Reference Books

1. James Allen, *Natural Language Understanding*, Benjamin /Cummings publishing company 2nd Edition, 1995.
2. Christopher D. Manning and Hinrich Schutze, *Foundations of Statistical Natural Language Processing*, MIT Press, 2003.

Course Code	Course Name	L	T	P	C
VIT336	RECOMMENDER SYSTEMS	3	0	0	3

Category: Professional Core

a. Preamble

This course introduces the leading approaches in recommender systems. This course enables the students to develop state-of-the-art recommender systems that automate a variety of choice-making strategies with the goal of providing affordable, personal, and high-quality recommendations.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Review the basic mathematical backgrounds, techniques and issues in the field of recommender systems	K2
CO2	Identify the various approaches in developing collaborative filtering recommender system	K2
CO3	Paraphrase the various methods used in content-based recommender system	K2
CO4	Outline the various approaches used in knowledge-based and hybrid recommender system	K2
CO5	Summarize the different metrics used to evaluate the recommender systems	K2

c. Course Syllabus

Total : 45 Periods

INTRODUCTION 9

Recommender System Functions – Linear Algebra Notation: Matrix Addition – Multiplication – Transposition – Inverses – Covariance Matrices – Understanding ratings – Applications of Recommendation Systems – Issues with Recommender System.

COLLABORATIVE FILTERING 9

User-based Nearest Neighbour Recommendation – Item- based Nearest Neighbour Recommendation – Ratings – Model-based and pre-processing based approaches – Applications.

CONTENT-BASED RECOMMENDATION 9

High-Level Architecture of Content-based Systems – Advantages and Drawbacks of Content-based Filtering – Item Profiles, Discovering Features of Documents – Obtaining Item Features from Tags – Representing Item Profiles – Methods for Learning User Profiles – Similarity Based Retrieval – Classification Algorithms.

KNOWLEDGE-BASED AND HYBRID RECOMMENDATION 9

Knowledge Based Recommendation: Knowledge Representation and Reasoning – Constraint-based Recommenders – Case-based Recommenders – Hybrid Approaches: Opportunities for hybridization – Monolithic Hybridization Design: Feature Combination – Feature Augmentation – Parallelized Hybridization Design: Weighted – Switching – Mixed

– Pipelined Hybridization Design: Cascade – Meta-level – Limitations of Hybridization Strategies.

EVALUATING RECOMMENDER SYSTEM

9

Introduction – General Properties of Evaluation Research – Evaluation Designs – Evaluation on Historical Datasets – Error Metrics – Decision-Support Metrics – User-Centered Metrics.

d. Activities

- Quiz
- Problem Solving
- Chart Preparation
- Case Study

e. Learning Resources

Text Book

1. Jannach D, Zanker M and FelFering A, *Recommender Systems: An Introduction*, Cambridge University Press, 1st Edition, 2011.

Reference Books

1. Ricci F, Rokach L, Shapira D and Kantor B.P, *Recommender Systems Handbook*, Springer, 1st Edition, 2011.
2. Manouselis N, Drachsler H, Verbert K and Duval E, *Recommender Systems for Learning*, Springer, 1st Edition, 2013.

Course Code	Course Name	L	T	P	C
VIT337	DATA VISUALIZATION TECHNIQUES	2	0	2	3

Category: Professional Elective

a. Preamble

This course has been designed to introduce students to the concepts and techniques of data visualization particularly the Tableau interface, charts and graphs, visual design building blocks, dashboards, etc. Students will learn data visualization tools that provide an accessible way to see

and understand trends, outliers, and patterns in data by using visual elements like charts, graphs, and maps. To analyze massive amounts of information and make data-driven decisions, data visualization techniques are considered to be an essential skill.

b. Course Outcome (Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Summarize the fundamental concepts of visual perception and core skills for visual analysis.	K2
CO2	Utilize the tools and techniques to translate the meaning of data into comprehensible visual or experiential content.	K3
CO3	Recognize visual design principles to simple and complex models that tell the stories found in data.	K2
CO4	Summarize the approaches used for visualization and present information from a scientific-centered perspective.	K2
CO5	Illustrate the concept of visualization interaction techniques.	K2

Course Outcome (Lab)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Implement the techniques to visualize continuous and categorical valued data.	K3
CO2	Implement the techniques to visualize spatial data.	K3
CO3	Develop programs to visualize text data.	K3
CO4	Apply the techniques to visualize 2D scalar and vector data.	K3
CO5	Create an Interactive Dashboard and animating transformation.	K3

c. Course Syllabus

Total : 60 Periods

INTRODUCTION

6

What is Visualization – The Visualization Process – Data Foundations – Types of Data – Continuous Data – Sampled Data – Discrete Datasets – Human Perception and Information Processing – Visualization Foundations.

SPATIAL DATA VISUALIZATION

6

Visualization techniques for 1D, 2D and 3D data – Dynamic Data – Geospatial Data – Visualizing Point – Line and Area Data – Visualization Techniques for Multivariate Data – Visualization Pipeline.

DATA VISUALIZATION METRICS

6

Visualization Techniques Graphs – Text and Document: Visualizing Trees, Graphs, and Networks – Displaying Hierarchical Structures – Arbitrary Graphs/Network – Levels of Text Representation – The Vector Space Model – Single Document Visualization – Document Collection Visualization.

SCIENTIFIC DATA VISUALIZATION

6

Scalar, Vector, Tensor Visualization – Domain Modeling Technique – Image and Volume Visualization.

INTERACTION CONCEPTS

6

Interaction Operators, Operands and Spaces, Interaction Techniques – Screen Space/Object Space, Data Space, Attribute Space – Animating Transformations – Designing Effective Visualizations Comparing and Evaluating Visualization Techniques – Visualization Systems.

PRACTICAL EXERCISES

30 Periods

LIST OF EXPERIMENTS

1. Working with Continuous and Categorical Data.
2. Visualize the Geospatial Data.
3. Sorting & Filtering Data.
4. Visualize Text Data
5. Create Custom Charts.
6. Visualize 2D Scalar and Vector Data.
7. Create and Publish Interactive Dashboards.
8. Animate Histograms.

d. Learning Resources

Text Books

1. Matthew O. Ward, Georges Grinstein, Daniel Keim, *Interactive Data Visualization: Foundations, Techniques, and Applications*, CRC Press, 2nd Edition 2015.
2. Nathan Yau, *Data Points: Visualization that Means Something*, Wiley, 2013.

Reference Books

1. Tamara Munzner, *Visualization Analysis and Design*, AK Peters Visualization Series, CRC Press, 2014.
2. Mathew Ward, Georges Grinstein, Daniel Keim, *Interactive Data Visualization Foundation, Techniques and Applications*, A K Peters, 2010.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, HDD 500 GB, 4 GB RAM)	30

2.	Printer	1
3.	Software: Language: Python / R Programming	Open Source

Course Code	Course Name	L	T	P	C
MBD001	MANAGEMENT INFORMATION SYSTEM	3	0	0	3

Category: Open Elective (Minor Degree)

a. Preamble

This course enables the students to impart the fundamentals of Management Information System. This course helps the students to know the various Management Information Systems and to review the role played by MIS in business environment. Introduce the core activities in the systems development process. This course expose MIS subsystems and technologies including software, hardware and networking and also to know about the security issues and control mechanism. This course improves the knowledge of emerging trends of Management Information Systems

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Summarize the basics of management information system.	K2
CO2	Show different ways to manage data in business environment.	K2
CO3	Outline various information systems for business.	K2
CO4	Interpret the issues related to ethical, social, and security in information systems and formulate controlling mechanisms.	K2
CO5	Summarize the recent trends in information system management.	K2

c. Course Syllabus

Total : 45 Periods

INTRODUCTION TO MIS 9

Introduction – Need for MIS and IT nature and scope of MIS – MIS characteristics – Structure of MIS – Role of MIS in global business – Challenges of Managing MIS.

DATA RESOURCE MANAGEMENT 9

System Development Life Cycle, Security System Life Cycle, Systems Analysis and System Design, Tools – Data Flow Diagram – Entity Relationship – Object Modelling, Database Management System – Relational Database Management System – Object Oriented Database Management System.

INFORMATION SYSTEM 9

Financial, Marketing, Personnel, Production, Materials Information System – Decision Support System – Executive Information System – Knowledge Management System – Geographical Information System – International Information System.

SECURITY AND CONTROL**9**

Security, Testing – Error detection – Controls – Information System Vulnerability – Computer Crimes – Securing the Web – Intranets and Wireless Networks – Software Audit – Ethics in IT.

NEW IT INITIATIVES**9**

e-business – e-government – Enterprise Resource Planning – Supply Chain Management – e-CRM – Data warehousing and Data Mining – Business Intelligence – Pervasive Computing – CMM.

d. Learning Resources**Text Books**

1. Robert Schultheis and Mary Summer, *Management Information Systems – The Managers View*, Tata McGrawHill, 2008.
2. Kenneth C. Laudon and Jane Price Laudon, *Management Informations Systems – Managing the digital firm*, (12th ed.) PHI Learning/Pearson Education, PHU, Asia, 2008.

Reference Books

1. Gordon Davis, *Management Information System: Conceptual Foundations, Structure and Development*, Tata McGraw Hill, 2000.
2. Haag, Cummings and McCubbrey, *Management Information Systems for the Information Age*, McGraw Hill, 2005.
3. Raymond McLeod and Jr. George P. Schell, *Management Information Systems*, Pearson Education, 2007.
4. James O Brien, *Management Information Systems – Managing Information Technology in the E-Business enterprise*, (4th ed.) Tata McGraw Hill, 2010
5. Corey Schou and Dan Shoemaker, *Information Assurance for the Enterprise – A Roadmap to Information Security*, Tata McGraw Hill, 2007.
6. Frederick Gallegor, Sandra Senft, Daniel P. Manson and Carol Gonzales, *Information Technology Control and Audit*, Auerbach Publications, 2007.

Course Code	Course Name	L	T	P	C
MBD002	INTRODUCTION TO BUSINESS ANALYTICS	3	0	0	3

Category: Open Elective (Minor Degree)

a. Preamble

This course imparts the importance of business analytics in the organizations. This course enables the students to know about the statistical and data mining techniques and understand relationships between the underlying business processes of an organization. Manage business processes using analytical and management tools. Use analytics in customer requirement analysis, general management, marketing, finance, operations and supply chain management. Analyse and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Outline the various business analytics methods in a business.	K2
CO2	Demonstrate hands-on skills in applying business analytics to real-world marketing functions.	K2
CO3	Relate the analytics tools to perform financial analysis.	K2
CO4	Interpret the importance of operations and supply chain analytics for business.	K2
CO5	Show the need of information technology to enhance the efficiency and effectiveness of human resource functions within the organization	K2

c. Course Syllabus

Total : 45 Periods

INTRODUCTION TO BUSINESS ANALYTICS 9

Journey of Information System – Business Analytics: Definition, Scope and applications of analytics: Marketing, finance, HR and operations – Types of analytics: Descriptive, Diagnostics, Discovery, Predictive and Prescriptive analytics – Data visualization.

MARKETING INTELLIGENCE 9

Advertising and Promotion Analytics – Pricing Analytics: Point-of-sale Data, Estimating Demand Curves and Optimize Price, Price Bundling – Social Network Analysis – Retail Analytics: Customer Analytics / Supply Chain Analytics, Conjoint Analysis. Text Analytics, Click Analytics Customer Segmentation Analytics, Customer Churn and Loyalty Analytics Use of Social Media in Advertising and Marketing. Use of Big Data in Analytics.

FINANCIAL ANALYTICS 9

Predictive Analytics / Trading, Sentiment Analysis, Financial Fraud, Credit Ratings, Pricing – Know Your Customer Records & Information management for financial analysis: financial

decision, process, terminology, governance, analytics, long term digital preservation – Applications of visual analytics in financial decision making: financial decision process, experimental methodology, visual analytics for financial decision making, decision process, role of visual analytics – Budgeting and Planning – Revenue Assurance and Leakage.

OPERATIONS ANALYTICS 9

Warehousing Decisions – Inventory Aggregation Models – Transshipment and Transportation Problems – Scheduling Algorithms: Deficit function Approach and Linking Algorithms – Risk Analysis in Supply Chain – Market Basket Analytics – Prediction of Demand and Forecasting Demand and Supply.

HUMAN RESOURCE ANALYTICS 9

Creating business understanding for HR initiatives: Workforce segmentation and search for critical job roles – Identifying and using key HR Metrics – Forecasting budget numbers for HR costs: Workforce planning including internal mobility and career path; training and development requirement – Predictive modeling in HR: Employee retention and turnover.

d. Learning Resources

Text Books

1. Camm, Cochran and et.al, *Essentials of Business Analytics*, Cengage Learning, 2015.
2. Evans James. R, *Business Analytics*, Pearson, 2015.

Reference Book

1. Dietrich Brenda L et.all, *Analytics across the enterprise*, Pearson, 2014

Course Code	Course Name	L	T	P	C
MBD003	BIG DATA ANALYTICS FOR BUSINESS	3	0	0	3

Category: Open Elective (Minor Degree)

a. Preamble

This course enables the students to understand the basic concepts of big data analytics. This course familiarizes the data warehouse concepts for storing and managing data. This course makes the students to relate the data mining for business analysis. This course helps to know the Hadoop and MapReduce framework for handling big data. This course disseminates various case studies for big data analytics in business.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Summarize the basic concepts of big data analytics	K2
CO2	Outline the need of data warehouse to store and process big data	K2
CO3	Relate the data mining concepts for business analysis	K2
CO4	Demonstrate Hadoop and MapReduce framework to handle big data	K2
CO5	Utilize big data analytics for managing big data in real-time business applications	K3

c. Course Syllabus

Total : 45 Periods

INTRODUCTION TO BIG DATA

9

Introduction to Big data – Evolution of Big data – Types of Data – Big data characteristics – Best Practices for Big data Analytics – Types of Big data Analytics – Validating – The Promotion of the Value of Big Data – Challenges with Big data – Big Data Use Cases – Applications.

DATA WAREHOUSING

9

Basic Concepts – Data Warehousing Components – Building a Data Warehouse – Database Architectures for Parallel Processing – Multidimensional Data Model – Data Warehouse Schemas for Decision Support Concept Hierarchies – Characteristics of OLAP Systems – OLAP Operations – OLAP and OLTP.

DATA MINING

9

Introduction to Data Mining Systems – Knowledge Discovery Process – Data Mining Techniques – Issues – Applications – Data Objects and Attribute Types – Statistical Description of Data – Data Pre-processing: Cleaning, Integration, Reduction,

Transformation and discretization – Data Visualization – Data similarity and dissimilarity measures.

HADOOP AND MAPREDUCE FRAMEWORK 9

A General Overview of High-Performance Architecture – Introducing Hadoop – RDBMS versus Hadoop – Hadoop Overview – HDFS (Hadoop Distributed File System) – Introduction to MapReduce and YARN – MapReduce Programming Model.

CASE STUDIES 9

Charles Book Club – German Credit – Takyo Software Cataloger – Segmenting Customer of Bath Soap – Catalog Cross Selling – Forecasting Public Transport Demand

d. Activities

- Quiz
- Crossword puzzle
- Chart Preparation

e. Learning Resources

Text Books

1. Jiawei Han, Micheline Kamber, *Data Mining Concepts and Techniques*, 3rd Edition, Elsevier, 2012.
2. Hurwitz JS, Nugent A, Halper F, Kaufman M, *Big data for dummies*, John Wiley & Sons, 2013.
3. Galit Shmueli, Nitin R. Patel, Peter C. Bruce, *Data Mining For Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner*, 2nd Edition, Wiley, 2010.

Reference Books

1. Alex Berson, Stephen J.Smith, *Data Warehousing, Data Mining and OLAP*, Tata McGraw-Hill Edition, 2008.
2. Tom White, *Hadoop: The Definitive Guide*, O’Reilly Publications, 2011.
3. Mark Van Rijmenam, *Think Bigger: Developing a Successful Big Data Strategy for Your Business*, Amazon, First edition, 2014.

Course Code	Course Name	L	T	P	C
MBD004	MACHINE LEARNING FOR BUSINESS ANALYTICS	3	0	0	3

Category: Open Elective (Minor Degree)**a. Preamble**

This course enables student to understand the different types of Machine learning. This course helps to identify appropriate learning algorithms to find solutions for the various types of business problems.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Summarize the fundamental concepts of machine learning	K2
CO2	Select an appropriate supervised learning algorithm for solving real-time problems	K3
CO3	Utilize the unsupervised and unsupervised learning algorithms to solve the real time applications	K3
CO4	Choose an appropriate probabilistic based learning algorithm to train the system	K3
CO5	Apply the machine learning techniques for the real-time business problems	K3

c. Course Syllabus**Total : 45 Periods****INTRODUCTION AND MATHEMATICAL FOUNDATIONS 9**

Introduction to Machine Learning: Definition – Need – History – Definitions – Applications – Advantages – Disadvantages – Challenges – Types of Machine Learning Problems – Mathematical Foundations: Linear Algebra & Analytical Geometry – Probability and Statistics – Bayesian Conditional Probability – Vector Calculus & Optimization – Decision Theory – Information theory

SUPERVISED LEARNING 9

Introduction – Discriminative and Generative Models – Regression: Linear Regression – Least Squares – Under-fitting / Overfitting – Cross-Validation – Lasso Regression – Classification: Support Vector Machines – K-Nearest Neighbours – Decision Trees – Ensemble Methods – Random Forest – Evaluation of Classification Algorithms

UNSUPERVISED AND REINFORCEMENT LEARNING 9

Clustering: Introduction – K-Means – Hierarchical Clustering – Cluster Validity – Dimensionality Reduction – Principal Component Analysis – EM algorithm. Reinforcement Learning: Elements – Model based Learning – Temporal Difference Learning

PROBABLISTIC METHODS FOR LEARNING 9

Introduction – Naïve Bayes Algorithm – Maximum Likelihood -Maximum Apriori – Bayesian Belief Networks – Probabilistic Modelling of Problems – Inference in Bayesian Belief Networks – Probability Density Estimation – Sequence Models – Markov Models – Hidden Markov Models

CASE STUDIES 9

Sentimental Analysis of Product Reviews – Sales Forecasting – Stock Prediction – Fake News Detection – Sports Prediction

d. Activities

- Quiz
- Crossword puzzle
- Problem Solving
- Case Studies

e. Learning Resources

Text Books

1. Stephen Marsland, *Machine Learning: An Algorithmic Perspective*, Chapman & Hall/CRC, 2nd Edition, 2014.
2. Kevin Murphy, *Machine Learning: A Probabilistic Perspective*, MIT Press, 2012.
3. Tom M Mitchell, *Machine Learning*, McGraw Hill Education, 2013.

Reference Books

1. Ethem Alpaydin, *Introduction to Machine Learning*, Third Edition, Adaptive Computation and Machine Learning Series, MIT Press, 2014.
2. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems*, 2nd Edition, O'Reilly, 2017.

Course Code	Course Name	L	T	P	C
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MBD005	DATA VISUALIZATION FOR BUSINESS ANALYTICS	3	0	0	3
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Category: Open Elective (Minor Degree)

a. Preamble

This course is all about data visualization, the art and science of turning data into readable graphics. This course explores how to design and create data visualizations based on data available. This process includes data modeling, data processing, mapping data attributes to graphical attributes and strategic visual encoding based on known properties of visual perception. Students will also learn to evaluate the effectiveness of visualization designs, such as choice of color and choice of visual encoding.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Outline the importance of visualization and steps involved in human perception.	K2
CO2	Demonstrate the visualization Techniques for spatial and Time oriented data.	K2
CO3	Illustrate the techniques to visualize time-oriented, multivariate and hierarchical data.	K2
CO4	Summarize the concepts of document visualization and Interaction design approaches.	K2
CO5	Infer the techniques for effective visualization and evaluation	K2

c. Course Syllabus

Total : 45 Periods

BASICS OF VISUALIZATION

9

Introduction: Visualization – History – Relationship with Other Fields – Visualization Process – Scatterplot – Role of the User – Data Foundation: Types of Data – Structure within and between Records – Data Preprocessing – Human Perception and Information Processing: Perception – Physiology – Perceptual Processing – Perception in Visualization – Metrics.

SPATIAL AND GEOSPATIAL DATA

9

Visualization Foundations: Visualization Process – Semiology of Graphical Symbols – Eight Visual Variables Historical Perspective – Taxonomies – Spatial Data: One-Dimensional Data – Two-Dimensional Data – Three-Dimensional Data – Dynamic Data Combining

Techniques – Geospatial Data: Visualizing Spatial Data, Visualization of Point Data – Visualization of Line Data – Visualization of Area Data – Other Issues in Geospatial Data Visualization.

TIME-ORIENTED, MULTIVARIATE AND HIERARCHICAL DATA 9

Time-Oriented Data: Definitions – Characterizing – Visualizing – Time Bench – Data Model and Software Library for Visual Analytics – Multivariate Data Techniques: Point-Based – Line-Based – Region-Based – Combinations of Techniques – Hierarchical Data: Displaying Hierarchical Structures – Displaying Arbitrary Graphs/Networks.

DOCUMENT VISUALIZATION AND INTERACTION 9

Document Visualization: Levels of Text Representations – Vector Space Model – Single Document Visualizations – Document Collection Visualizations – Extended Text Visualizations – Interaction Concepts: Interaction Operators – Interaction Operands and Spaces – Unified Framework – Interaction Techniques: Screen Space – Object Space – Data Space – Attribute Space – Data Structure Space – Visualization Structure Space.

EFFECTIVE VISUALIZATION AND EVALUATION 9

Designing Effective Visualizations: Steps in Designing Visualizations – Problems in Designing Effective Visualizations – Evaluating Visualization Techniques: User Tasks – Characteristics – User, Data, Visualization – Structures for Evaluating Visualizations – Benchmarking Procedures – Visualization Systems: Systems Based on Data Type – Systems Based on Analysis Type – Text Analysis and Visualization.

d. Activities

- Quiz
- Case Study

e. Learning Resources

Text Book

1. Matthew O. Ward, Georges Grinstein, Daniel Keim, *Interactive Data Visualization: Foundations, Techniques, and Applications*, CRC Press, 2nd Edition 2015.

Reference Books

1. Andy Krik, *Data Visualization: a successful design process*, 1st Edition, Sage Publication, 2016
2. J. Koponen, J. Hilden, *Data Visualization Handbook*, Springer CRC Press, 2019

Course Code	Course Name	L	T	P	C
MBD006	MARKETING ANALYTICS	3	0	0	3

Category: Open Elective (Minor Degree)

a. Preamble

This course provides a strong foundation in marketing analytics in order to handle diversified marketing data, build advanced analytical models and deliver effective visualization product and comprehensive reports.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Summarize the basic concepts of marketing.	K2
CO2	Interpret various pricing strategies to maximize the profit.	K2
CO3	Infer the result of sales forecasting for making decisions related to business.	K2
CO4	Demonstrate the importance of ranking product attributes and methods to measures the customer values.	K2
CO5	Outline the factors influences the product sale and the model to measure the effectiveness of the advertisement.	K2

c. Course Syllabus

Total : 45 Periods

INTRODUCTION TO MARKETING ANALYTICS 9

Introduction: Meaning, characteristics, advantages and disadvantages of marketing analytics, Market Data Sources (Primary and Secondary). Market Sizing: Stakeholders, Applications & Approaches (Top-down and Bottom-up), PESTLE Market Analysis, Porter Five Force Analysis.

PRICING ANALYTICS 9

Estimating Demand Curves and Using Solver to Optimizer Price – Price Bundling – Nonlinear Pricing – Price Skimming and Sales – Revenue Management Forecasting.

SALES FORECASTING 9

Simple Linear Regression and Correlation – Using Multiple Regression to Forecast Sales – Forecasting in the Presence of Special Events – Modelling Trend and Seasonality – Ratio to Moving Average Forecasting Method – Winter’s Method – Using Neural Networks to Forecasting Sales.

CUSTOMER ANALYTICS

9

Conjoint Analysis – Logistics Regression – Discrete Choice Analysis – Calculating Lifetime Customer Value – Using Customer Value to Value a Business – Customer Value, Monte Carlo Simulation, and Marketing Decision Making – Allocating Marketing Resources between Customer Acquisition and Retention.

RETAILING & ADVERTISING ANALYSIS

9

Retailing: Market Basket Analysis and Lift – RFM Analysis and Optimizing Direct Mail Campaigns – Using the SCAN*PRO Model and Its Variants – Allocating Retail Space and Sales Resources – Forecasting Sales from Few Data Points.

Advertising: Measuring the Effectiveness of Advertising – Media Selection Models – Pay Per Click (PPC) Online Advertising.

d. Learning Resources

Text Book

1. Wayne L. Winston, *Marketing Analytics - Data-Driven Techniques with Microsoft Excel*, Wiley, 2014.

Reference Books

1. Christina J. Inge, *Marketing Analytics: A Comprehensive Guide v1.0*, Kindle Edition, 2022.
2. Joseph Hair, Dana E. Harrison and Haya Ajjan, *Essentials of Marketing Analytics*, 1st Edition, McGraw Hill eBook, 2022.

Course Code	Course Name	L	T	P	C
MBD007	HUMAN RESOURCE ANALYTICS	3	0	0	3

Category: Open Elective (Minor Degree)

a. Preamble

This course is to acquaint the students with the concepts and significance of HR analytics, the tools, methods, approaches and techniques of HR analytics. It helps the students to understand the application of analytics in various HR sub-systems. This course makes the students to learn about the recent trends in HR analytics and the future challenges.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Outline the basic concepts of HR analytics.	K2
CO2	Illustrate the concepts of human resource information system for HR analytics.	K2
CO3	Interpret the data for HR analytics.	K2
CO4	Identify the application and use of HR analytics in various HR sub-systems.	K2
CO5	Summarize the current trends and challenges faced in HR analytics.	K2

c. Course Syllabus

Total : 45 Periods

BASICS OF HR ANALYTICS 9

Introduction – Evolution – Role of Analytics – Analytical Capabilities – Analytic Value Chain - Analytical Model – Typical Application of HR analytics – Significance and concept of HR Analytics - HR Analytics and Business Linkages - Prerequisites of HR Analytics - Models and Frameworks of HR Analytics - Measuring Intellectual Capital – Need and Rationale for HR Accounting & Audit.

HUMAN RESOURCE INFORMATION SYSTEM FOR HR ANALYTICS 9

Introduction to Human Resource Information System (HIRS) – Role of HRIS in Analytics - HRIS Development and Implementation – Development Process - Need Analysis - Systems Design – Structure and Culture – HRIS Applications – Making HRIS Work.

DATA DRIVEN HUMAN RESOURCE ANALYTICS 9

Data Driven HR – Evolution of Intelligent HR – Capitalizing on the Data Explosion – Data Driven HR Tools – Data Privacy, Transparency and Security.

ANALYTICS FOR HR SYSTEM AND SUB-SYSTEMS 9

HR Performance Frameworks and Measurement Systems – HR Maturity Framework: From level 1 to level 5 – HR Analytics Frameworks: LAMP framework, HCM:21 Framework, and Talentship Framework – Five Overarching Components of an Effective Analytics Framework – HR Scorecard – Data Driven: Recruitment, Employee Management, Learning and Development, Performance Management.

RECENT TRENDS AND FUTURE CHALLENGES 9

Technology and Changes in HR Analytics – Role of Social Media – Big Data and Predictive Analytics in HR – Assessing the Effectiveness of HR Analytics - Post Analysis Steps – Review and Monitoring – Issues in HR Valuation and Measurement – Emerging Challenges: Global and Indian Experience.

d. Learning Resources

Text Book

1. Bernard Marr, *Data-Driven HR: How to Use Analytics and Metrics to Drive Performance*, Kindle Edition, 2018.

Reference Books

1. Jac Fitz-enz, John R. Mattox, *Predictive analytics for Human Resources*, Wiley, 2014.
2. Becker, B. E., Huselid, M. A., & Ulrich, D, *The HR scorecard: Linking people, strategy, and performance*, Harvard Business Press, 2010.
3. Laurie Bassi and Rob Carpenter, *HR Analytics Handbook*, Kindle Edition, 2012.
4. Fitz-enz, J., & Mattox, J, *Predictive Analytics for Human Resources*, Wiley, 2014.
5. Phillips, J., & Phillips, P.P, *Making Human Capital Analytics Work: Measuring the ROI of Human Capital Processes and Outcomes*, McGraw-Hill, 2014.
6. Director, S, *Financial Analysis for HR Managers: Tools for Linking HR Strategy to Business Strategy*, Pearson FT Press 6, 2014.