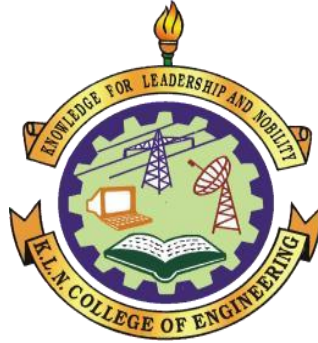


K.L.N COLLEGE OF ENGINEERING

Pottapalayam–630612, Sivagangai District

(An Autonomous Institution, Affiliated to Anna University, Chennai)



Estd:1994

THIRD YEAR

CURRICULUM & SYLLABUS

REGULATIONS 2024

For Under Graduate Program

B.TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

CHOICE BASED CREDIT SYSTEM

(For the students admitted from the academic year 2024-2025 onwards)

Dr.S.Suresh Raja,
Professor & Head,
Department of AIDS,
K.L.N. College of Engineering,
Pottapalayam, Sivaganga – 630612



K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM
(An Autonomous Institution, Affiliated to Anna University, Chennai)



VISION OF THE INSTITUTION

- To become a Centre of Excellence in Technical Education and Research in producing Competent and Ethical professionals to the society.

MISSION OF THE INSTITUTION

- To impart Value and Need based curriculum to the students with enriched skill development in the field of Engineering, Technology, Management and Entrepreneurship and to nurture their character with social concern and to pursue their career in the areas of Research and Industry.

VISION OF THE DEPARTMENT

- To become a centre of Excellence in producing competent and futuristic professionals in Artificial Intelligence and Data Science through quality Education and Research to the Society and Industry.

MISSION OF THE DEPARTMENT

- To produce intellectual, innovative and ethical professionals by imparting technical and industry oriented skills with ethical values in Artificial Intelligence and allied areas to pursue their career in Industry and Research.



K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM
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PROGRAM SPECIFIC OUTCOMES (PSOs)

- PSO 1:** Ability to apply major key algorithms, techniques and theoretical findings in the field of Artificial Intelligence, Machine Learning and Deep Learning.
- PSO 2:** Ability to incorporate data science theories and methodologies into new research in data management, data visualization, and statistical analysis of data.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

- PEO 1:** To excel in professional career and pursue higher education in the field of artificial intelligence and data science.
- PEO 2:** To apply their knowledge and skills to develop innovative solutions for real world problem through lifelong learning.
- PEO 3:** To excel as socially committed engineers or entrepreneurs with good communication and team work skills with high regard to ethical and moral values.



K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM
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Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re- use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes

Program Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7)

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Teamwork: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)



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REGULATIONS2024

For Under Graduate Program

B. TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

CHOICE BASED CREDIT SYSTEM

CATEGORYOFCOURSES

- i. **Humanities and Social Sciences(HS)Courses** include Technical English, Environmental Science and Engineering ,Engineering Ethics and human values, Communication Skills and Management courses.
- ii. **Basic Sciences(BS)Courses** include Mathematics, Physics, and Chemistry.
- iii. **Engineering Sciences (ES) Courses** include Engineering Practices, Engineering Graphics, Basics of Electrical / Electronics / Mechanical / Computer Engineering /Instrumentation etc.
- iv. **Professional Core (PC) Courses** include the core courses relevant to the chosen programme of study.
- v. **Professional Elective (PE) Courses** include the elective courses relevant to the chosen programme of study.
- vi. **Open Elective(OE) Courses** include courses from other departments which a student can choose from the list specified in the curriculum of the students B.E. /B.Tech. Programmes.
- vii. **Employability Enhancement Courses (EEC)**include Project Work and/or Internship, Seminar, Professional Practices, Case Study and Industrial/Practical Training.
- viii. **Mandatory Courses (MC)** include Personality and Character development and the courses recommended by the regulatory bodies such as AICTE, UGC, etc

SEMESTER V

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	24AD501	Machine Learning Techniques	PC	3	3	0	0	3
2	24AD502	Big Data Analytics	PC	3	3	0	0	3
3	24AD503	Artificial Intelligence for Robotics	PC	3	3	0	0	3
4	24CI502	Internet of Things (Common to B.E CSE, B.Tech IT, AI&DS)	PC	3	3	0	0	3
5		Professional Elective I	PE	3	3	0	0	3
6		Professional Elective II	PE	3	3	0	0	3
PRACTICAL								
7	24AD5L1	Machine Learning Techniques Laboratory	PC	3	0	0	3	1.5
8	24CI5L2	Internet of Things Laboratory (Common to B.E CSE, B.Tech IT, AI&DS)	PC	3	0	0	3	1.5
9	24AD5L2	Micro Project	EEC	2	0	0	2	1
10	24HS5L1	Programming Skill- I (Common to B.E. ECE,EEE,CSE, CSE(CS),CSE(IoT) and B.Tech IT & AIDS programmes)	HS	2	0	0	2	1*
TOTAL				29	19	0	10	22
For Honours Degree								
1		Capstone Design Project – Level I	EEC	12	0	0	12	6
OR								
1		Honours Elective – I		3	3	0	0	3
2		Honours Elective – II		3	3	0	0	3
For Minor Degree								
1		Minor Elective – I		3	3	0	0	3
2		Minor Elective – II		3	3	0	0	3

***The grades earned by the students will be recorded in the mark sheet, however the same shall not be considered for the computation of CGPA**

SEMESTER VI

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	24AD601	Deep Learning	PC	3	3	0	0	3
2	24AD602	Natural Language Processing	PC	3	3	0	0	3
3		Professional Elective III	PE	3	3	0	0	3
4		Professional Elective IV	PE	3	3	0	0	3
5		Open Elective	OE	3	3	0	0	3
6	24MC601	Disaster Management (Common to all B.E./B.Tech programmes)	MC	2	2	0	0	0
7	24CS603	Standards in Computer Science Engineering (Common to B.E.CSE, CSE(CS),CSE(IoT), B.Tech. AI&DS)	PC	1	1	0	0	1
THEORY CUM PRACTICAL								
8	24IT602	Cloud Computing Techniques (Common to B.Tech IT, AI&DS)	PC	5	3	0	2	4
PRACTICAL								
9	24AD6L1	Deep Learning Laboratory	PC	3	0	0	3	1.5
10	24AD6L2	Natural Language Processing Laboratory	PC	3	0	0	3	1.5
11	24HS6L1	Programming Skill –II (Common to B.E. ECE,EEE,CSE, CSE(CS),CSE(IoT) and B.Tech IT & AIDS programmes)	HS	2	0	0	2	1*
TOTAL				31	21	0	10	23
For Honours Degree								
1		Capstone Design Project – Level II	EEC	12	0	0	12	6
OR								
1		Honours Elective – III		3	3	0	0	3
2		Honours Elective – IV		3	3	0	0	3
For Minor Degree								
1		Minor Elective – III		3	3	0	0	3
2		Minor Elective – IV		3	3	0	0	3

*The grades earned by the students will be recorded in the mark sheet, however the same shall not be considered for the computation of CGPA

mandatory Summer internship (2 weeks – 1 credit)

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical- I	Vertical- II	Vertical-III	Vertical-IV	Vertical-V
Cloud Computing and Data Center Technologies	Creative Media	Intelligent Computing	Security and Privacy	Innovative Computing Technologies
Storage Technologies	Image processing and computer vision	Generative AI	Security and Privacy in Cloud	Augmented Reality and Virtual Reality
Data Warehousing and Data Mining	Digital Content and Communication	Multiagent Systems	Web Application Security	AI in IOT
Software Defined Networks	UI and UX design	Robotic Process Automation	Engineering Secure Software Systems	Industrial IOT and Industry 4.0
Virtualization	Digital Marketing	Ethics and AI	Quantum Computing	App Development
Cloud Computing	Visual Effects	Reinforcement Learning	Social Media Security	Wearable computing
Cloud Service Management	Game Design and Development	Explainable AI	Authentication Techniques	Drone Technologies

PROFESSIONAL ELECTIVES**Vertical 1: Cloud Computing and Data Center Technologies**

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	24CSV11	Storage Technologies	PE	3	3	0	0	3
2	24CSV21	Data Warehousing and Data Mining	PE	3	3	0	0	3
3	24CSV31	Software Defined Networks	PE	3	3	0	0	3
4	24CSV41	Virtualization	PE	4	2	0	2	3
5	24CSV51	Cloud Computing	PE	3	3	0	0	3
6	24CSV61	Cloud Service Management	PE	3	3	0	0	3

Vertical 2: Creative Media

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	24ITV12	Image processing and computer vision	PE	3	3	0	0	3
2	24ITV22	Digital Content and Communication	PE	4	2	0	2	3
3	24ITV32	UI and UX design	PE	4	2	0	2	3
4	24ITV42	Digital Marketing	PE	3	3	0	0	3
5	24ITV52	Visual Effects	PE	4	2	0	2	3
6	24ITV62	Game Design and Development	PE	4	2	0	2	3

Vertical 3: Intelligent Computing

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	24ADV13	Generative AI	PE	3	3	0	0	3
2	24ADV23	Multiagent Systems	PE	3	3	0	0	3
3	24ADV33	Robotic Process Automation	PE	4	2	0	2	3
4	24ADV43	Ethics and AI	PE	3	3	0	0	3
5	24ADV53	Reinforcement Learning	PE	3	3	0	0	3
6	24ADV63	Explainable AI	PE	3	3	0	0	3

Vertical 4: Security and Privacy

SI. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	24SCV14	Security and Privacy in Cloud	PE	3	3	0	0	3
2	24SCV24	Web Application Security	PE	3	3	0	0	3
3	24SCV34	Engineering Secure Software Systems	PE	3	3	0	0	3
4	24SCV44	Quantum Computing	PE	3	3	0	0	3
5	24SCV54	Social Media Security	PE	3	3	0	0	3
6	24SCV64	Authentication Techniques	PE	3	3	0	0	3

Vertical 5: Innovative Computing Technologies

SI. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	24CIV15	Augmented Reality and Virtual Reality	PE	3	3	0	0	3
2	24CIV25	AI in IOT	PE	3	3	0	0	3
3	24CIV35	Industrial IOT and Industry 4.0	PE	3	3	0	0	3
4	24CIV45	App Development	PE	4	2	0	2	3
5	24CIV55	Wearable computing	PE	3	3	0	0	3
6	24CIV65	Drone Technologies	PE	3	3	0	0	3

OPEN ELECTIVE

SI. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	24OE401	Introduction to Operating Systems	OE	3	3	0	0	3
2.	24OE402	Introduction to Database Management Systems	OE	3	3	0	0	3
3.	24OE403	Computer Communication Networks	OE	3	3	0	0	3
4.	24OE404	Cloud Infrastructure and Technologies	OE	3	3	0	0	3
5.	24OE405	Data Science using Python	OE	3	3	0	0	3

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
6.	24OE406	Foundations of Machine Learning	OE	3	3	0	0	3
7.	24OE407	Introduction to Artificial Intelligence	OE	3	3	0	0	3
8.	24OE408	Cyber Security Fundamentals	OE	3	3	0	0	3
9.	24OE409	Information Security	OE	3	3	0	0	3
10.	24OE410	Introduction to IOT	OE	3	3	0	0	3

VERTICALS FOR MINOR DEGREE

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	24CSM01	Introduction to Data Science	PE	3	3	0	0	3
2	24CSM02	Data mining	PE	3	3	0	0	3
3	24CSM03	Data Visualization	PE	3	3	0	0	3
4	24CSM04	Big Data Technologies	PE	3	3	0	0	3
5	24CSM05	Introduction to Cloud Computing	PE	3	3	0	0	3
6	24CSM06	Business Intelligence Systems	PE	3	3	0	0	3
7	24CSM07	Artificial Intelligence Essentials	PE	3	3	0	0	3
8	24CSM08	Neural Networks and Deep Learning	PE	3	3	0	0	3

24AD501	MACHINE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Machine Learning(ML)
- To understand the concepts of Supervised Learning
- To understand the concepts of Unsupervised Learning
- To understand the concepts of Reinforced Learning
- To evaluate and analysis of Machine Learning Experiments

UNIT-I MACHINE LEARNING BASICS 8

Introduction to Machine Learning (ML) - Essential concepts of ML – Types of learning – Machine learning methods based on Time–Dimensionality–Linearity and Nonlinearity Early trends in Machine learning–Data Understanding Representation and visualization – Confusion Matrix – MSE

UNIT-II SUPERVISED LEARNING 10

Regression: Types – Linear Regression, Polynomial Regression, Bayesian linear regression, Classification – binary classification, Gradient Descent – Choosing Step size, Support Vector Machine, Decision Tree, Random Forest, K Nearest Neighbors , Naïve Bayes.

UNIT-III UNSUPERVISED LEARNING 9

Unsupervised learning: K-means clustering, Hierarchical clustering , Anomaly detection, Principal Component Analysis , Independent Component Analysis, Singular value decomposition

UNIT- IV REINFORCED LEARNING 9

Introduction to Reinforced Learning terminology, component, working of Reinforcement Learning. Reinforcement Learning Algorithm – Approaches, types – positive type, negative type. Learning Models – Introduction to Markov decision process (MDP), state and action value functions – Application of Reinforcement Learning

UNIT-V ANALYSIS OF MACHINE LEARNING 9

Cross Validation (CV) and resampling – K-fold CV, bootstrapping, measuring classifier performance, assessing a single classification algorithm and comparing two classification algorithms – t test, McNemar's test, K-fold CV paired t test

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Ameet V Joshi, Machine Learning and Artificial Intelligence, Springer Publications, 2020
2. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.

REFERENCES:

1. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", Second Edition, MIT Press, 2018.
2. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
3. Sebastain Raschka, Vahid Mirjalili , "Python Machine Learning", Packt publishing, 3rd Edition, 2019.

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Machine Learning Techniques		Course Code : 24AD501	
CO	Course Outcomes	Unit	K –CO
C301.1	Explain the basic concept of Machine Learning and its performance matrix	I	K2
C301.2	Analyze various Regression and classification algorithms to predict data based on an Independent variable.	II	K4
C301.3	Apply unsupervised learning techniques and dimensionality reduction to the unlabeled data.	III	K3
C301.4	Apply the components of Reinforcement Learning to RL frameworks.	IV	K3
C301.5	Apply various statistical testing methods in Machine Learning experiments.	V	K3

HOD/AI&DS

24AD502**BIG DATA ANALYTICS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand big data.
- To learn and use NoSQL big data management.
- To learn map reduce analytics using Hadoop and related tools.
- To work with map reduce applications.
- To understand the usage of Hadoop related tools for Big Data Analytics.

UNIT-I UNDERSTANDING BIG DATA 9

Introduction to big data – convergence of key trends – unstructured data – industry examples of big data – web analytics – big data applications– big data technologies – introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics.

UNIT-II NOSQL DATA MANAGEMENT 9

Introduction to NoSQL – aggregate data models – key-value and document data models – relationships – graph databases – schemaless databases – materialized views – distribution models – master-slave replication – consistency - Cassandra – Cassandra data model – Cassandra examples – Cassandra clients

UNIT-III MAP REDUCE APPLICATIONS 9

MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of MapReduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – MapReduce types – input formats – output formats

UNIT- IV BASICS OF HADOOP 9

Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures - Cassandra – Hadoop integration

UNIT-V HADOOP RELATED TOOLS 9

Hbase – data model and implementations – Hbase clients – Hbase examples – praxis. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries.

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
3. Sadalage, Pramod J. "NoSQL distilled", 2013.

REFERENCES:

1. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
2. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
3. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
4. Alan Gates, "Programming Pig", O'Reilley, 2011.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Big Data Analytics		Course Code : 24AD502	
CO	Course Outcomes	Unit	K –CO
C302.1	Discuss the basic concept of the Big Data.	I	K2
C302.2	Apply the concepts and techniques of NoSQL databases for big data management.	II	K3
C302.3	Apply MapReduce workflows to process datasets.	III	K3
C302.4	Analyze Hadoop Distributed File System (HDFS) concepts, Hadoop I/O techniques for Scalable data analysis.	IV	K4
C302.5	Apply HBase, Pig, and Hive to design and execute real-world data analytics solutions.	V	K3

HOD/AI&DS

24AD503**ARTIFICIAL INTELLIGENCE FOR ROBOTICS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn concepts of robot locomotion.
- To understand the kinematics models of Robots.
- To learn the sensors used in mobile robots
- To learn the strategies for extracting information from the sensors.

UNIT-I ROBOT LOCOMOTION 9

Introduction to AI and Robotics – Legged Mobile Robots- Leg configurations and stability- Examples of legged robot locomotion-Wheeled Mobile Robots-Wheeled locomotion: the design space

UNIT-II MOBILE ROBOT KINEMATICS 9

Kinematic models and constraints – mobile robot maneuverability – mobile robot workspace – Beyond Basic Kinematics– motion control-Open loop control.

UNIT-III ROBOT PERCEPTION 9

Sensors for mobile robots – representing uncertainty: statistical representation – error propagation –Feature extraction: Feature extraction based on range data-Visual appearance based feature extraction

UNIT- IV MOBILE ROBOT LOCALIZATION 9

Introduction to localization-The Challenge of Localization: Noise and Aliasing: noise and aliasing – localization-based navigation – belief representation– map representation – probabilistic map-based localization – Localization Systems-autonomous map building.

UNIT-V ROBOT PLANNING NAVIGATION 9

Planning and reacting: Path planning- obstacle avoidance – navigation architectures: Modularity for code reuse and sharing-Control localization-Techniques for decomposition

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. R. Siegwart, I. R. Nourbaksh, and D. Scarramuzza, "Introduction to Autonomous Mobile Robots", Second Edition, MIT Press, 2011.

REFERENCES:

1. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2020.

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Artificial Intelligence For Robotics		Course Code : 24AD503	
CO	Course Outcomes	Unit	K –CO
C303.1	Explain legged and wheeled robot designs, stability, and locomotion methods.	I	K2
C303.2	Apply kinematic models and constraints to determine the feasible motions of mobile robots.	II	K3
C303.3	Construct perception models, uncertainty handling, and feature extraction from range and visual Data.	III	K3
C303.4	Apply the probabilistic localization algorithm that integrates sensor measurements.	IV	K3
C303.5	Illustrate path planning, obstacle avoidance, and navigation methods.	V	K3

HOD/AI&DS

24CI502**INTERNET OF THINGS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To Understand the concepts of Internet of Things and able to build IoT applications
- To learn the programming and use of Arduino and Raspberry Pi boards.
- To Know about data handling and analytics

UNIT-I INTRODUCTION TO IOT 9

Evolution of Internet of Things-Characteristics of IoT- Physical design of IoT-Functional blocks of IoT-Sensing-Actuation- Basics of Networking- Communication Protocols- Sensor Networks- Concept of IOT Devices – IOT Devices Versus Computers – IOT Configurations – Basic Components

UNIT-II IOT ARCHITECTURE 9

IoT architecture outline, standards - IoT Technology Fundamentals- Devices and gateways, Local and wide area networking- Data management- Business processes in IoT- Everything as a Service (XaaS)- M2M and IoT Analytics

UNIT-III IOT PHYSICAL DEVICES 9

Introduction to Arduino – Types of Arduino – Arduino Tool chain - Arduino Programming Structure – Sketches – Pins – Input/output From Pins Using Sketches – Integration of Sensors and Actuators- Machine-to-Machine Communications- Difference between IoT and M2M communication- Interoperability in IoT- Integration of Sensors and Actuators with Arduino

UNIT- IV PYTHON AND RASPBERRY PI 9

Raspberry Pi: Board configuration- Interfacing Raspberry Pi with basic peripherals-Implementation of IoT with Raspberry Pi - Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – IoT- Data Handling and Analytics – Connecting data to cloud

UNIT-V APPLICATIONS OF IOT 9

Smart Cities and Smart Homes- Connected Vehicles- Smart Grid- Industrial IoT- Case Study- Agriculture- Healthcare Activity Monitoring, Sensor -Smart grid-data critical applications-logistics- planetary explorations.

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. "Make sensors": Terokarvinen, kemo, karvinen and villey valtokari, 1st edition, maker media,2014.
3. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti.

REFERENCES:

1. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach"
2. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"
3. Beginning Sensor networks with Arduino and Raspberry Pi – Charles Bell, Apress

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Internet of Things		Course Code : 24CI502	
CO	Course Outcomes	Unit	K –CO
C304.1	Illustrate the fundamental concepts, characteristics, physical design, and architecture of IoT systems.	I	K2
C304.2	Demonstrate IoT technologies, communication protocols, and standards for effective networking and data management.	II	K3
C304.3	Apply Arduino programming, sensors, and actuators to design simple IoT applications.	III	K3
C304.4	Discuss the use of Raspberry Pi and Python programming for interfacing devices and implementing IoT solutions.	IV	K3
C304.5	Classify about the applications and case studies in real-world scenarios.	V	K3

HOD/AI&DS

24AD5L1	MACHINE LEARNING TECHNIQUES LABORATORY	L	T	P	C
		0	0	3	1.5

- To understand the data sets and apply suitable algorithms for selecting the appropriate features for analysis.
- To learn to implement supervised machine learning algorithms on standard datasets and evaluate the performance.
- To experiment the unsupervised machine learning algorithms on standard datasets and evaluate the performance.
- To compare the performance of different ML algorithms and select the suitable one based on the application

LIST OF EXPERIMENTS:

1. Demonstrate the working of the decision tree using an appropriate dataset
2. Develop Logistic Regression Model for a given dataset.
3. Implement Random forest algorithm for given dataset.
4. Build K-Nearest Neighbor model for a given dataset.
5. Apply Medical Diagnosis using various ML Algorithm. Compare the results of those algorithms
6. Implement K-Means Clustering algorithm for given dataset
7. Implement Unsupervised Learning using Singular Value Decomposition
8. Implement Reinforced Learning algorithm for a given dataset.
9. Develop a Simple Application using reinforced learning algorithm.
10. Mini Project

TOTAL: 45 PERIODS

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Machine Learning Techniques Laboratory		Course Code : 24AD5L1	
CO	Course Outcomes	EXP	K –CO
C307.1	Apply supervised machine learning algorithms on standard datasets and evaluate the performance.	1,2,3,4	K3
C307.2	Apply unsupervised machine learning algorithms and evaluate the performance.	6,7	K3
C307.3	Analyze various ML algorithms and compare the performance.	5	K4
C307.4	Build the Reinforced Learning models for standard data sets.	8,9	K3
C307.5	Build an application based on Machine learning algorithm.	10	K3

HOD/AI&DS

24CI5L2**INTERNET OF THINGS LABORATORY**

L	T	P	C
0	0	3	1.5

OBJECTIVES:

- To learn tools relevant to IoT development.
- To write simple programs that uses various features of the IOT.
- To explore python Programs for IOT & Arduino processors.
- To develop simple applications using Arduino/Raspberry Pi/open platform.

LIST OF EXPERIMENTS

1. Familiarization of Raspberry Pi/Arduino kit and perform necessary software installation.
2. Interface LED with Raspberry Pi/Arduino to turn ON LED for 1second after every 2 Seconds.
3. Interface motor with Raspberry Pi/Arduino.
4. Interface sensor with Raspberry Pi/Arduino to print temperature readings.
5. Interface Bluetooth with Raspberry Pi to send sensor data to smartphone.
6. Interface Raspberry Pi to turn ON/OFF LED when 1/0 received from smartphone using Bluetooth.
7. Interface WiFi module with Raspberry Pi.
8. Interface IR sensor with Raspberry Pi to read the interference of objects.
9. Implement Traffic Signal controls using Raspberry Pi.
10. Upload temperature data to Thingspeak Cloud using Raspberry Pi.
11. Miniproject

TOTAL: 45 PERIODS**LAB COMPONENT :**

1. Raspberry Pi/Arduino Kit
2. Interfacing Kit

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Internet of Things Laboratory		Course Code : 24CI5L2	
CO	Course Outcomes	EXP	K –CO
C308.1	Apply Raspberry Pi/Arduino programming to interface basic input and output devices	1,2,3	K3
C308.2	Demonstrate sensor interfacing techniques to acquire and process real-time data using Raspberry Pi/Arduino.	4,8	K3
C308.3	Implement Bluetooth-based wireless communication for data transmission and device control.	5,6	K3
C308.4	Apply Wi-Fi networking concepts to connect Raspberry Pi with IoT platforms and services.	7,10	K3
C308.5	Develop IoT-based embedded applications by integrating sensors, actuators, and communication modules.	9,11	K3

HOD/AI&DS

24AD5L2

MICRO PROJECT

L	T	P	C
0	0	2	1

OBJECTIVES:

To develop students' ability to apply fundamental concepts of a subject to solve a well-defined and narrowly scoped problem. It also aims to build basic implementation skills and introduce students to simple documentation and presentation practices.

Students are required to work individually or in small groups (2–3 members) on a topic approved by the faculty member. Upon completion, students must submit a brief report demonstrating the implementation and results. The progress of the project is evaluated through a minimum of three review sessions, conducted by the faculty member. These reviews are used for internal assessment. At the end of the course, students are required to submit the final report and give a brief oral presentation (viva voce) to internal examiner constituted by the Head of the Department.

TOTAL: 30 PERIODS**OUTCOMES:****AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Micro Project		Course Code : 24AD5L2
CO	Course Outcomes	K –CO
C309.1	Apply fundamental concepts to implement a solution for a well-defined problem.	K3
C309.2	Use appropriate tools and techniques to develop a basic working model.	K3
C309.3	Analyze the problem requirements and identify suitable approaches for implementation.	K4
C309.4	Demonstrate the working of the developed solution through testing and validation.	K3
C309.5	Organize and present the project work through a structured report and	K4

HOD/AI&DS

24HS5L1

Programming Skills I

L	T	P	C
0	0	2	1

OBJECTIVES:

- To **understand** the fundamental data structures (stack, queue, heap, binary tree) and their applications in problem solving.
- To **Apply** searching and traversal algorithms to solve problems efficiently under time and memory constraints.
- To **Analyze** real-world problem statements and map them to suitable data structures and algorithms.
- To **Evaluate** algorithmic solutions for correctness, performance, and optimality in competitive coding scenarios.
- To **Create** modular, efficient programs by combining multiple algorithmic concepts

1. Sample problems to be solved**Story Book Stack**

Arun reads lot of story books and he keeps all the story books piled as a single stack. He wants to write a program to keep the order of the books in the pile. The program must implement the following functionalities.

- Add a book to the top of the pile when 1 is followed by the name of the book.
- Remove a book from the top of the pile when -1 is given as the input (provided the pile has at least one book).
- Print the name of the book on the top of the pile when 2 is given as the input (provided the pile has at least one book).
- The program must exit when 0 is given as the input.

Boundary Condition(s):

The maximum number of story books in the pile will be 100.

The name of the book will not exceed 100 characters.

2. Shorter left wind mill

There are N wind mills in a straight line from left to right. The height of all N wind mills is passed as the input. For each wind-mill M, the program must print the number of wind-mills which are shorter than the current wind-mill present to the left of M.

Note: If private test cases fail implement the logic using an algorithm which is efficient - complexity is less than $O(n^2)$

Boundary Condition(s):

$1 \leq N \leq 10^6, 1 \leq \text{Height of wind mill} \leq 10^5$

3. First K Largest Integer

The program must accept N integers and an integer K as the input. The program must print the first K largest integers among the N integers as the output.

Hint: The value of N will be large, so sorting N integers and printing the first K integers gives the timeout for this program.

Boundary Condition(s): $1 \leq N \leq 10^5, 1 \leq \text{Each integer value} \leq 10^8, 1 \leq K \leq N$

4. There are N baskets with different number of balls. The number of balls in each basket is passed as input to the program. The program must make all the baskets with at least B balls based on the following condition.

-Two baskets with the least number of balls B_1 and B_2 can be combined to form a new basket with $B_1 + (2 \times B_2)$ balls where $B_1 < B_2$.

Note: Additional balls will be supplied as needed from the store

The value of B is also passed as the input to the program. The program must print the number of times T the baskets can be combined to make all the baskets with at least B

Ball Boundary Condition(s): $1 \leq N \leq 10^6$

$\leq \text{Number of balls in each basket} \leq 10^6, 1 \leq B \leq 10^9$

5. There are N queues maintained in a railway station to process customer's query. Each customer will take different time to process his/her query. The customer id and the time taken to process the customer's query of each customer in each queue are given as the input. The program must print the customer id of Kth serviced customer as the output. If more than one customer has serviced at the same time as the Kth customer then print the customer id having the minimum value among those customer ids.

Boundary Condition(s):

$1 \leq N \leq 100$

$1 \leq \text{Size of each queue} \leq 100$

$1 \leq K \leq \text{Total number of customers in all the queues}$

$1 \leq \text{Customer id, Time taken to process the customer's query} \leq 1045$

6. In an organization chart, the team members are represented using a binary tree. A team member can have a maximum of two junior team members under him/her. It is possible that a team member does not have any juniors under him/her.

Annual performance allowance is to be paid and the allowance amount that can be paid to the team member on the top of the hierarchy is passed as the input. A junior will get half the amount of the allowance of his/her senior if two juniors are under the senior. Else the junior will get the same amount as allowance as the senior.

Fill in the missing lines of code to complete the implementation for the function findMinAllowance so that it returns the least possible allowance paid to a team member.

Note:

- currNode which is passed as the argument is the root node of the binary tree.
- networth is the allowance amount receivable by the team member represented by the currNode
- currMinAllowance is the currently payable minimum allowance amount to an team member at curNode.

The struct Node is as given below (Here data is not needed for calculation but represents a positive integer)

```
struct Node
{
int data;
struct Node *left, *right;
};
```

You can create and implement additional functions (methods) as per your requirement

Boundary Condition(s): 1 <= Value of a Node <= 1000

7. Fill in the missing lines of code to complete the implementation for the function mirror so that it mirrors the given binary tree.

Note: currentNode which is passed as the argument is the root node of the binary tree.

The struct Node is as given below.

```
struct Node
{
int data;
struct Node *left, *right;
};
```

You can create and implement additional functions (methods) as per your requirement.

Boundary Condition(s):

1 <= Value of a Node <= 1000

8. The program must accept a string S as the input. The program must print the first occurring vowel in the string S as the output. If there is no vowel in the string S then the program must print -1 as the output.

Boundary Condition(s): 1 <= Length of S <= 1000

9. The program must accept two string values S1 (may contain space) and S2 (one word) as the input. The words in S1 are sorted lexicographically and separated by exactly one space.

The program must insert the the string S2 in S1 such that all the words in the modified S1 are also in sorted order.

Note: The string values contain only lower case alphabets

Boundary Condition(s): $1 \leq \text{Length of S1} \leq 1000, 1 \leq \text{Length of S2} \leq 100$

10. A maze is given as an $N \times N$ matrix containing only 0s and 1s. In the maze matrix, 0 represents a blocked cell and 1 represents an open cell. The program must accept the maze matrix of size $N \times N$ as the input. There are a rabbit and a carrot inside the maze whose positions $R(x, y)$ and $C(x, y)$ are also passed as input to the program. The rabbit can move inside the maze based on the following condition.

- The rabbit can move along any row or column in any direction until it reaches the edge of the maze or a blocked cell.

The program must print the minimum number of straight-line traversals T along a row or a column required for the rabbit to reach the carrot as the output.

Note: The maze matrix is always having at least a path from the rabbit to the carrot.

Boundary Condition(s): $1 \leq N \leq 100$

TOTAL PERIODS: 30 PERIODS

REFERENCES

1. <https://skillrack.com/faces/candidate/codeprogram.xhtml>
2. <https://www.geeksforgeeks.org/blogs/how-to-approach-a-coding-problem/>
3. <https://leetcode.com/>

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Programming Skills I		Course Code : 24HS5L1
CO	Course Outcomes	
C310.1	Use stack, queue, heap, and binary tree operations in solving structured problems.	
C310.2	Apply efficient algorithms to searching, sorting, and traversal problems.	
C310.3	Analyze computational complexity of algorithms and optimize program performance.	
C310.4	Evaluate different problem-solving approaches and select the most suitable data structure or algorithm.	
C310.5	Design and develop programs that integrate multiple data structures to solve real-world and competitive programming challenges.	

**HOD/AI&DS**

24AD601**DEEP LEARNING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand and need and principles of deep neural networks
- To understand CNN and RNN architectures of deep neural networks
- To comprehend advanced deep learning models
- To learn the evaluation metrics for deep learning models

UNIT-I DEEP NETWORKS BASICS 9

Linear Algebra: Scalars – Vectors – Matrices and tensors, Probability Distributions – Gradient-based Optimization – Machine Learning Basics: Capacity – Overfitting and underfitting – Hyperparameters and validation sets – Estimators -- Bias and variance – Stochastic gradient descent – Challenges motivating deep learning, Deep Networks: Deep feedforward networks, Regularization –Optimization.

UNIT-II CONVOLUTIONAL NEURAL NETWORKS 9

Convolution Operation – Sparse Interactions – Parameter Sharing – Equivariance – Pooling – Convolution Variants: Strided – Tiled – Transposed and dilated convolutions, CNN Learning: Nonlinearity Functions – Loss Functions – Regularization – Optimizers – Gradient Computation.

UNIT-III RECURRENT NEURAL NETWORKS 10

Unfolding Graphs – RNN Design Patterns: Acceptor – Encoder – Transducer; Gradient Computation – Sequence Modeling Conditioned on Contexts – Bidirectional RNN – Sequence to Sequence RNN – Deep Recurrent Networks – Recursive Neural Networks – Long Term Dependencies, Leaky Units: Skip connections and dropouts, Gated Architecture: LSTM.

UNIT- IV MODEL EVALUATION 8

Performance metrics – Baseline Models – Hyperparameters: Manual Hyperparameter – Automatic Hyperparameter – Grid search – Random search – Debugging strategies.

UNIT-V AUTOENCODERS AND GENERATIVE MODELS 9

Autoencoders: Undercomplete autoencoders – Regularized autoencoders – Stochastic encoders and decoders – Learning with autoencoders, Deep Generative Models: Variational autoencoders – Generative adversarial networks.

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, ``Deep Learning'', MIT Press, 2016.
2. Andrew Glassner, "Deep Learning: A Visual Approach", No Starch Press, 2021.

REFERENCES:

1. Salman Khan, Hossein Rahmani, Syed Afaq Ali Shah, Mohammed Bennamoun, ``A Guide to Convolutional Neural Networks for Computer Vision'', Synthesis Lectures on Computer Vision, Morgan & Claypool publishers, 2018.
2. Francois Chollet, "Deep Learning with Python", Manning Publications Co, 2018.
3. Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", Springer International

Publishing, 2018.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Deep Learning		Course Code : 24AD601	
CO	Course Outcomes	Unit	K –CO
C311.1	Explain the basics concepts in deep neural networks	I	K2
C311.2	Apply Convolution Neural Network for image processing	II	K3
C311.3	Apply Recurrent Neural Network and its variants for text analysis	III	K3
C311.4	Apply model evaluation for various applications	IV	K3
C311.5	Demonstrate autoencoders and generative models in deep learning	V	K3

HOD/AI&DS

24AD602	NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn mathematical models and methods in NLP.
- To learn syntax and semantics of natural languages
- Understand the syntactic structures with context-free grammars, constituency parsing, and dependency parsing
- Use of NLP models to real-world applications.

UNIT-I INTRODUCTION TO NATURAL LANGUAGE PROCESSING 8

Introduction - Regular Expressions- Words - Text Normalization, Minimum Edit Distance - N-gram Language Models - Evaluating Language Models - Sampling sentences from a language model – Smoothing.

UNIT-II SENTIMENT CLASSIFICATION AND LOGISTIC REGRESSION 9

Naive Bayes Classifiers - Optimizing for Sentiment Analysis - Evaluation: Precision, Recall, Fmeasure - Logistic Regression: Classification with Logistic Regression - Multinomial logistic regression - Learning in Logistic Regression - The cross-entropy loss: Gradient Descent - Regularization.

UNIT-III SEMANTIC PARSING 9

Lexical Semantics - Vector Semantics - Words and Vectors - Cosine for measuring similarity - TF-IDF: Weighing terms in the vector - Pointwise Mutual Information - Word2vec - Visualizing Embeddings - Bias and Embeddings - Evaluating Vector Models.

UNIT- IV ANNOTATING LINGUISTIC STRUCTURE 9

Context-Free Grammars and Constituency Parsing: Context-Free Grammars – Treebanks - Grammar Equivalence and Normal Form – Ambiguity - Span-Based Neural Constituency Parsing - Evaluating Parsers - Dependency Parsing: Dependency Relations - Transition-Based Dependency Parsing - GraphBased Dependency Parsing – Evaluation.

UNIT-V MACHINE TRANSLATION AND INFORMATION RETRIEVAL 10

Machine Translation: Language Divergences and Typology - Machine Translation using Encoder-Decoder - Translating in low-resource situations - MT Evaluation - Question Answering and Information Retrieval: Information Retrieval - IR-based Factoid Question Answering - Entity Linking - Knowledge-based Question Answering - Using Language Models to do QA

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2023.
2. Foundations of Statistical Natural Language Processing by Christopher D. Manning and Hinrich Schuetze, MIT Press, 2018

REFERENCES:

1. Steven Bird, Ewan Klein and Edward Loper Natural Language Processing with Python, O'Reilly Media; 1 edition, 2009
2. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Natural Language Processing		Course Code : 24AD602	
CO	Course Outcomes	Unit	K –CO
C312.1	Discuss the fundamental mathematical models and algorithms in the field of NLP.	I	K2
C312.2	Illustrate the logistic regression for classification and sentiment analysis	II	K3
C312.3	Apply semantic parsing for measuring word semantics and evaluation	III	K3
C312.4	Apply the principles of language resource annotation to annotate the data	IV	K3
C312.5	Illustrate the concept of Machine Translation and Information Retrieval in NLP	V	K3

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REFERENCES:

1. Nishith Rai and A.K. Singh, "Disaster Management in India: Perspectives, Issues and Strategies", New Royal Book Company, 2007.
2. Pardeep Sahni, Alka Dhameja and Uma Medury, "Disaster Mitigation: Experiences and Reflections", Prentice Hall India Learning Private Limited, 2001.
3. S.L.Goel, "Disaster Administration and Management: Text and Case Studies", Deep & Deep Publication Pvt.Ltd., 2007



HOD/AI&DS

24CS603 STANDARDS IN COMPUTER SCIENCE ENGINEERING

L	T	P	C
1	0	0	1

OBJECTIVES:

- To introduce the fundamental concepts and significance of standardization, certification, and quality assurance.
- To familiarize students with national and international standardization bodies and their regulatory frameworks.
- To provide knowledge of key software engineering and IT standards such as ANSI and IEEE.
- To impart understanding of ISO standards for quality management, IT service management, and information security.
- To expose students to Internet, web, and professional standards for ensuring interoperability, cybersecurity, and ethical practices.

MODULE I OVERVIEW OF STANDARDS**5**

Basic concepts of standardization: Purpose of Standardization, marking and certification of articles and processes; Importance of standards to industry, policy makers, trade, sustainability and innovation. Bureau of Indian Standards Objectives, roles and functions of BIS, Bureau of Indian Standards Act, ISO/IEC Directives; WTO Good Practices for Standardization.

MODULE II INTERNATIONAL NETWORKS STANDARDS IN COMPUTER SCIENCE**5**

Introduction–Importance of standards in IT– Overview of key international standards organizations ANSI and IEEE Standards –ANSI standards for software engineering -IEEE standards and their applications in software engineering – ISO/IEC 20000: IT Service Management – Scope and requirements– Service delivery process– Certification and implementation challenges–ISO 9000 Series: Quality Management – Overview of ISO 9001– Quality management principles– Certification process and benefits.

MODULE III INTERNATIONAL COMMUNICATION STANDARDS IN COMPUTER SCIENCE**5**

IETF Standards in Internet Protocols– Overview of key IETF standards (e.g., RFC 791 for IPv4)– Evolution and adoption of internet protocols– W3C Standards for the World Wide Web – Key W3C standards (e.g., HTML5, CSS3, Web Accessibility Guidelines)– Role of standards in web development and interoperability

ISO/IEC 27001: Information Security Management – Principles and Framework– Risk assessment and Management– Controls and compliance– NIST Standards and Frameworks – NIST Cyber

security Framework (CSF), ACM Standards and Guidelines – ACM Code of Ethics and Professional Conduct– ACM Computing Classification System (CCS) and its role in standardization

TOTAL: 15 PERIODS

REFERENCES:

1. Manual for Standards Formulation 2022, Bureau of Indian Standards
2. Kunas, Michael, "Implementing service quality based on ISO/IEC 20000: A management guide" IT Governance publishing, 2012.
3. Kan,S.H."Standards for Information Technology and Systems", Prentice Hall, 2017.
4. IEEE Computer Society.(2014)"IEEE Guide to the Software Engineering Body of Knowledge (SWEBOK)", Version 3.0. IEEE. Retrieved from IEEE Xplore
5. Calder,Alan."ISO/IEC27001:2013–A pocket Guide" IT Governance Publishing, 2013.
6. Sikos,Leslie,"Web Standards: Mastering HTML5, CSS3 and XML." A press, 2011.
7. Association for Computing Machinery. "ACM Code of Ethics and Professional Conduct: A Guide" ACM, 2018.
8. Calder, Alan, "NIST Cyber security Framework: A Pocket Guide. IT Governance Publishing" 2018.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Standards in Computer Science Engineering		Course Code : 24CS603	
CO	Course Outcomes	MODULE	K –CO
C317.1	Explain the basic concepts, purpose, and importance of standardization and certification in industry, trade, sustainability, and innovation.	I	K2
C317.2	Describe the roles, functions, and legal frameworks of national and international standardization bodies such as BIS, ISO/IEC, and WTO.	I	K2
C317.3	Discuss ANSI and IEEE standards in the development and evaluation of software engineering practices and IT systems.	II	K2
C317.4	Explain ISO standards (ISO/IEC 20000, ISO 9001, ISO/IEC 27001) in managing IT services, quality processes, and information security.	II	K2
C317.5	Discuss Internet, web, and professional standards (IETF, W3C, NIST, ACM) to ensure interoperability, cyber security, and ethical computing practices.	III	K2

HOD/AI&DS

24IT602**CLOUD COMPUTING TECHNIQUES**

L	T	P	C
3	0	2	4

OBJECTIVES:

- To understand the principles of cloud architecture, models and infrastructure.
- To understand the concepts of virtualization and virtual machines.
- To gain knowledge about virtualization Infrastructure.
- To explore and experiment with various Cloud deployment environments.
- To learn about the security identity and access management.

UNIT - I CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE 9

Cloud Computing Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud deployment models – Cloud service models; Service level agreement, Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges

LAB COMPONENT: 6

1. Install Virtualbox/VMware/ Equivalent open source cloud Workstation with different flavours of Linux or Windows OS on top of windows 8 and above.
2. Install a C compiler in the virtual machine created using a virtual box and execute Simple Programs.

UNIT - II VIRTUALIZATION BASICS 9

Virtual Machine Basics – Taxonomy of Virtual Machines – Hypervisor – Key Concepts – Virtualization structure – Implementation levels of virtualization – Virtualization Types: Full Virtualization – Para Virtualization – Hardware Virtualization – Virtualization of CPU, Memory and I/O devices.

LAB COMPONENT: 6

3. Find a procedure to transfer the files from one virtual machine to another virtual machine.
4. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.

UNIT - III VIRTUALIZATION INFRASTRUCTURE AND DOCKER 9

Desktop Virtualization – Network Virtualization – Storage Virtualization – System-level of Operating Virtualization – Application Virtualization – Virtual clusters and Resource Management – Containers vs. Virtual Machines – Introduction to Docker – Docker Components – Docker Container – Docker Images and Repositories.

LAB COMPONENT: 6

5. Creating and Executing Your First Container Using Docker.

6. Run a Container from Docker Hub

UNIT - IV CLOUD DEPLOYMENT ENVIRONMENT 9

Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – OpenStack-Serverless computing.

LAB COMPONENT: 6

7. Install Google App Engine. Create a hello world app and other simple web applications using python/java.

8. Use the GAE launcher to launch the web applications.

UNIT - V CLOUD SECURITY 9

Virtualization System-Specific Attacks: Guest hopping – VM migration attack – hyperjacking. Data Security and Storage, Identity and Access Management (IAM) – IAM Challenges – IAM Architecture and Practice.

LAB COMPONENT: 6

9. Implementation of Role Based Access Control(RBAC) and cloud policies using Open Source Cloud Platform.

TOTAL: 75 PERIODS

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. James Turnbull, "The Docker Book", O'Reilly Publishers, 2014.

REFERENCES:

1. James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
2. Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy: an enterprise perspective on risks and compliance", O'Reilly Media, Inc., 2009.
3. Krutz, R. L., Vines, R. D, "Cloud security. A Comprehensive Guide to Secure Cloud Computing", Wiley Publishing, 2010.

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Cloud Computing Techniques		Course Code : 24IT602	
CO	Course Outcomes	Unit	K –CO
C318.1	Demonstrate virtual machine tools to install and configure OS for cloud experiments.	I	K3
C318.2	Apply the concept of virtualization and its types.	II	K3
C318.3	Apply virtualization of hardware resources and Docker for deployment tasks.	III	K3
C318.4	Develop and deploy services on the cloud and set up a cloud environment.	IV	K3
C318.5	Apply security challenges in the cloud environment.	V	K3

HOD/AI&DS

24AD6L1**DEEP LEARNING LABORATORY**

L	T	P	C
0	0	3	1.5

- To understand the tools and techniques to implement deep neural networks
- To apply different deep learning architectures for solving problems
- To implement generative models for suitable applications
- To learn to build and validate different models

LIST OF EXPERIMENTS:

1. Implement a Feed-Forward Network in Tensor Flow/Keras.
2. Apply XOR problem using DNN
3. Demonstrate Character recognition using ANN
4. Implement an Image Classifier using CNN
5. Build a Language modeling using RNN
6. Apply Sentiment analysis using LSTM
7. Apply Machine Translation using Encoder-Decoder model
8. Demonstrate Image augmentation using GANs
9. Recommendation system from sales data using Deep Learning
10. Mini-project on real world applications

TOTAL: 45 PERIODS

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Deep Learning Laboratory		Course Code : 24AD6L1	
CO	Course Outcomes	Exp	K –CO
C319.1	Apply deep neural network for simple problems	1,2	K3
C319.2	Apply Convolution Neural Network and Artificial Neural Network for image processing	3,4	K3
C319.3	Apply Recurrent Neural Network and its variants for text analysis	5,6,7	K3
C319.4	Apply generative models for data augmentation	8	K3
C319.5	Develop real-world solutions using suitable deep neural networks	9,10	K3

HOD/AI&DS

	NATURAL LANGUAGE PROCESSING	L	T	P	C
24AD6L2	LABORATORY	0	0	3	1.5

- To Understand concepts of NLP including syntax, semantics, and pragmatics
- To Implement NLP tasks like text classification and sentiment analysis
- To learn semantic parsing and word representation techniques
- To apply NLP methods for speech processing and text-based applications

LIST OF EXPERIMENTS:

1. Use stemming and tokenization process to get the root words in the given sentences.
2. Split the words and display the words and count of the words in the given sentence using tokenizer function.
3. Remove connectors and prepositions in a sentence. (Note: connectors and prepositions represent stop words take them in a text file for required output)
4. Remove Stop words and identify parts of speech in the given sentence.
5. Use n-gram language model to predict the next sequence of word or letter in sentence.
6. Construct a parse tree that satisfies the given rule for the sentence using chunk parsing.
7. Find the probability of given sentence using PCF Parsing.
8. Implement a program that processes a word and discovers synonym, definition and example.
9. Apply sentiment analysis and categorizing opinions expressed in a piece of text.
10. Mini-project on real world applications

TOTAL: 45 PERIODS

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Natural Language Processing Laboratory		Course Code : 24AD6L2	
CO	Course Outcomes	Exp	K –CO
C320.1	Apply text preprocessing techniques to analyze and process the sentences.	1,2,3,10	K3
C320.2	Apply syntactic analysis to identify parts of speech and construct parse trees.	4,6,10	K3
C320.3	Develop a n-gram language models to compute and predict the sentence probabilities.	5,7,10	K3
C320.4	Apply semantic resources for lexical analysis.	8,10	K3
C320.5	Apply sentiment analysis techniques in textual data.	9,10	K3

HOD/AI&DS

24HS6L1

Programming Skills II

L	T	P	C
0	0	2	1

OBJECTIVES:

- To Develop logical reasoning and problem-solving ability to break down real-world tasks into structured computational steps.
- To Strengthen programming fundamentals including loops, conditionals, recursion, string manipulation, and mathematical operations.
- To Enhance algorithmic thinking for designing efficient solutions under given boundary conditions and time limits.
- To Promote analytical skills to handle diverse problem domains like number theory, text processing, and data structures.
- To Encourage optimization and performance awareness by working within strict execution time and memory constraints

Sample problems

1. A positive integer N is passed as the input. If we print all the numbers from 1 to N continuously, the program must find the number of characters(digits) C printed and print the count C as the output.
2. Given a string S as input which consists of multiple words separated by a space, the program must print the count C of the words which are repeated exactly N times. The comparison of the words is case sensitive.
3. The program must accept the score of N players in a cricket match. The program must print the number of combinations with exactly 4 players and total runs scored by the 4 players is greater than or equal to 100 as the output.
Boundary Condition(s): $4 \leq N \leq 250$
4. Given N numbers, the program must print the first number F of the last non-decreasing subset sequence present.
5. Given a string S with only alphabets, print the alphabet and its count as shown in the Example
6. The program must accept two integers N and X as the input. The program must print the number of subsets of N divisible by X as the output.
Boundary Condition(s): $1 \leq N \leq 10^5$
7. A set of space separated integers are passed as the input. The program must replace the alternate duplicate integer values with zero. Then the program must print the revised set of integers as the output.
Boundary Condition(s): $1 \leq \text{Each integer value} \leq 10^5$
8. Lalitha has three children. She wants to distribute N candies among all three in such a way that exactly one child gets the maximum number of candies among all three and each child gets at least one candy. The task is to find the total number of ways to distribute the N candies among the three children.
Boundary Condition(s): $3 < N \leq 100$
9. The program must accept a string S as the input. The program must split the given string S into three substrings FRONT, MIDDLE and END based on the following conditions. If the length of S is a multiple of 3, then each substring will contain $\frac{1}{3}$ characters. If the remainder when the length of S is divided by 3 is 1, then the MIDDLE substring will contain

that one extra character, If the remainder when the length of 5 is divided by 3 is 2, then each of the FRONT and END substrings will contain that one extra character
Finally, the program must print the three substrings of S as the output

Boundary Condition(s): $3 \leq \text{Length of } S \leq 100$

10. The program must accept N integers as the input. The program must print the maximum length of the subset whose sum of integers is a composite integer.

Boundary Condition(s): $1 \leq N \leq 10, 1 \leq \text{Each integer value} \leq 10^5$

TOTAL PERIODS: 30 PERIODS

REFERENCES:

1. <https://skillrack.com/faces/candidate/codeprogram.xhtml>
2. <https://www.geeksforgeeks.org/blogs/how-to-approach-a-coding-problem/>
3. <https://leetcode.com/>

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Programming Skills II		Course Code : 24HS6L1
CO	Course Outcomes	
C321.1	Design and implement algorithms to solve problems with varying levels of complexity.	
C321.2	Analyze constraints and select appropriate techniques (brute force, modular arithmetic, etc.	
C321.3	Apply logical reasoning to handle edge cases and ensure correctness under all input conditions.	
C321.4	Develop an efficient code for problem requirements into using standard programming constructs.	
C321.5	Deduce optimized solutions under strict execution time and memory constraints.	

HOD/AI&DS

24CSV11

STORAGE TECHNOLOGIES

L	T	P	C
3	0	0	3

OBJECTIVES:

- Characterize the functionalities of logical, Physical and Cloud -native storage components of storage
- Describe modern storage networking technologies including NVMe, FCoE, and hyper converged storage.
- Identify advanced storage virtualization and container - based storage solutions.
- Discuss modern backup, replication, disaster recovery, and ransomware protection strategies.
- Understand storage security, governance and AI-driven storage management solutions.

UNIT - I STORAGE SYSTEMS AND DATA CENTER INFRASTRUCTURE 9

Digital data and its types - Unstructured, Semi-structured, Streaming. Information lifecycle management (ILM) and Data gravity. Evolution of data centers – from traditional to cloud-native and hyper converged infrastructure. Third Platform & Beyond: Cloud-native computing, Containers, Kubernetes storage (CSI drivers), Server less impact on storage. Data Center Environment: Software-defined data center (SDDC), Edge data centers, Green/energy-efficient storage.

UNIT - II ADVANCED STORAGE SYSTEMS AND RAID 9

Hard disk drives (HDDs), Solid-State Drives (SSDs), NVMe and NVMe-over-Fabrics. Hybrid and All-Flash Arrays. RAID concepts, Erasure coding, and data protection mechanisms. Intelligent storage systems with AI-driven optimization. Scale-up, Scale-out, and Hyperconverged Storage Architecture.

UNIT - III STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION 9

Block - based, File-based, Object-based, and Unified Storage. SAN Technologies: Fibre Channel SAN, FCoE, NVMe-oF, and InfiniBand. IP-based Storage: iSCSI, FCIP, RDMA over Converged Ethernet (RoCE). Storage Virtualization: Virtual Volumes (vVOLs), Container-native storage, Storage for Kubernetes and OpenShift. Software-Defined Storage (SDS) and Cloud Storage Gateways.

UNIT - IV BACKUP, REPLICATION AND DISASTER RECOVERY 9

Modern Business Continuity strategies. Backup methods: Snapshots, Continuous Data Protection (CDP), Cloud and SaaS backups. Deduplication and compression technologies. Replication: Compute-based, Storage-based, and Cloud-based replication. Disaster Recovery: Orchestration tools, Disaster Recovery as a Service (DRaaS), Ransomware protection in storage. Data Migration across hybrid and multi-cloud environments.

UNIT - V STORAGE SECURITY, MANAGEMENT AND TRENDS 9

Information Security in Storage: Zero-Trust Storage Models, Data-at-rest & in-motion encryption. Threats: Ransomware, insider threats, cloud misconfigurations. Governance, Risk, and Compliance (GRC). Storage infrastructure management: AI/ML in predictive storage management, Cloud-native monitoring tools (Prometheus, Grafana). Future Trends: Quantum storage, DNA storage, Sustainability in storage.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. EMC Corporation, Information Storage and Management, Wiley, India
2. Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel and Libor Miklas, Introduction to Storage Area Networks, Ninth Edition, IBM - Redbooks, December 2017

REFERENCES:

1. Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein , Storage Networks Explained, Second Edition, Wiley, 2009
2. Tom Clark, Designing Storage Area Networks, Addison Wesley.
3. Nigel Poulton, Kubernetes and Cloud Native Storage: The Complete Guide, 2022.
4. J Metz et al., Ethernet Storage Fabrics: A Complete Guide to Next-Generation Storage Networking, Addison-Wesley, 2020.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Storage Technologies		Course Code : 24CSV11	
CO	Course Outcomes	Unit	K –CO
CO1	Demonstrate fundamentals of modern information storage management, cloud-native storage, and cloud deployment models	I	K3
CO2	Illustrate advanced intelligent storage systems, NVMe, and RAID/Erasure coding	II	K3
CO3	Identify various storage networking architectures including SAN, NVMe-oF, and SDS	III	K3
CO4	Apply storage subsystems, virtualization, and container-native storage solutions	IV	K3
CO5	Examine disaster recovery, replication, and ransomware protection strategies; Assess security needs and zero-trust measures for storage infrastructure	V	K3

HOD/AI&DS

24CSV21	DATA WAREHOUSING AND DATA MINING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand data warehouse concepts, architecture, business analysis and tools
- To understand data pre-processing and data visualization techniques
- To study algorithms for finding hidden and interesting patterns in data
- To understand and apply various classification and clustering techniques using tools.

UNIT - I DATA WAREHOUSING, BUSINESS ANALYSIS AND ON-LINE ANALYTICAL PROCESSING (OLAP) 9

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

UNIT - II DATA MINING - INTRODUCTION 8

Introduction– Data – Types of Data – Data Mining Functionalities – Interestingness of Patterns. Introduction to Data Mining Systems – Knowledge Discovery Process – Data Mining Techniques – Issues – applications- Data Objects and attribute types, Statistical description of data, Data Preprocessing – Cleaning, Integration, Reduction, Transformation and discretization, Data Visualization, Data similarity and dissimilarity measures.

UNIT - III FREQUENT PATTERN ANALYSIS 9

Mining Frequent Patterns, Associations and Correlations – Mining Methods- Pattern Evaluation Method – Pattern Mining in Multilevel, Multi Dimensional Space – Constraint Based Frequent Pattern Mining, Classification using Frequent Patterns

UNIT - IV CLASSIFICATION AND CLUSTERING 9

Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification by Back Propagation – Support Vector Machines —Clustering Techniques – Cluster Analysis-Partitioning Methods - Hierarchical Methods – Density Based Methods - Grid Based Methods – Evaluation of clustering – Clustering high dimensional data- Clustering with constraints, Outlier analysis

UNIT - V DATA MINING TOOLS 9

Datasets – Introduction, Iris plants database, Breast cancer database, Auto imports database – Data mining tools: WEKA, Hadoop, Spark, R tool – Learning algorithms, Clustering algorithms, Association–rule learners.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jiawei Han and MichelineKamber, Data Mining Concepts and Techniques, Third Edition, Elsevier, 2012.
2. Alex Berson and Stephen J.Smith, Data Warehousing, Data Mining & OLAP, Tata McGraw – Hill Edition, 5th Reprint 2016.

REFERENCES:

1. K.P. Soman, ShyamDiwakar and V. Ajay, Insight into Data Mining Theory and Practice, Eastern Economy Edition, Prentice Hall of India, 2006.
2. Ian H.Witten and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, Elsevier, Second Edition.
3. Daniel T.Larose, "Data Mining Methods and Models", Wiley-Interscience, 2006.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Data Warehousing and Data Mining		Course Code : 24CSV21	
CO	Course Outcomes	Unit	K –CO
CO1	Discuss data warehouse system and business analysis with OLAP tools	I	K2
CO2	Describe various pre-processing and visualization techniques for data analysis	II	K2
CO3	Apply frequent pattern and association rule mining techniques	III	K3
CO4	Select and apply an appropriate classification and Clustering algorithm for labeled data and Unlabeled Data set.	IV	K3
CO5	Apply learning and clustering algorithms using data mining tools	V	K3



HOD/AI&DS

24CSV31	SOFTWARE DEFINED NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamentals of software defined networks.
- To understand the separation of the data plane and the control plane.
- To study about the SDN Programming.
- To understand the concepts of Data centers and Network Functions Virtualization.
- To study about SDN Frameworks.

UNIT - I INTRODUCTION TO SOFTWARE DEFINED NETWORK 9

SDN Origins and Evolution – Introduction - Traditional Switch Architecture – Why SDN? - How SDN Works - Centralized and Distributed Control and Data Planes.

UNIT - II OPEN FLOW AND SDN CONTROLLERS 9

Open Flow Specification – Drawbacks of Open SDN, SDN via APIs, SDN via Hypervisor Based Overlays – SDN via Opening up the Device – SDN Controllers – General Concepts.

UNIT - III DATA CENTERS 9

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

UNIT - IV SDN PROGRAMMING 9

Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs – Network Functions Virtualization (NFV) - NFV Architecture

UNIT - V SDN FRAMEWORK 9

Juniper SDN Framework – IETF SDN Framework – Open Daylight Controller – Floodlight Controller – Bandwidth Calendaring – Data Center Orchestration

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Paul Goransson and Chuck Black, Software Defined Networks: A Comprehensive Approach, First Edition, Morgan Kaufmann, 2014.
2. William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud", Pearson Education, 1st Edition, 2015

REFERENCES:

1. SiamakAzodolmolky, Software Defined Networking with Open Flow, Packet Publishing, 2013.
2. VivekTiwari, SDN and Open Flow for BeginnersII, Amazon Digital Services, Inc., 2013.
3. Fei Hu, Editor, Network Innovation through Open Flow and SDN: Principles and Design, CRC Press, 2014.
4. Ken Gray, Thomas D. Nadeau, "Network Function Virtualization", Morgan Kauffman, 2016.

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Software Defined Networks		Course Code : 24CSV31	
CO	Course Outcomes	Unit	K –CO
CO1	Explain the key benefits of SDN by separation of Data and Control Planes.	I	K2
CO2	Apply the openflow specification and different controllers of SDN.	II	K3
CO3	Apply various Data centers and SDN solutions for the Data Center networks.	III	K3
CO4	Develop various applications of SDN using current languages and tools and Describe the concepts of Network function virtualization	IV	K3
CO5	Apply different framework and controller used in SDN	V	K3

HOD/AI&DS

24CSV41	VIRTUALIZATION	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To Learn the basics and types of Virtualization
- To understand the Hypervisors and its types
- To Explore the Virtualization Solutions
- To Experiment the virtualization platforms

UNIT - I	INTRODUCTION TO VIRTUALIZATION	6
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Virtualization and cloud computing - Need of virtualization System Models – Bare-Metal vs Hosted. Taxonomy of Virtual Machines – Process VM vs System VM. Hypervisors – Type 1 & Type 2, Virtual Machine Monitor (VMM). Implementation Levels – Hardware, OS, Application.

PRACTICAL ACTIVITY	6
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1. Install **VirtualBox** or **VMware Workstation** on your laptop (this is a *Hosted Hypervisor*). Allocate memory and storage space as per requirement. Install Guest OS on that **VirtualBox** or **VMware Workstation**.
2. Install gcc compiler in the VM created and execute a simple C program.

UNIT - II	VIRTUALIZATION CONCEPTS, INFRASTRUCTURE, AND RESOURCE MANAGEMENT	6
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CPU Virtualization – privilege rings, trap-and-emulate, binary translation; Memory Virtualization – shadow paging, nested page tables, ballooning; I/O Virtualization – device pass-through, SR-IOV; Types of Virtualization – full, para, hardware-assisted; Desktop Virtualization – VDI, thin clients; Storage Virtualization – block, file, object, vSAN; Network Virtualization – virtual switches, VLANs, VXLAN, SDN integration; System Virtualization – namespaces, cgroups;

PRACTICAL ACTIVITY	6
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1. Create and run a VM in VirtualBox/VMware, adjust CPU, memory, and I/O resources, and observe how the hypervisor manages virtualization.
2. Deploy a VM in a cloud platform (AWS/Azure/GCP), attach extra storage, configure network settings (VLAN/IP), and observe how storage and network virtualization enable flexible resource management.

UNIT - III	CONTAINERS, ORCHESTRATION & MODERN TRENDS	6
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Containers vs Virtual Machines – Architecture & Use-Cases. Docker Platform – Engine, CLI, Daemon, Registries, Volumes, Networking. Container Security Basics – Namespaces, cgroups, Image Signing. Kubernetes Basics – Pods, Services, Deployments, Scaling. Micro-VMs & Serverless – AWS Firecracker.

PRACTICAL ACTIVITY	6
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1. Run a Docker container for a web server and check how CPU and memory limits work.
2. Deploy an app in Kubernetes, scale it from 1 to 3 pods, and test if all are working.

UNIT - IV VM SECURITY AND MANAGEMENT

Security Threats – VM Escape, Guest Hopping, Hyper-jacking. Hardening Hypervisors & Containers – Patching, IAM, Least Privilege. Monitoring& Performance Optimization – Metrics & Alerts. Backup, Disaster Recovery & High Availability. Licensing, Compliance & Auditing.

PRACTICAL ACTIVITY

6

1. Apply VM isolation testing to demonstrate that one VM cannot access another VM's files or network.
2. Apply Snapshot and Rollback Security Test: Apply snapshot and rollback testing to verify that a VM can be safely restored after malicious changes.

UNIT – V VIRTUALIZATION TOOLS

6

VMWare-Amaon AWS-Microsoft HyperV- Oracle VM Virtual Box - IBM PowerVM- Google Virtualization- Case study.

PRACTICAL ACTIVITY

6

1. Create Nested Virtual Machine (VM under another VM)
2. Apply the concept of virtualization to explain how a small website can use a virtual server in the cloud instead of a physical server.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
2. Chris Wolf, Erick M. Halter, "Virtualization: From the Desktop to the Enterprise", APress, 2005

REFERENCES:

1. David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach
2. Cloud computing a practical approach - Anthony T. Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010
3. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011.

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Virtualization		Course Code : 24CSV41	
CO	Course Outcomes	Unit	K –CO
CO1	Demonstrate the basics of virtualization, system models, and hypervisors in practical scenarios	I	K3
CO2	Build CPU, memory, storage, and network virtualization for efficient VM management	II	K3
CO3	Experiment applications with Docker and Kubernetes containers.	III	K3
CO4	Illustrate the VM security practices such as isolation and hypervisor hardening.	IV	K3
CO5	Utilize virtualization tools and cloud-based virtual servers to host applications and manage resources	V	K3

HOD/AI&DS

24CSV51**CLOUD COMPUTING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the principles of cloud architecture, models and infrastructure.
- To understand the concepts Cloud Application Development & Microservices.
- To gain knowledge about Cloud Resource Management, Orchestration & Cost Optimization.
- To explore and experiment with various Cloud deployment environments.
- To learn about the security issues in the cloud environment.

UNIT - I CLOUD ARCHITECTURE, MODELS AND INFRASTRUCTURE 9

Cloud Architecture: Distributed and Cloud Computing Models – NIST Cloud Computing Reference Architecture – Introduction to Virtualization-Cloud Deployment Models – Service Models (IaaS, PaaS, SaaS, FaaS). Cloud Infrastructure: Compute, Storage, and Networking Design – Design Challenges – Software Defined Networking (SDN) in Cloud.

UNIT - II CLOUD APPLICATION DEVELOPMENT & MICROSERVICES 9

Cloud-Native Applications – Characteristics – Twelve-Factor App Principles – RESTful Services – Event-Driven Architectures. Microservices Architecture – Benefits & Challenges – Service Discovery – API Gateways – Scaling Microservices. Serverless Computing – Function-as-a-Service (FaaS) – Use Cases and Limitations.

UNIT - III CLOUD RESOURCE MANAGEMENT, ORCHESTRATION & COST OPTIMIZATION 9

Resource Provisioning and Scheduling – Auto-Scaling Mechanisms – Load Balancing in Cloud Environments. Container Orchestration: Kubernetes Basics – Pods, Services, Deployments – Horizontal & Vertical Scaling. Cloud Cost Management – Pricing Models of Major Providers – Cost Optimization Strategies – Capacity Planning & Performance Monitoring.

UNIT - IV CLOUD DEPLOYMENT ENVIRONMENT 9

Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack.

UNIT - V CLOUD SECURITY 9

Virtualization System-Specific Attacks: Guest hopping – VM migration attack – hyper jacking. Data Security and Storage; Identity and Access Management (IAM) - IAM Challenges - IAM Architecture and Practice

TOTAL: 45 PERIODS**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. James Turnbull, "The Docker Book", O'Reilly Publishers, 2014.

REFERENCES:

1. Krutz, R. L., Vines, R. D, "Cloud security. A Comprehensive Guide to Secure Cloud Computing", Wiley Publishing, 2010..
2. Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy: an enterprise perspective on risks and compliance", O'Reilly Media, Inc., 2009.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Cloud Computing		Course Code : 24CSV51	
CO	Course Outcomes	Unit	K –CO
CO1	Apply cloud architecture principles and deployment models to design a basic cloud infrastructure	I	K3
CO2	Build cloud-native applications and microservices using RESTFUL and event-driven architectures.	II	K3
CO3	Plan the cloud resources, perform orchestration using Kubernetes, and optimize cloud costs.	III	K3
CO4	Utilize various cloud platforms (AWS, Azure, GCP) and software environments for application deployment	IV	K3
CO5	Apply cloud security techniques to protect virtualized systems, manage IAM, and prevent common attacks	V	K3

HOD/AI&DS

24CSV61	CLOUD SERVICE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand cloud service management fundamentals.
- To understand the concepts cloud services strategy.
- To gain knowledge about cloud service management
- To learn about cloud service economics.
- To learn about cloud service governance and value.

UNIT - I CLOUD SERVICE MANAGEMENT FUNDAMENTALS 9

Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models.

UNIT - II CLOUD SERVICES STRATEGY 9

Cloud Strategy Fundamentals- Cloud Strategy Management Framework- Cloud Policy, Key Driver for Adoption- Risk Management, IT Capacity and Utilization- Demand and Capacity matching- Demand Queueing, Change Management- Cloud Service Architecture

UNIT - III CLOUD SERVICE MANAGEMENT 9

Cloud Service Reference Model, Cloud Service LifeCycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management..

UNIT - IV CLOUD SERVICE ECONOMICS 9

Pricing models for Cloud Services- Freemium, Pay Per Reservation- Pay per User, Subscription based Charging- Procurement of Cloud-based Services- CapexvsOpex Shift- Cloud service Charging- Cloud Cost Models

UNIT - V CLOUD SERVICE GOVERNANCE & VALUE 9

IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix, Understanding Value of Cloud Services, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Cloud Service Management and Governance: Smart Service Management in Cloud Era by Enamul Haque, Enel Publications.
2. Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, Zaigham Mohammad 2013.

REFERENCES:

1. Economics of Cloud Computing by Praveen Ayyappa, LAP Lambert Academic Publishing
2. Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S.Thamarai Selvi

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Cloud Service Management		Course Code : 24CSV61	
CO	Course Outcomes	Unit	K –CO
CO1	Demonstrate the essential characteristics of cloud service management and different service models in practical scenarios.	I	K3
CO2	Apply cloud strategy frameworks to manage risk, capacity, and change in cloud service environments	II	K3
CO3	Illustrate cloud service lifecycle processes, including design, deployment, migration, and operations management.	III	K3
CO4	Plan pricing models and cost optimization strategies for cloud services	IV	K3
CO5	Utilize cloud governance frameworks to measure service value and ensure compliance with IT policies	V	K3

HOD/AI&DS

24ITV12	IMAGE PROCESSING AND COMPUTER VISION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn concepts of fundamentals of digital image processing techniques.
- To study the principles of various image enhancement technique used in digital image processing.
- To become familiar with image compression methods.
- To gain knowledge on the fundamental concepts related to Image processing and computer vision.
- To develop skills on image based rendering and recognition

UNIT - I	DIGITAL IMAGE FUNDAMENTALS	9
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Steps in Digital Image Processing - Elements of Visual Perception - Image Sensing and Acquisition - Image Sampling and Quantization - Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT

UNIT - II	IMAGE ENHANCEMENT	9
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Spatial Domain: Gray level transformations - Histogram processing - Basics of Spatial Filtering - Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform - Smoothing and Sharpening frequency domain filters - Ideal, Butterworth and Gaussian filters, Homomorphic filtering.

UNIT - III	IMAGE COMPRESSION	9
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Fundamentals of image compression - Compression methods - Huffman Coding, Arithmetic Coding, LZW Coding, Run-Length coding, Symbol-Based Coding, Bit-Plane Coding, Block Transform Coding, Predictive Coding, Wavelet Coding.

UNIT - IV	COMPUTER VISION	9
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Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Pyramids and wavelets - Geometric transformations - Global optimization

UNIT - V	IMAGE-BASED RENDERING AND RECOGNITION	9
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View interpolation Layered depth images - Light fields and Lumi graphs - Environment mattes - Video-based rendering-Object detection - Face recognition - Instance recognition - Category

recognition - Context and scene understanding - Recognition databases and test sets.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Pearson, Fourth Edition, 2017.
2. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022.

REFERENCES:

1. Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson, 2002.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name :Image Processing and Computer Vision		Course Code : 24ITV12	
CO	Course Outcomes	Unit	K- CO
CO1	Apply fundamental digital image processing techniques	I	K3
CO2	Apply various image enhancement techniques in digital image processing	II	K3
CO3	Illustrate different coding methods for image compression.	III	K3
CO4	Implement basic and some advanced geometric transformations in Computer Vision	IV	K3
CO5	Develop innovative image processing and computer vision applications	V	K3

HOD/AI&DS

24ITV22	DIGITAL CONTENT AND COMMUNICATION	L	T	P	C
		2	0	2	3

OBJECTIVES:

- Provide an understanding of digital communication principles and multimedia content creation.
- Familiarize students with digital media platforms, formats, and emerging technologies.
- Equip learners with tools and strategies for effective content design, management, and delivery.
- Explore analytics-driven insights for optimizing communication in digital environments.
- Develop ethical and professional skills in handling digital content.

UNIT - I
INTRODUCTION TO DIGITAL COMMUNICATION
6

Fundamentals of Communication: Functions of communication – Types – Traditional vs. digital communication – Components of digital communication system – Signal representation – Transmission and reception – Advantages and limitations of digital media, Evolution of Online Communication, Media Convergence and Digital Ecosystems: Convergence of print, audio, video, and online platforms – Participatory culture and user-generated content – Social media ecosystems – Integration of communication channels for unified messaging, Case Studies.

Lab Component
6

1. Compare information flow, latency, interactivity, and reach between a chosen traditional media example (newspaper / radio) and a matched digital media example (blog / podcast).
2. Analyze a digital campaign (e.g., Swachh Bharat, #ShareTheLoad, or a social media brand campaign) and evaluate its communication strategy, content types, and effectiveness.

UNIT - II
DIGITAL CONTENT CREATION
6

Principles of Content Design: Content types – Text, audio, video, graphics – Storytelling, branding, and messaging strategy – Designing for target audience. Tools for Content Creation: Introduction to Canva, Adobe Photoshop, Premiere Pro, Audacity – Features, functionalities, and application for digital content. Content Development Workflow: Scriptwriting, storyboarding, recording, editing, and publishing – Best practices for consistency and quality – Integration of multimedia elements.

Lab Component
6

3. Design and develop a digital poster applying basic design principles (contrast, alignment, repetition, proximity) using image editing software.
4. Create a short digital video or podcast integrating audio, visuals, and narration using multimedia editing tools.

Digital Platforms Overview: Social media platforms – YouTube, Instagram, LinkedIn, X – Features, audience reach, and content formats. Content Management Systems (CMS): WordPress, Drupal, Blogger – Installation, customization, theme selection, and content publishing workflow. SEO and SEM: Basics of Search Engine Optimization – Keywords, meta tags, descriptions, analytics – Search Engine Marketing strategies for digital campaigns.

5. Create and configure a personal or group blog, and publish posts with text, images, and multimedia elements.
6. Optimize blog posts using SEO techniques (keywords, meta-tags, backlinks) and promote content through social media platforms.

Web and Social Media Analytics: Introduction to analytics tools – Google Analytics, Meta Insights, YouTube Analytics – Metrics: engagement, reach, impressions, CTR, conversion. Data Analysis for Digital Content: Collection, processing, and visualization of data – Tools and software for data interpretation. Sentiment Analysis and A/B Testing: Opinion mining using Python/NLTK/Text Blob – Conducting A/B tests on digital content for optimization – Evaluation of digital campaign effectiveness.

7. Design and run a mock digital communication campaign, and collect user engagement data such as reach, impressions, likes, shares, and comments.
8. Analyze collected engagement data, generate analytical reports, and apply sentiment analysis techniques to evaluate audience feedback.

Ethical and Legal Aspects: Copyright, plagiarism, and fair use – Digital privacy, data protection, misinformation – Professional conduct in digital communication. Emerging Trends in Digital Media: AI-powered content tools (ChatGPT, DALL·E), AR/VR, Metaverse, immersive storytelling – Future directions in digital communication technology, Case Studies about ethical and legal aspects.

9. Study and discuss real-world digital communication scenarios, such as misinformation, deepfakes, or copyright violations, and identify the underlying issues.
10. Propose preventive and corrective strategies for identified ethical and legal issues in digital communication, ensuring professional and responsible practices.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Brian Carroll, Writing and Editing for Digital Media, 1st Edition, Routledge, 2021.
2. Eugenia Siapera, Understanding New Media, 1st Edition, Routledge, 2018.

REFERENCES:

1. Mike Ward, Journalism Online: Digital Tools, Digital Age, 1st Edition, Routledge, 2021.
2. Charles Ess, Digital Media Ethics, 1st Edition, Polity Press, 2020.
3. Paul Messaris & Lee Humphreys, Digital Media: Transformations in Human Communication, 1st Edition, Peter Lang, 2019.
4. Roland G. Fryer, Social Media Analytics and Tools, 1st Edition, Springer, 2020.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Digital Content and Communication		Course Code : 24ITV22	
CO	Course Outcomes	Unit	K- CO
C01	Apply the foundations of digital communication and media technologies	I	K3
C02	Design and develop digital content across various platforms.	II	K3
C03	Apply tools for multimedia production, editing, and content management.	III	K3
C04	Analyze the impact of digital communication using data-driven insights.	IV	K3
C05	Demonstrate ethical, legal, and professional practices in digital media.	V	K3

HOD/AI&DS

24ITV32

UI AND UX DESIGN

L T P C

2 0 2 3

COURSE OBJECTIVES:

- To survey the Content information based on people needs
- To acquire knowledge in components of UI & UX design
- To survey the various UI systems
- To understand the user experience design techniques

UNIT I FOUNDATIONS OF DESIGN

6

UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Architecture and Application -Meet the Goals of People and the Organization - Introduction to Design Sprint methodology.

Lab Component:

6

- 1.Designing a Responsive layout for a Societal Application
- 2.Brainstorming feature for proposed product
- 3.Defining the Look and Feel of the new Project.

UNIT II FOUNDATIONS OF UI DESIGN

6

Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides and Aesthetics-Visual Design for Enterprise Applications-Laws

Lab Component:

6

- 4.Exploring various UI Interaction Patterns
- 5.Developing an interface with proper UI Style Guides

UNIT III FOUNDATIONS OF UX DESIGN

6

Introduction to User Experience - Why You Should Care about User Experience – Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goal.

Lab Component:

6

- 6.Exploring various open source collaborative interface Platform
- 7.Hands on Design Thinking Process for a new product

UNIT IV WIREFRAMING, PROTOTYPING AND TESTING

6

Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing – Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with

Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research
Methods - Synthesizing Test Findings - Prototype Iteration.

Lab Component: 6

8. Developing Wireflow diagram for application using open source software.

9. Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)

UNIT V UX DESIGN 6

User Research-Interviews-Identifying and Writing Problem Statements - Identifying Appropriate Research Methods – Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams – Flow Mapping - Information Architecture.

Lab Component: 6

10. Conduct end-to-end user research - creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping

11. Sketch, design with popular tool and build a prototype and perform usability testing and identify improvements

TOTAL: 60 PERIODS

TEXTBOOKS:

1. Yablonski, Jon. *Laws of UX: Using Psychology to Design Better Products & Services* 2nd ed., O'Reilly Media, 2024.

2. Joel Marsh, "UX for Beginners", O'Reilly, first edition- 2022.

REFERENCES:

1. Jenifer Tidwell, Charles Brewer, Aynne Valencia, "Designing Interface" 3rd Edition, O'Reilly 2020

2. Steve Schoger, Adam Wathan "Refactoring UI", 2018

3. Steve Krug, "Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile", Third Edition, 2015.

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : UI and UX Design		Course Code : 24ITV32	
CO	Course Outcomes	Unit	K- CO
CO1	Classify divergent and convergent thinking, Application Structure	I	K3
CO2	Construct the fundamental needs of UI design	II	K3
CO3	Illustrate methods and tools to the process of UX design for research	III	K3
CO4	Determine the sketching principles, UI /UX prototyping & testing with suitable tools	IV	K3
CO5	Identify and write problem statements, appropriate research methods for creating scenarios	V	K3

HOD/AI&DS

- To train the students to acquire knowledge in digital marketing
- To know the Customer behavior in digital marketing world
- To acquire knowledge about digital marketing strategies
- To know the social channels of digital marketing
- To understand the business analysis and optimization techniques

Introduction – Planning – Types – Strategies - Market segmentation – Online consumer behavior – Evolution - challenges - Factor Affecting marketing - Decision process - Online buying models – Strategic digital marketing - Factors impacting digital marketing – Types of digital media and attribution model - Online marketplace analysis Micro & Macro Environment - Value chain digitization.

Consumer for Digital Marketing – Consumer behavior – Web experience – website planning and development – Consumer demand – Integrated marketing communications - marketing Customer Relation Management- Importance of Customer Experience – Content Creation

Digital Marketing: Analytics – Digital advertising – Assessment Phase – Strategy Definition- Communications and Channel Mix – Operation Set-ups – Campaign Management –Execution Elements – Implementation challenges – security-privacy – Ethical – social challenges.

Direct Marketing – Marketing using AI - Social Media – Mobile - E-Mail – Internet – Pay-per Click – Key performance Indicators - Google ads - Affiliate - Advertising in META platforms (Facebook, Instagram, WhatsApp) LinkedIn, Blogging as a social medium - Micro blogging with Twitter - Social Sharing with YouTube.

Data-Driven Business – Optimizing – Mistakes – Tools – Search engine optimization -Rules of Marketing and PR – Reaching Buyers Directly – Web Based Communications – Analyzing Data for Success- Landscape and Emerging Area- Google analytics – Digital Marketing Environment – E-business Analytics- Online Advertising vs. Traditional Advertising - Payment Methods of Online Advertising - CPM (Cost-per-Thousand) and CPC (Cost-per-click) - Display Ads - Choosing a Display Ad Format.

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Greg Jarboe, Matt Bailey and Michael Stebbins, "Digital Marketing Fundamentals", Wiley, 2023.
2. Stephanie Diamond, "Digital Marketing All-In-One for Dummies", Wiley, 2023.

REFERENCES:

1. David Meerman Scott, "The New Rules of Marketing and PR", Seventh Edition, Wiley 2020
2. Puneet Bhatia, "Fundamentals of Digital Marketing", Second Edition, Pearson, 2019
3. Dr.Prince Gupta and Dr.Gaurab Kumar Sharma, "Digital Marketing – An Insight to Fundamentals, Strategies & Implementations", Notion Press, 2019.
4. Ryan Deiss and Russ Henneberry, "Digital Marketing For Dummies", Wiley, 2017

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Digital Marketing		Course Code : 24ITV42	
CO	Course Outcomes	Unit	K- CO
CO1	Apply digital marketing concepts and techniques in business applications	I	K3
CO2	Apply customer behavior principles to identify customer needs in digital marketing	II	K3
CO3	Implement marketing strategies for effective digital marketing execution.	III	K3
CO4	Apply the current digital marketing and social media marketing channels	IV	K3
CO5	Identify online digital marketing platforms with optimal efficiency	V	K3

HOD/AI&DS

24ITV52

VISUAL EFFECTS

L	T	P	C
2	0	2	3

OBJECTIVES:

- To get a basic idea on animation principles and techniques
- To get exposure to CGI, color and light elements of VFX
- To have a better understanding of basic special effects techniques
- To have a knowledge of state of the art vfx techniques
- To become familiar with popular compositing techniques

UNIT - I ANIMATION BASICS**6**

VFX production pipeline, Principles of animation, Techniques: Keyframe, kinematics, Full animation, limited animation, Rotoscoping, stop motion, object animation, pixilation, rigging, shape keys, motion paths.

UNIT - II CGI,COLOR,LIGHT**6**

virtual worlds, Photorealism, physical realism, function realism, 3D Modeling and Rendering: color - Color spaces, color depth, Color grading, color effects, HDRI, Light – Area and mesh lights, image based lights, PBR lights.

UNIT - III SPECIAL EFFECTS**6**

Special Effects – props, scaled models, animatronics, pyrotechniques, Schüfftan process, Particle effects – wind, rain, fog, fire

UNIT - IV VISUAL EFFECTS TECHNIQUES**6**

Motion Capture, Matt Painting, Rigging, Front Projection. Rotoscoping, Match Moving – Tracking, camera reconstruction, planar tracking, Calibration, Point Cloud Projection, Ground plane determination.

UNIT - V COMPOSITING**6**

Compositing – chroma key, blue screen/green screen, background projection, alpha compositing, deep image compositing, multiple exposure, matting, VFX tools - Blender, Natron, GIMP.

TOTAL: 30 PERIODS**Laboratory Experiments:****Using Natron:**

- Understanding Natron Environment:
- Working with color and using color grading
- using Channels
- Merging images
- Using Rotopaint
- performing Tracking and stabilizing

Using Blender:

- Motion Tracking – camera and object tracking
- Camera fx, color grading, vignettes
- Compositing images and video files

Lab Component : 30 PERIODS

TOTAL: 60 PERIODS**TEXT BOOKS:**

1. Chris Roda, Real Time Visual Effects for the Technical Artist, CRC Press, 1st Edition, 2022.
2. Steve Wright, Digital Compositing for film and video, Routledge, 4th Edition, 2017.
3. John Gress, Digital Visual Effects and Compositing, New Riders Press, 1st Edition, 2014.

REFERENCES:

1. Jon Gress, "Digital Visual Effects and Compositing", New Riders Press, 1st Edition, 2014.
2. Luiz Velho, Bruno Madeira, "Introduction to Visual Effects A Computational Approach", Routledge, 2023.
3. Jasmine Katatikarn, Michael Tanzillo, "Lighting for Animation: The art of visual storytelling", Routledge, 1st Edition, 2016.
4. Jeffrey A. Okun, Susan Zwerman, Christopher McKittrick, "The VES Handbook of Visual Effects: Industry Standard VFX Practices and Procedures", Third Edition, 2020.

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Visual Effects		Course Code : 24ITV52	
CO	Course Outcomes	Unit	K- CO
CO1	Implement animation in 2D/3D by applying animation principles and techniques	I	K3
CO2	Apply CGI, color, and light elements effectively in VFX applications	II	K3
CO3	Apply special effects using state-of-the-art VFX tools and techniques	III	K3
CO4	Apply visual effects techniques such as motion capture and match moving	IV	K3
CO5	Implement VFX applications using various compositing tools.	V	K3

HOD/AI&DS

24ITV62	GAME DESIGN AND DEVELOPMENT	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To know the basics of 2D and 3D graphics for game development.
- To know the stages of game design and development.
- To understand the architecture and components of a game engine.
- To survey the gaming platforms, frameworks and development tools.
- To learn and develop simple games using Pygame and Unity.

UNIT - I	3D GRAPHICS FOR GAME DESIGN	6
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Genres of Games, Game Components - Basics of 2D and 3D Graphics for Game Avatars - 2D and 3D Transformations, Projections - Color Models, Illumination and Shader Models - Animation: Controller-based Animation, Keyframes.

Lab Component :	6
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1. Installation of a game engine (Unity/Unreal) and familiarization of the GUI. Conceptualize the theme for a 2D game.
2. Basic 2D/3D graphics programming – create simple avatars and apply transformations (scaling, rotation, projection).

UNIT - II	GAME DESIGN PRINCIPLES	6
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Character Development, Storyboard & Script Design – Script Narration, Game Balancing, Core Mechanics – Principles of Level Design – Preproduction → Production → Post-production Workflow – Player Experience (UX) and Feedback Loops.

Lab Component :	6
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3. Character design: sprites, movement, and character control.
4. Level design: world design using tiles with interactive and collectible objects.

UNIT - III	GAME ENGINE ARCHITECTURE	6
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Rendering Concept – Software Rendering – Hardware Rendering – Audio Engine – Spatial Sorting Algorithms – Algorithms for Game Engine – Collision Detection – Game Logic – Game AI – Path finding.

Lab Component :	6
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5. Implement player–world interaction using a physics engine (gravity, collisions).
6. Implement simple game AI/pathfinding (e.g., enemy chasing player).

UNIT - IV **GAMING PLATFORMS AND FRAMEWORKS** **6**

Overview of Gaming Platforms: PC, Console, Mobile, VR/AR – Game Engines: Pygame (Python), Unity (C#), Unreal Engine (C++), Godot – Development Tools: Blender, Photoshop, Maya – Prototyping & Version Control (Figma, Git).

Lab Component : **6**

7. Design menus and user interaction for mobile platforms.
8. Develop a 3D game prototype using Unreal Engine (basic environment setup).

UNIT - V **GAME DEVELOPMENT USING PYGAME** **6**

Game Development in Pygame: 2D/3D interactive games, avatar creation, sound, physics, input handling – Unity Implementation: asset import, scene management, scripting (C#), collision & physics – Pygame vs Unity approaches – Future Trends: VR/AR, cloud gaming, AI-assisted design

Lab Component : **6**

9. Develop a 2D interactive game using Pygame (avatar, graphics, sound, physics).
10. Capstone Mini Project (Team-based): End-to-end mini-game in Pygame (Python) or Unity (C#) such as Side-scroller, Puzzle game, Top-down shooter, 3D maze, Multiplayer game.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. David H. Eberly, “3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics”, Second Edition, CRC Press,2006.
2. Jung Hyun Han, “3D Graphics for Game Programming”, Chapman and Hall/CRC, 2011.

REFERENCES:

1. Sanjay Madhav, “Game Programming Algorithms and Techniques: A Platform Agnostic Approach”, Addison Wesley,2013.
2. Will McGugan, “Beginning Game Development with Python and Pygame: From Novice to Professional”, Apress,2007.
3. Paul Craven, “Python Arcade games”, Apress Publishers,2016.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Game Design And Development		Course Code : 24ITV62	
CO	Course Outcomes	Unit	K- CO
CO1	Apply the concepts of 2D and 3D graphics in game design and development	I	K3
CO2	Apply effective game design documents for game planning and production.	II	K3
CO3	Implement game engine algorithms for game functionality.	III	K3
CO4	Apply gaming platforms, frameworks, and development tools for game design applications.	IV	K3
CO5	Implement simple games using Pygame and Unity	V	K3

HOD/AI&DS

24ADV13**GENERATIVE AI**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the fundamentals of Generative AI and its applications
- To Understanding of Generative Adversarial Networks (GANs)
- To understand the architecture and working of Large Language Models (LLMs).
- Learn the Foundations and Techniques of Prompt Engineering
- To analyze and apply prompt design strategies for various AI tasks.

UNIT-I INTRODUCTION TO GENERATIVE AI 10

Generative Modeling: Generative Versus Discriminative Modeling, Autoencoders – Build First Autoencoder – The Encoder – The Decoder – Joining the Encoder to the Decoder – Analysis of the Autoencoder – The Variational Autoencoder Building a variational Autoencoder – The Encoder- The Loss Function – Analysis of the Variational Autoencoder – Using VAE's to Generate Faces – Training the VAE – Analysis of the VAE

UNIT-II GENERATIVE ADVERSARIAL NETWORKS 10

Building First GAN - The Discriminator - The Generator - Training the GAN - GAN Challenges - Oscillating Loss - Mode Collapse - Uninformative Loss - Hyperparameters - Tackling the GAN Challenges - Wasserstein GAN - Wasserstein Loss - The Lipschitz Constraint - Weight Clipping - Training and analysing WGAN - WGAN-GP - The Gradient Penalty Loss

UNIT-III TRANSFORMER NETWORKS 8

Introduction to Transformer Architecture: Evolution from RNNs, Self-attention Mechanism and Positional Encoding, multi-head attention mechanisms The Transformer - Positional Encoding - The Decoder - Analysis of the Transformer.

UNIT- IV ARCHITECTURAL TECHNIQUES AND SYSTEMS 8

Introduction to GPT, BERT, and T5 model's: Architecture, Training, and In-context Learning – Scaling Issues: Model Size, Computation, and Memory.

UNIT-V PROMPTING TECHNIQUES 9

Overview of prompting techniques – Prompting LLMs – Different prompting strategies – Theoretical Insights into Prompting – Prompt Design Principles – Transfer Learning, Fine-tuning

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. David Foster, Generative Deep Learning-Teaching Machines to Paint, Write, Compose, and Play, O'Reilly, 2019
2. Jakub Langr and Vladimir Bok, GANs in Action: Deep learning with Generative Adversarial Networks, Manning, 2019

REFERENCES:

1. John. Ibrahim, ART OF ASKING CHATGPT FOR HIGH-QUALITY ANSWERS: A Complete Guide to Prompt Engineering Techniques, Nzunda Technologies Limited, 2023
2. Jay Alamar, Maarten Grootendorst, "Hands-On Large Language Models", O'Reilly Media, Inc 2024.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Generative AI		Course Code : 24ADV13	
CO	Course Outcomes	Unit	K –CO
CO1	Discuss the fundamental concepts and techniques of generative modeling and autoencoders.	I	K2
CO2	Apply the Generative Adversarial Networks techniques to create new data.	II	K3
CO3	Illustrate the structure of transformer networks and Large Language Models.	III	K3
CO4	Describe the Architectural Techniques in LLM.	IV	K2
CO5	Apply the prompt design techniques.	V	K3

HOD/AI&DS

24ADV23**MULTIAGENT SYSTEMS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To operate autonomously to achieve goals by setting their own objectives
- To plan steps, and executing tasks with minimal human intervention
- To make decisions based on current context and past experiences to adapt and learn over time

UNIT-I INTRODUCTION TO AGENT 9

Agentic systems requirements-Understanding self-governance, agency, and autonomy – Reviewing intelligent agents and their characteristics – Exploring the architecture of agentic systems- Understanding multi-agent systems

UNIT-II ESSENTIAL COMPONENTS OF INTELLIGENT AGENTS 9

Knowledge representation in intelligent agents- Reasoning in intelligent agents- Learning mechanisms for adaptive agents- Decision-making and planning in agentic systems- Enhancing agent capabilities with generative AI

UNIT-III REFLECTION, PLANNING AND TOOLS IN AGENTS 9

The importance of reflection in agents- Introspection in intelligent agent- Implementing reflective capabilities- Understanding the concept of tool use in agents, Planning algorithms for agents- Integrating tool use and planning

UNIT- IV AGENT COMMUNICATION AND COLLABORATION 9

Exploring practical implementations - Understanding the CWD model-Communication and collaboration between agents- Designing agents with role assignments- Communication and collaboration between agents

UNIT-V EFFECTIVE AGENTIC SYSTEM DESIGN TECHNIQUES 9

Focused system prompts and instructions for agents- State spaces and environment modeling- Agent memory architecture and context management- Sequential and parallel processing in agentic workflows

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Anjanana Biswas & Wrick Talukdar, "Building Agentic AI Systems" Published by Packt Publishing Ltd. First published: April 2025
2. Michael Woolridge, "An Introduction to MultiAgent Systems", 2nd Edition, Wiley publishers

REFERENCES:

1. Pascal Bornet, "Agentic Artificial Intelligence : Harnessing AI Agents to Reinvent Business, Work, and Life" by Irreplaceable Publishing, 2025
2. Michael Albada "Building Applications with AI Agent", O'Reilly Publications, 2025
3. Kevin Leyton-Brown and Yoav Shoham, "Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations", Cambridge University Press, 2008.

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Multiagent Systems		Course Code : 24ADV23	
CO	Course Outcomes	Unit	K –CO
CO1	Illustrate about types, applications and challenges of Generative AI	I	K2
CO2	Apply the components of Intelligent systems in reasoning and decision making	II	K3
CO3	Demonstrate the ability for planning, reflection and tools usage	III	K3
CO4	Construct agents to perform communication and collaboration	IV	K3
CO5	Build model environments and manage agent architecture.	V	K3

**HOD/AI&DS**

24ADV33	ROBOTIC PROCESS AUTOMATION	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To understand the basic concepts of Robotic Process Automation.
- To expose to the key RPA design and development strategies and methodologies.
- To learn the fundamental RPA logic and structure.
- To explore the Exception Handling, Debugging and Logging operations in RPA.
- To learn to deploy and Maintain the software bot.

UNIT-I INTRODUCTION TO ROBOTIC PROCESS AUTOMATION 6

Emergence of Robotic Process Automation(RPA), Evolution of RPA, Differentiating RPA from Automation- Benefits of RPA - Application areas of RPA, Components of RPA, RPA Platforms. Robotic Process Automation Tools - Templates, User Interface, Domains in Activities, Workflow Files

UNIT-II AUTOMATION PROCESS ACTIVITIES 6

Sequence, Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management, File operations Controls: Finding the control, waiting for a control, Act on a control, Ui Explorer, Handling Events.

UNIT-III APP INTEGRATION, RECORDING AND SCRAPING 6

App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboard action stopper form operation, Scraping data from website and writing to CSV. Process Mining

UNIT- IV EXCEPTION HANDLING AND CODE MANAGEMENT 6

Exception handling, Common exceptions, Logging-Debugging techniques, Collecting crash dumps, Error reporting. Code management and maintenance: Project organization, Nesting workflows, Reusability, Templates, Commenting techniques, State Machine.

UNIT-V DEPLOYMENT AND MAINTENANCE 6

Publishing using publish utility, Orchestration Server, Control bots, Orchestration Server to deploy bots, License management, Publishing and managing updates. RPA Vendors -Open Source RPA, Future of RPA.

PRACTICAL EXERCISES

1. Create a Sequence to obtain user inputs display the message box;
2. Create a Flow chart to navigate to a desired page based on a condition;
3. Create a State Machine work flow to compare user input with a random number.
4. Build a process in the RPA platform using UI Automation Activities.
5. Create an automation process using key System Activities, Variables and Arguments
6. Automate login to (web) Email account
7. Recording mouse and keyboard actions.
8. Web Scraping
9. Recording mouse and keyboard actions.

TOTAL: 60 PERIODS

TEXT BOOKS:

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

REFERENCES:

1. Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston(Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation, Amazon Asia-Pacific Holdings Private Limited, 2018
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant, Amazon Asia-Pacific Holdings Private Limited, 2018
3. A Gerardus Blokdyk, "Robotic Process Automation Rpa A Complete Guide ",2020

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Robotic Process Automation		Course Code : 24ADV33	
CO	Course Outcomes	Unit	K –CO
CO1	Apply the key distinctions between RPA and existing automation techniques and platforms.	I	K3
CO2	Apply UiPath to design control flows and work flows for the target process	II	K3
CO3	Apply recording, web scraping and process mining by automation	III	K3
CO4	Apply UIPath Studio to detect, and handle exceptions in automation processes	IV	K3
CO5	Construct Orchestrator for creation, monitoring, scheduling, and controlling of automated bots and processes.	V	K3

HOD/AI&DS

24ADV43**ETHICS AND AI**

L	T	P	C
3	0	0	3

OBJECTIVES:

- Study the morality and ethics in AI
- Learn about the Ethical initiatives in the field of artificial intelligence
- Study about AI standards and Regulations
- Study about social and ethical issues of Robot Ethics

UNIT-I INTRODUCTION 9

Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on The legal system-Impact on the environment and the planet-Impact on trust

UNIT-II ETHICAL INITIATIVES IN AI 9

International ethical initiatives-Ethical harms and concerns-Case study: health care robots, Autonomous Vehicles, Warfare and weaponization

UNIT-III AI STANDARDS AND REGULATION 9

Model Process for Addressing Ethical Concerns During System Design-Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations -Ontological Standard for Ethically Driven Robotics and Automation Systems

UNIT- IV ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS 9

Robot-Roboethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology - Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility- Roboethics Taxonomy.

UNIT-V AI AND ETHICS- CHALLENGES AND OPPORTUNITIES 9

Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries-National and International Strategies on AI.

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield ,”The ethics of artificial intelligence: Issues and initiatives”, EPRS | European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452 – March 2020
2. Patrick Lin, Keith Abney, George A Bekey,” Robot Ethics: The Ethical and Social Implications of Robotics”, The MIT Press- January 2014.

REFERENCES:

1. Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017
2. Mark Coeckelbergh,” AI Ethics”, The MIT Press Essential Knowledge series, April 2020

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Ethics and AI		Course Code : 24ADV43	
CO	Course Outcomes	Unit	K –CO
CO1	Describe about morality and ethics in AI	I	K2
CO2	Discuss the knowledge of real time application ethics and the ethical harms in AI	II	K2
CO3	Illustrate AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems	III	K3
CO4	Demonstrate the concepts of Robo ethics and Morality with professional responsibilities.	IV	K3
CO5	Illustrate about societal issues in AI with National and International Strategies on AI	V	K3

HOD/AI&DS

24ADV53**REINFORCEMENT LEARNING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the core principles behind the RL
- To understand the concepts of value functions, deriving Bellman equations.
- Acquire the knowledge to Markov Decision Processes with its properties.
- To understand the concepts of Monte Carlo Methods to solve real-world problems.

UNIT-I REINFORCEMENT LEARNING PRIMITIVES 9

The Reinforcement Learning Problem- Elements of Reinforcement Learning - Limitations and Scope - Multi-arm Bandits - An n-Armed Bandit Problem - Tracking a Non stationary Problem - UpperConfidence-Bound Action Selection - Gradient Bandits.

UNIT-II MARKOV DECISION PROCESS 9

The Agent–Environment Interface - Goal and Rewards - Returns - Unified Notation for Episodic and Continuing Tasks - The Markov Property - Markov Decision Processes - Sequential Decision Making with Evaluative Feedback - Learning Action Values - Estimating Action Values Incrementally

UNIT-III VALUE FUNCTIONS AND BELLMAN EQUATIONS 9

Specifying Policies-Value Functions - Bellman Equation Derivation -Why Bellman Equations - Optimal Policies - Optimal Value Functions - Using Optimal Value Functions to Get Optimal Policies.

UNIT- IV DYNAMIC PROGRAMMING 9

Policy Evaluation vs. Control - Iterative Policy Evaluation - Dynamic Programming: Polices – Evaluation - Improvement - Iteration - Value Iteration - Asynchronous Dynamic Programming - Generalized Policy Iteration - Efficiency of Dynamic Programming.

UNIT-V MONTE CARLO METHODS 9

Monte Carlo Prediction - Estimation of Action Values - Control and Control without Exploring Starts - Off-policy Prediction via Importance Sampling - Incremental Implementation - Off-Policy Monte Carlo Control - Importance Sampling on Truncated Returns – Applications of Reinforcement Learning.

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An Introduction", Second Edition, MIT Press, 2019.
2. Phil Winder, "Reinforcement Learning", O'Reilly Media, First Edition, 2020

REFERENCES:

1. Marco Wiering, Martijn Van Otterlo, "Reinforcement learning State-of-the-Art", Springer Berlin Heidelberg, 2012
2. Michael Wooldridge, "An Introduction to Multi Agent Systems", John Wiley, 2002.

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Reinforcement Learning		Course Code : 24ADV53	
CO	Course Outcomes	Unit	K –CO
CO1	Explain the importance of Reinforcement Learning primitives.	I	K2
CO2	Illustrate the RL Framework and Markov Decision Process.	II	K3
CO3	Illustrate the value functions for optimal decision-making.	III	K3
CO4	Apply dynamic programming to solve complex problems.	IV	K3
CO5	Apply the Monte Carlo methods to solve the real-world problems.	V	K3

HOD/AI&DS

24ADV63**EXPLAINABLE AI**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basics of Explainable AI
- To understand the concepts of tabular data
- To understand the techniques in image data
- To understand explainable models for text data.

UNIT-I AN OVERVIEW OF EXPLAINABLE AI 9

Introduction to Explainable AI (XAI): Historical background and evolution, significance, needs, challenges, explainability evaluation – Interpretability and Explainability – Types of Explanations – Themes Throughout.

UNIT-II EXPLAINABILITY FOR TABULAR DATA 9

Permutation Feature Importance – Shapley Values and SHAP – Visualizing Feature Attributions – Explaining Tree-Based Models – LIME for Tabular Data – Surrogate Models for Model Interpretation – Counterfactual Explanations – Partial Dependence Plots and Related Plots.

UNIT-III EXPLAINABILITY FOR IMAGE DATA 9

Integrated Gradients (IG) – XRAI and Grad-CAM – LIME for Image Data – Guided Backpropagation and Grad-CAM – Improving Grad-CAM & LIME Explanations – Activation- based Explanations – Alternative Input Attribution.

UNIT- IV EXPLAINABILITY FOR TEXT DATA 9

Tokenization and Word Embeddings – LIME for Text Data – Gradient $\times$ Input and LRP – Language Interpretability Tool – Transformer Interpretability Methods – Attention-based Explanations – Layer Integrated Gradients.

UNIT-V ADVANCED AND EMERGING TOPICS 9

Alternative Explainability Techniques – Evaluation of Explainability Techniques – Interpretable Deep Learning Models – Counterfactual Reasoning for Explainable AI – Example-based Explanations – Time-series & Multimodal Explainability – Common Pitfalls & Human Biases – Human-in-the-loop Explainability.

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Michael Munn, David Pitman, "Explainable AI for Practitioners", O'Reilly Media, Inc., October 2022.

REFERENCES:

1. W. Samek, G. Montavon, A. Vedaldi, L. K. Hansen, and K.-R. Müller, Explainable AI: Interpreting, Explaining and Visualizing Deep Learning, 2nd ed., Cham, Switzerland: Springer, 2023.
2. John Liu, Uday Kamath, "Explainable Artificial Intelligence: An Introduction to Interpretable Machine Learning", Springer Nature Switzerland AG, December 2021.

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Explainable AI		Course Code : 24ADV63	
CO	Course Outcomes	Unit	K –CO
CO1	Explain the fundamental concepts and methodologies of Explainable AI	I	K2
CO2	Apply explainability techniques for tabular data.	II	K3
CO3	Apply explainability methods in image data.	III	K3
CO4	Apply explainable models for text data.	IV	K3
CO5	Describe multimodal explainability and time series techniques.	V	K2

HOD/AI&DS

24SCV14	SECURITY AND PRIVACY IN CLOUD	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Introduce Cloud Computing terminology, definition & concepts
- To understand the various levels of infrastructure and data security in cloud
- To understand the Identity, Access control in Cloud
- To understand the security, vulnerability and patch management in cloud
- To be able to ensure privacy and audit the cloud for compliance

UNIT - I FUNDAMENTALS OF CLOUD SECURITY CONCEPTS 9

Cloud Computing Defined - Cloud Computing Software Security Fundamentals - Cloud Information Security Objectives - Cloud Security Services - Relevant Cloud Security Design Principles - The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise

UNIT - II INFRASTRUCTURE AND DATA SECURITY IN CLOUD 9

Infrastructure Security: Infrastructure Security: The Network Level, Infrastructure Security: The Host Level, Infrastructure Security: The Application Level
Data Security and Storage: Aspects of Data Security, Data Security Mitigation, Provider Data and Its Security

UNIT - III IDENTITY AND ACCESS MANAGEMENT 9

Identity and Access Management: Trust Boundaries and IAM, Why IAM? - IAM Challenges - IAM Definitions - IAM Architecture and Practice - Getting Ready for the Cloud, Relevant IAM Standards and Protocols for Cloud Services - IAM Standards, Protocols, and Specifications for Consumers- IAM Practices in the Cloud - Cloud Authorization Management - Cloud Service Provider IAM Practice

UNIT - IV SECURITY MANAGEMENT IN CLOUD 9

Security Management Standards- ITIL ,ISO 27001/27002 - SaaS,PaaS and IaaS Availability Management, Access Control, Security Vulnerability, Patch, and Configuration Management - Intrusion Detection and Incident Response - Customer Versus CSP Responsibilities

UNIT - V PRIVACY AND POLICY COMPLIANCE 9

Privacy – Data Life Cycle - Key Privacy Concerns in the Cloud - Who Is Responsible for Protecting Privacy? - Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing - Auditing the Cloud for Compliance - Governance, Risk, and Compliance (GRC) - Auditing the Cloud for Compliance

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Mather, Kumaraswamy and Latif, "Cloud Security and Privacy", OREILLY 2011
2. RonaldL. Krutz, Russell Dean Vines,"Cloud Security"[ISBN:0470589876],2010.

REFERENCES:

1. John Ritting house, James Ransome, "Cloud Computing" CRC Press; 1 edition [ISBN:1439806802], 2009.
2. J.R.("Vic")Winkler,"Securing the Cloud"Syngress[ISBN:1597495921]2011
1stEdition,KindleEdition

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Security and Privacy in Cloud		Course Code : 24SCV14	
CO	Course Outcomes	Unit	K –CO
CO1	Discuss the fundamental concepts of cloud security	I	K2
CO2	Apply Infrastructure and data protection strategies for cloud	II	K3
CO3	Apply cloud service provider IAM practices to manage users, roles, policies, and secure resource access effectively.	III	K3
CO4	Implement vulnerability, patch and configuration management for SaaS, PaaS, and IaaS services.	IV	K3
CO5	Apply privacy principles and compliance requirements to manage the data life cycle in cloud environments	V	K3

HOD/AI&DS

24SCV24	WEB APPLICATION SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of web application security
- To focus on wide aspects of secure development and deployment of web applications
- To learn how to build secure APIs
- To learn the basics of vulnerability assessment and penetration testing
- To get an insight about Hacking techniques and Tools

UNIT - I FUNDAMENTALS OF WEB APPLICATION SECURITY 9

The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation

UNIT - II SECURE DEVELOPMENT AND DEPLOYMENT 9

Web Applications Security - Security Testing, Security Incident Response Planning, The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM)

UNIT - III SECURE API DEVELOPMENT 9

API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Micro service APIs: Service Mesh, Locking Down Network Connections, Securing **Incoming Requests**

UNIT - IV VULNERABILITY ASSESSMENT AND PENETRATION TESTING 9

Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database-based vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.

UNIT - V HACKING TECHNIQUES AND TOOLS 9

Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, First Edition, 2020, O'Reilly Media, Inc.
2. Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, The McGraw-Hill Companies.

REFERENCES:

1. Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA
2. Michael Cross, Developer's Guide to Web Application Security, 2007, Syngress Publishing, Inc.
3. Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC.
4. Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA.
5. Malcom McDonald, Web Security for Developers, 2020, No Starch Press, Inc.
6. Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron Williams Grey Hat Hacking: The Ethical Hacker's Handbook, Third Edition, 2011, The McGraw-Hill Companies.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Web Application Security		Course Code : 24SCV24	
CO	Course Outcomes	Unit	K –CO
CO1	Explain the fundamental concept of Web application security	I	K2
CO2	Apply secure development and deployment practices to design, test, and maintain secure web applications	II	K3
CO3	Implement security controls such as encryption, rate limiting, and audit logging to enhance API confidentiality, integrity, and availability.	III	K3
CO4	Apply vulnerability assessment methodologies and appropriate scanning tools to identify security weaknesses in cloud, host, network, and	IV	K3
CO5	Demonstrate the use of Burp Suite and related tools to identify and validate security flaws in systems and applications.	V	K3

HOD/AI&DS

24SCV34	ENGINEERING SECURE SOFTWARE SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Know the importance and need for software security.
- Know about various attacks.
- Learn about secure software design.
- Understand risk management in secure software development.
- Know the working of tools related to software security.

PRE-REQUISITE:NIL**UNIT - I NEED OF SOFTWARE SECURITY AND LOW-LEVEL ATTACKS 9**

Software Assurance and Software Security - Threats to software security - Sources of software insecurity - Benefits of Detecting Software Security - Properties of Secure Software – Memory Based Attacks: Low-Level Attacks Against Heap and Stack - Defense Against Memory-Based Attacks.

UNIT - II SECURE SOFTWARE DESIGN 9

Requirements Engineering for secure software - SQUARE process Model - Requirements elicitation and prioritization- Isolating The Effects of Untrusted Executable Content - Stack Inspection – Policy Specification Languages – Vulnerability Trends – Buffer Overflow – Code Injection - Session Hijacking. Secure Design - Threat Modeling and Security Design Principles.

UNIT - III SECURITY RISK MANAGEMENT 9

Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management.

UNIT - IV SECURITY TESTING 9

Traditional Software Testing – Comparison - Secure Software Development Life Cycle - Risk Based Security Testing – Prioritizing Security Testing With Threat Modeling – Penetration Testing – Planning and Scoping - Enumeration – Remote Exploitation – Web Application Exploitation - Exploits and Client Side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection - Tools for Penetration Testing.

UNIT - V SECURE PROJECT MANAGEMENT 9

Governance and security - Adopting an enterprise software security framework - Security and project management - Maturity of Practice.

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Julia H. Allen, "Software Security Engineering", Pearson Education, 2008
2. Evan Wheeler, "Security Risk Management: Building an Information Security Risk Management Program from the Ground Up", First edition, Syngress Publishing, 2011

REFERENCES:

1. Chris Wysopal, Lucas Nelson, Dino Dai Zovi, and Elfriede Dustin, "The Art of Software Security Testing: Identifying Software Security Flaws (Symantec Press)", Addison-Wesley Professional, 2006.
2. Robert C. Seacord, "Secure Coding in C and C++ (SEI Series in Software Engineering)", Addison-Wesley Professional, 2005.
3. Jon Erickson, "Hacking: The Art of Exploitation", 2nd Edition, No Starch Press, 2008.
4. Mike Shema, "Hacking Web Apps: Detecting and Preventing Web Application Security Problems", First edition, Syngress Publishing, 2012
5. Lee Allen, "Advanced Penetration Testing for Highly-Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled)", Kindle Edition, Packt Publishing, 2012

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Engineering Secure Software Systems		Course Code : 24SCV34	
CO	Course Outcomes	Unit	K –CO
CO1	Explain various vulnerabilities related to memory attacks and low level attacks.	I	K2
CO2	Apply security principles in software development and secure design.	II	K3
CO3	Implement appropriate risk mitigation strategies based on risk exposure and evaluation outcomes.	III	K3
CO4	Apply various testing techniques related to software security in the testing phase of software development	IV	K3
CO5	Implement enterprise software security frameworks to enhance security throughout the project lifecycle.	V	K3

HOD/AI&DS

24SCV44**QUANTUM COMPUTING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To know the background of classical computing and quantum computing.
- To learn the fundamental concepts behind quantum computation.
- To study the details of quantum mechanics and its relation to Computer Science.
- To gain knowledge about the basic hardware and mathematical models of quantum computation.
- To learn the basics of quantum information and the theory behind it.

UNIT - I QUANTUM COMPUTING BASIC CONCEPTS**9**

Complex Numbers - Linear Algebra - Matrices and Operators - Global Perspectives
Postulates of Quantum Mechanics – Quantum Bits - Representations of Qubits – Super positions

UNIT -II QUANTUM GATES AND CIRCUITS**9**

Universal logic gates - Basic single qubit gates - Multiple qubit gates - Quantum circuits, Solovay-Kitaev theorem, Circuit development - Quantum error correction

UNIT- III QUANTUM ALGORITHMS**9**

Quantum parallelism - Deutsch's algorithm - The Deutsch–Jozsa algorithm - Quantum Fourier transform and its applications - Quantum Search Algorithms: Grover's Algorithm

UNIT- IV QUANTUM INFORMATION THEORY**9**

Data compression - Shannon's noiseless channel coding theorem - Schumacher's quantum noiseless channel coding theorem - Classical information over noisy quantum channels - Coding a quantum computer using a simulator to carry out basic quantum measurement and state analysis.

UNIT -V QUANTUM CRYPTOGRAPHY**9**

Classical cryptography basic concepts - Private key cryptography - Shor's Factoring Algorithm - Quantum Key Distribution - BB84 - Ekert 91

TOTAL: 45 PERIODS**TEXT BOOKS**

1. Parag K Lala, Mc Graw Hill Education, "Quantum Computing, A Beginners Introduction", First edition (1 November 2020).
2. Chris Bernhardt, The MIT Press; Reprint edition (8 September 2020), "Quantum Computing for Everyone".

REFERENCE:

1. Michael A. Nielsen, Issac L. Chuang, "Quantum Computation and Quantum Information", Tenth Edition, Cambridge University Press, 2010.
2. Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 2013.
3. N.David Mermin, "Quantum Computer Science: An Introduction", Cambridge, 2007.

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Quantum Computing		Course Code : 24SCV44	
CO	Course Outcomes	Unit	K –CO
CO1	Discuss the basics of quantum computing	I	K2
CO2	Implement quantum gates and circuits to design and analyze basic quantum computing systems.	II	K3
CO3	Apply quantum algorithms for problem-solving applications.	III	K3
CO4	Apply quantum information theory concepts to analyze quantum information systems	IV	K3
CO5	Implement quantum cryptographic techniques to secure communication systems.	V	K3

HOD/AI&DS

24SCV54**SOCIAL MEDIA SECURITY**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand social networks & social media
- To demonstrate the usage of Social Media.
- To understand the need of security in social data.
- To become familiar in the Phishing attacks
- To demonstrate the basic concepts of Policies and Privacy

UNIT - I INTRODUCTION**9**

Introduction to Social Media, Understanding Social Media, Different Types and Classifications, The Value of Social Media, Cutting Edge Versus Bleeding Edge, The Problems That Come With Social Media, Is Security Really an Issue? Taking the Good With the Bad.

UNIT - II THE DARK SIDE**9**

Dark side Cybercrime, Social Engineering, Hacked accounts, cyberstalking, cyberbullying, predators, phishing, hackers.

UNIT - III BEING BOLD VERSUS BEING OVERLOOKED**9**

Being bold versus being overlooked Good social media campaigns, Bad social media campaigns, Sometimes it's better to be over looked, Social media hoaxes, The human factor, Content management, Promotion of social media.

UNIT - IV RISK MANAGEMENT**9**

Risks of Social media Introduction Public embarrassment, Once it's out there, it's out there False information, Information leakage, Retention and archiving, Loss of data and equipment.

UNIT - V POLICIES AND PRIVACY**9**

Policies and Privacy Blocking users controlling app privacy, Location awareness, Security Fake accounts passwords, privacy and information sharing

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Michael Cross, Social Media Security Leveraging Social Networking While Mitigating Risk.
2. Online Social Networks Security, Brij B. Gupta, Somya Ranjan Sahoo, Principles, Algorithm, Applications, and Perspectives, CRC press.

REFERENCES:

1. Interdisciplinary Impact Analysis of Privacy in Social Networks, Recognizing Your Digital Friends, Encryption for Peer-to-Peer Social Networks Crowd sourcing and Ethics, Authors: Altshuler Y, Elovici Y, Cremers A.B, Aharony N, Pentland A. (Eds.).

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Social Media Security		Course Code : 24SCV54	
CO	Course Outcomes	Unit	K –CO
CO1	Describe social media, Cutting Edge Versus Bleeding Edge	1	K2
CO2	Apply knowledge of attacker techniques and cyber threats to analyze vulnerabilities in digital communication systems.	II	K3
CO3	Implement appropriate social media practices to analyze campaign effectiveness and manage online communication challenges.	III	K3
CO4	Apply risk management techniques in social media environments	IV	K3
CO5	Implement privacy and security practices to safeguard personal information on online platforms.	V	K3

HOD/AI&DS

24SCV64**AUTHENTICATION TECHNIQUES**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand concept of authentication types, protocols, physical identification, and various authentication algorithms.
- To learn text and voice-based authentication techniques.
- To learn different types of digital identification.
- To acquire knowledge of different international standards and policies for authentication
- To explore different tools used for authentication.

UNIT - I INTRODUCTION**9**

Definition of Authentication, Identification/verification, Stages and steps of authentication, Authentication Entity : User, Device and Application; Authentication attributes: Source, Location, Path, Time duration etc.; Authentication Types : Direct / Indirect, One Way / Mutual, On demand/ Periodic/Dynamic/Continuous authentication, Assisted/Automatic; Factors of authentication; Passwords, Generation of passwords of varied length and of mixed type, OTP, passwords generation using entity identity credentials; Secure capture, processing, storage, verification and retrieval of passwords

UNIT - II PHYSICAL IDENTIFICATION**9**

Physical identification using smart cards, remote control device, proximity sensors, surveillance camera, authentication in Card present / Card Not Present transactions as ATM/ PoS Device, mobile phone, wearable device and IoT device - based authentication; single sign on; Symmetric Key Generation, Key Establishment, Key Agreement Protocols

UNIT - III MULTI MODAL BIOMETRICS**9**

Biometrics – photo, face, iris, retinal, handwriting, signature, fingerprint, palm print, hand geometry, voice – Text based and text independent voice authentication, style of talking, walking, writing, keystrokes, gait etc. multi-modal biometrics.

UNIT - IV ALGORITHMS AND STANDARDS**9**

Matching algorithms, Patterns analysis, errors, performance measures, ROC Curve; Authentication Standards– International, UIDAI Standard. Kerberos, X.509 Authentication Service, Public Key Infrastructure, Scanners and Software; Web Authentication Methods: Http based, Token Based, OAuth and API.

UNIT - V AUTHENTICATION PROTOCOLS AND TOOLS**9**

User authentication protocols in multi server environment, BAN Logic, Representation of authentication protocols using BAN Logic, Random Oracle Model, Scyther Tools, Proverif tool, Chebyshev Chaotic Map, Fuzzy Extractor, Fuzzy Extractor Map, Bloom Filter, LU Decomposition based User Authentication, Blockchain based authentication.

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Protocols for Authentication and Key Establishment, Colin Boyd and Anish Mathuria, Springer, 2021
2. Guide to Biometrics, Ruud M. Bolle, Sharath Pankanti, Nalini K. Ratha, Andrew W. Senior, Jonathan H. Connell, Springer 2009.

REFERENCES:

1. Digital Image Processing using MATLAB, Rafael C. Gonzalez, Richard Eugene Woods, 2nd Edition, Tata McGraw-Hill Education 2010.
2. Biometric System and Data Analysis: Design, Evaluation, and data Mining, Ted Dunstone and Neil Yager, Springer.
3. Biometrics Technologies and verification Systems, John Vacca, Elsevier Inc., 2007.
4. Pattern Classification, Richard O. Duda, David G. Stork, Peter E. Hart, Wiley 2007.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Authentication Techniques		Course Code : 24SCV64	
CO	Course Outcomes	Unit	K –CO
CO1	Implement authentication mechanisms including direct, indirect, continuous, and dynamic methods to enhance system security.	1	K3
CO2	Discuss text based and voice-based authentication techniques	II	K2
CO3	Apply physiological and behavioral biometric techniques to design secure authentication solutions	III	K3
CO4	Apply authentication algorithms and standards to design secure authentication mechanisms in computing systems	IV	K3
CO5	Apply various authentication protocols in multi-server environment and their representation	V	K3

HOD/AI&DS

24CIV15	AUGMENTED REALITY AND VIRTUAL REALITY	L 3	T 0	P 0	C 3
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OBJECTIVES:

- To impart the fundamental aspects and principles of AR/VR technologies.
- To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
- To know the technologies involved in the development of AR/VR based applications.

UNIT-I INTRODUCTION to AR/VR 9

Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.

UNIT-II VR MODELING 9

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management

UNIT-III VR PROGRAMMING 9

VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D.

UNIT- IV APPLICATIONS 9

Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education.

UNIT-V AUGMENTED REALITY 9

Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation-Navigation-Wearable devices.

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile", Packt Publisher, 2018
2. Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles & Practice", Addison Wesley, 2016

REFERENCES:

1. John Vince, "Introduction to Virtual Reality", Springer-Verlag, 2004.
2. William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design", Morgan Kaufmann, 2003
3. Gerard Jounghyun Kim, "Designing Virtual Reality Systems: The Structured Approach",

Springer, 2005.

4. Jason Jerald, "The VR Book: Human-Centered Design for Virtual Reality", ACM Books, 2015.
5. Steve Aukstakalnis, "Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR", Addison-Wesley Professional, 2016

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Augmented Reality And Virtual Reality		Course Code : 24CIV15	
CO	Course Outcomes	Unit	K –CO
CO1	Illustrate the basic concepts of AR and VR	I	K2
CO2	Demonstrate the tools and technologies related to VR	II	K3
CO3	Apply the working principle of VR related Sensor devices	III	K3
CO4	Develop VR applications in different domains	IV	K3
CO5	Classify various models using modeling techniques of AR	V	K3

HOD/AI&DS

24CIV25

AI in IoT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn integrate AI into IoT systems for real time decision making.
- To Learn AI driven data analytics through real time data processing
- Formalize a given problem in the language/framework of different AI methods

UNIT-I	INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND DATA PROCESSING	9
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Overview of Artificial Intelligence and its applications across various industries- Characteristics of Intelligent Agents –Typical Intelligent Agents–Problem Solving Approach to Typical AI Problems– Search Strategies-AI models-Data Acquisition and Learning Aspects in AI,Underlying Assumption, Data preprocessing: Processing IoT data streams and sensor data, Filtering and normalization

UNIT-II	KNOWLEDGE REPRESENTATION AND REASONING	9
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Representations and Mappings, Approaches to Knowledge Representation. Using Predicate Logic, Representation Simple Facts in Logic, Representing instance and Relationships, Computable Functions and Predicates, Resolution. Representing Knowledge Using Rules, Procedural versus Declarative Knowledge, Forward versus Backward Reasoning

UNIT-III	IOT PLATFORMS AND TOOLS FOR INTEGRATION	9
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Overview of open-source IoT platforms, APIs and middleware for AI integration, implementation challenges, scalability, interoperability and regulatory considerations. AIOT platforms- AWS Green grass, Google Cloud Vertex AI, and Azure IoT, AIoT Integration - Connecting Devices- Techniques for establishing seamless communication between mobile devices, IoT gateways and cloud.

UNIT- IV	NATURAL LANGUAGE PROCESSING	9
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Introduction- Syntactic Processing, Semantic Analysis, Discourse and Pragmatic Processing. Connectionist Models- Hopfield Network, Learning in Neural Networks, Connectionist AI and Symbolic AI, NLP applications

UNIT-V	ENERGY EFFICIENCY AND REAL TIME ANALYTICS IN AI DRIVEN IOT	9
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Managing power consumption in IoT systems, Optimizing AI inference for low-energy IoT devices, AI techniques to extend battery life in IoT devices, AI for real-time monitoring, control and decision-making, Stream processing with AI in IoT systems, AI applications.

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Artificial Intelligence -By Elaine Rich And Kevin Knight(2nd Edition) Tata Mcgraw-Hill
2. Artificial Intelligence” (Fifth Edition) -By George F Luger, Pearson Education.

REFERENCES:

1. “Artificial Intelligence” (Second Edition)-By Stuart Russell and Peter Norvig, Pearson Education.
2. Artificial Intelligence Application Programming, Tim Jones, Wiley India.
3. Artificial Intelligence And Expert Systems ” -By D.W Patterson
4. “The Future of Artificial Intelligence, the Internet of Things, and Blockchain: From AI to AIoT to AIoT2”. By Eugene Chang. Publisher: Amazon. 2019.
5. “AIoT Innovation”,ed. Fadi Al-Turjman Publisher: Springer 2020

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : AI in IOT		Course Code : 24CIV25	
CO	Course Outcomes	Unit	K –CO
CO1	Describe the fundamental concepts and Data Processing of AI.	I	K2
CO2	Illustrate Knowledge Representation Techniques	II	K3
CO3	Demonstrate IoT Platforms and Tools for Integration	III	K3
CO4	Classify the concept of NLP and its applications in real world scenarios.	IV	K3
CO5	Apply AI models and Techniques for IoT operation efficiency.	V	K3

HOD/AI&DS

24CIV35	INDUSTRIAL IOT AND INDUSTRY 4.0	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the evolution and principles of Industry 4.0 and Industrial IoT (IIoT)
- To develop knowledge of IIoT architecture, technologies, and data analytics frameworks
- To explore automation, digital transformation, and security in smart manufacturing systems

UNIT-I INTRODUCTION TO INDUSTRY 4.0 9

Evolution of Industrial Revolutions (Industry 1.0 to 4.0) - Key enabling technologies in Industry 4.0 - Cyber - Physical Systems (CPS) - Smart Manufacturing & Smart Factories - Differences between IIoT and IoT - Applications of Industry 4.0 in various sectors.

UNIT-II FUNDAMENTALS OF INDUSTRIAL IoT 9

Architecture of IIoT - Perception, Network, Edge, Application layers - IIoT Devices: Sensors, Actuators, RFID, Smart Meters, PLCs - Communication Protocols: Modbus, OPC-UA, MQTT, CoAP, DDS, AMQP - Industrial wireless technologies: 5G for IIoT - Data acquisition, storage, and preprocessing.

UNIT-III DATA ANALYTICS AND CLOUD/EDGE COMPUTING 9

Industrial Data Lifecycle - Role of Big Data in IIoT - HDFS, Spark, NoSQL databases - Cloud computing platforms for IIoT (AWS IoT, Azure IoT Hub, Google Cloud IoT) - Edge and Fog computing in IIoT - Machine Learning and AI applications in predictive maintenance.

UNIT- IV INDUSTRIAL AUTOMATION AND SMART SYSTEMS 9

PLC, SCADA, and DCS in Industry 4.0 -Digital Twins – Concept, Architecture, and Applications - Additive Manufacturing - 3D Printing in Industry 4.0 - Robotics and Autonomous Systems - Human-Machine Interfaces and Augmented Reality in Industry 4.0.

UNIT-V SECURITY, STANDARDS, AND CASE STUDIES 9

Security challenges in IIoT - Industry 4.0 standards: RAMI 4.0, Industrial Internet Reference Architecture (IIRA) - Case studies: Smart Grid, Smart Logistics, Smart Healthcare, Smart Cities, Predictive Maintenance - Future trends: Industry 5.0, Human–Robot collaboration.

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, 2016.
2. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, Industrial Internet of Things: Cybermanufacturing Systems, Springer, 2017.

REFERENCES:

1. S. K. Singh, Industrial Instrumentation and Control, Tata McGraw-Hill Education, 2016.
2. Ovidiu Vermesan and Peter Friess (Editors), Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers, 2013.
3. Buyya, Amir Vahid Dastjerdi, Internet of Things: Principles and Paradigms, Morgan Kaufmann, 2016.

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Industrial Iot and Industry 4.0		Course Code : 24CIV35	
CO	Course Outcomes	Unit	K –CO
CO1	Explain the evolution of industrial revolutions and the role of enabling technologies.	I	K2
CO2	Demonstrate the role of wireless technologies in industrial connectivity	II	K3
CO3	Apply data analytics, cloud, edge, and AI/ML techniques to manage and utilize industrial big data	III	K3
CO4	Illustrate cross platform applications with basic GUI and event handling.	IV	K3
CO5	Elaborate IIoT security challenges, industry standards, and real-world case studies	V	K3

HOD/AI&DS

24CIV45**APP DEVELOPMENT**

L	T	P	C
2	0	2	3

OBJECTIVES:

- To learn development of native applications with basic GUI Components
- To develop cross-platform applications with event handling
- To develop applications with location and data storage capabilities

UNIT-I	FUNDAMENTALS OF MOBILE & WEB APPLICATION DEVELOPMENT	6
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Basics of Web and Mobile application development, Native App, Hybrid App, Cross-platform App, What is Progressive Web App, Responsive Web design

UNIT-II	NATIVE APP DEVELOPMENT USING JAVA	6
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Native Web App, Benefits of Native App, Scenarios to create Native App, Tools for creating Native App, Cons of Native App, Popular Native App Development Frameworks, Java & Kotlin for Android, Swift & Objective-C for iOS, Basics of React Native, Native Components, JSX, State, Props

UNIT-III	HYBRID APP DEVELOPMENT	6
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Hybrid Web App, Benefits of Hybrid App, Criteria for creating Native App, Tools for creating Hybrid App, Cons of Hybrid App, Popular Hybrid App Development Frameworks, Ionic, Apache Cordova

UNIT- IV	CROSS-PLATFORM APP DEVELOPMENT USING REACT-NATIVE	6
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What is Cross-platform App, Benefits of Cross-platform App, Criteria for creating Cross-platform App, Tools for creating Cross-platform App, Cons of Cross-platform App, Popular Cross-platform App Development Frameworks, Flutter, Xamarin, React-Native, Basics of React Native, Native Components, JSX, State, Props

UNIT-V	NON-FUNCTIONAL CHARACTERISTICS OF APP FRAMEWORKS	6
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Comparison of different App frameworks, Build Performance, App Performance, Debugging capabilities, Time to Market, Maintainability, Ease of Development, UI/UX, Reusability

PRACTICAL EXERCISES:

1. Using react native, build a cross platform application for a BMI calculator.
2. Build a cross platform application for a simple expense manager which allows entering expenses and income on each day and displays category wise weekly income and expense.
3. Develop a cross platform application to convert units from imperial system to metric system (km to miles, kg to pounds etc.,)
4. Design and develop a cross platform application for day to day task (to-do) management.
5. Design an android application using Cordova for a user login screen with username, password, reset button and a submit button. Also, include header image and a label. Use layout managers.
6. Design and develop an android application using Apache Cordova to find and display the current location of the user.
7. Write programs using Java to create Android application having Databases

- For a simple library application.
- For displaying books available, books lend, book reservation.

Assume that student information is available in a database which has been stored in a database server.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Head First Android Development, Dawn Griffiths, O'Reilly, 1st edition
2. Apache Cordova in Action, Raymond K. Camden, Manning. 2015.

REFERENCES:

1. Android Programming for Beginners, John Horton, Packt Publishing, 2nd Edition
2. Native Mobile Development by Shaun Lewis, Mike Dunn
3. Building Cross-Platform Mobile and Web Apps for Engineers and Scientists:
An Active Learning Approach, Pawan Lingras, Matt Triff, Rucha Lingras
4. Apache Cordova 4 Programming, John M Wargo, 2015
5. React Native Cookbook, Daniel Ward, Packt Publishing, 2nd Edition.
6. Full Stack React Native: Create beautiful mobile apps with JavaScript and React Native, Anthony Accomazzo, Houssein Djirdeh, Sophia Shoemaker, Devin Abbott, FullStack publishing

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : App Development		Course Code : 24CIV45	
CO	Course Outcomes	Unit	K –CO
CO1	Demonstrate Native applications with GUI Components	I	K3
CO2	Illustrate hybrid applications with basic event handling.	II	K3
CO3	Discuss cross-platform applications with location and data storage capabilities.	III	K3
CO4	Apply cross platform applications with basic GUI and event handling.	IV	K3
CO5	Develop web applications with cloud database access.	V	K3

HOD/AI&DS

24CIV55**WEARABLE COMPUTING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To Describe and discuss constraints unique to wearable and ubiquitous computing platforms and applications
- To Design, develop and evaluate a wearable computing application
- To Apply state-of-the-art hardware and software development tools to computer system design.

UNIT-I	INTRODUCTION TO WEARABLE TECHNOLOGIES	9
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Fundamentals of Wearable Technologies - History of wearable Technologies -User Experience Design for Internet of Things - Social Aspects of Wearability - Internet of Things – Applications - Wearable Chemical and Biochemical Sensors - Technology of Connected Devices – Device Types- Sensors- Actuators.

UNIT-II	WEARABLE COMPUTING ARCHITECHTURE	9
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Wearable Algorithms - Web of Things – Architecture Standardization- Data Mining for Body Sensor Network - Internet of Things – Embedded Device UX Design

UNIT-III	WEARABLE COMPUTING APPLICATIONS	9
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Medical Applications of Wearable Technologies - Wearable Technologies - Energy Expenditure and Energy Harvesting - Technology of Connected Devices – Energy Considerations - Flexible Electronics and Textiles for Wearable Technologies.

UNIT- IV	COMMUNICATION TECHNOLOGIES	9
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Physical Activity Modeling and Behavior Change - Internet of Things – Interface and Interaction Design - Human Body Communication -Data Rate Sensor Network- Internet of Things – Networking. - Wireless Body Area Networks - Wearable Computing urban design

UNIT-V	BUILDING BLOCKS & CASE STUDIES	9
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Bluetooth Low Energy (BLE) - Embedded Software Programming - Sensors for wearable - Data from Wearable Device Android Wear - Apple Watch Kit - Cloud Services - Google Fit - Apple Health Kit –Case studies: Wearable Sensors for Monitoring –Physical & Physiological Changes for Early Detection of Diseases - Wearable and Non-Invasive Assistive Technologies

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. " Linowes Jonathan, Augmented Reality for Developers, 1st edition, Packt Publishing Limited,2017
2. Fortino, Giancarlo, Raffaele Gravina, and Stefano Galzarano, Wearable computing: from modeling to implementation of wearable systems based on body sensor networks, 1st edition.

REFERENCES:

1. Simon Monk , Programming the Raspberry Pi: Getting Started with Python 2nd edition, 2016
2. Barfield, Woodrow, ed. Fundamentals of wearable computers and augmented reality, 1st edition, CRC press, 2015.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Wearable Computing		Course Code : 24CIV55	
CO	Course Outcomes	Unit	K –CO
CO1	Describe the advanced and emerging technologies	I	K2
CO2	Extend the knowledge achieved and apply it to solve real world problems.	II	K3
CO3	Categorize different methodologies for research on wearable technology.	III	K3
CO4	Demonstrate the ethical issues related to the Wearable devices.	IV	K3
CO5	Apply several domain through wearable technology.	V	K3

HOD/AI&DS

24CIV65	DRONE TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of drone concepts
- To learn and understand the fundamentals of design, fabrication and programming of drone
- To understand the safety risks and guidelines of fly safely

UNIT-I	INTRODUCTION TO DRONE TECHNOLOGY	9
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Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability

UNIT-II	DRONE DESIGN, FABRICATION AND PROGRAMMING	9
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Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.

UNIT-III	DRONE FLYING AND OPERATION	9
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Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity - Removable storage devices- Linked mobile devices and applications

UNIT- IV	DRONE COMMERCIAL APPLICATIONS	9
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Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing

UNIT-V	FUTURE DRONES AND SAFETY	9
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The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", 2021 John Wiley & Sons, Inc.
2. Terry Kilby and Belinda Kilby, "Make:Getting Started with Drones ",Maker Media, Inc, 2016

REFERENCES:

1. John Baichtal, "Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs", Que Publishing, 2016
2. Zavrnsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2018

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Drone Technologies		Course Code : 24CIV65	
CO	Course Outcomes	Unit	K –CO
CO1	Explain the various type of drone technology, drone fabrication and programming	I	K2
CO2	Utilize the suitable operating procedures for functioning a drone	II	K3
CO3	Classify appropriate sensors and actuators for Drones	III	K3
CO4	Develop a drone mechanism for specific applications	IV	K3
CO5	Develop the programs for various drones for future	V	K3

HOD/AI&DS

OPEN ELECTIVE

24OE401	INTRODUCTION TO OPERATING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic concepts and functions of operating systems.
- To understand Processes and Threads.
- To analyze Scheduling algorithms.
- To understand the concept of Deadlocks.
- To analyze various memory management schemes.
- To understand I/O management and File systems.
- To study various operating systems like Distributed OS, Real-Time OS.

UNIT-I OPERATING SYSTEM OVERVIEW 9

Operating System Overview - Objectives and Functions, Evolution of Operating Systems, Operating System Structure and Operations- System Calls, System Programs, Operating Systems Generation and System Boot.

UNIT-II PROCESS MANAGEMENT AND CONCURRENCY CONTROL 9

Processes - Process Concept and Scheduling, Operations on Processes, Inter Process Communication - CPU Scheduling - Scheduling criteria, Scheduling algorithms; Threads- Multithreading models, Threading issues; Process Synchronization - The critical-section problem - synchronization hardware - Semaphores

UNIT - III DEADLOCK AND MEMORY MANAGEMENT 9

Deadlock - Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock; Main Memory - Swapping, Contiguous Memory Allocation - Paging - Segmentation - Fragmentation; Virtual Memory - Demand Paging - Page Replacement.

UNIT - IV MASS STORAGE AND FILE SYSTEMS 9

Overview of Mass Storage System and Structure- Disk Structure, Disk Scheduling; File-System-Interface- File concept, Access methods, File Sharing and Protection, Allocation Methods, Free Space Management; Directory- Structure, organization, implementation.

UNIT - V ADVANCED OPERATING SYSTEMS 9

Basics of Network Operating System, Server Operating System, Real Time Operating System and Distributed Operating Systems - MAC OS, Linux, Ubuntu.

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, - Operating System Concepts, 10th Edition, John Wiley and Sons Inc., 2018.
2. William Stallings, "Operating Systems - Internals and Design Principles", 9th Edition, Prentice Hall, 2018.

REFERENCES:

1. Andrew S. Tanenbaum, "Modern Operating Systems", Fifth Edition, Pearson Publications, 2022.
2. AchyutS.Godbole, AtulKahate, - Operating SystemsII, McGraw Hill Education, 2016.
3. RamazElmasri, A. Gil Carrick, David Levine, - Operating Systems - A Spiral Approach, Tata McGraw Hill Edition, 2010.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Introduction to Operating Systems		Course Code : 24OE401	
CO	Course Outcomes	Unit	K –CO
CO1	Explain the basic functions of Operating System and Process communications.	I	K2
CO2	Apply various CPU scheduling algorithms specifically FCFS, SJF, Priority and Round Robin.	II	K3
CO3	Apply various process synchronization methods and deadlock avoidance algorithm for a given scenario	III	K3
CO4	Design memory management schemes using paging and segmentation	IV	K3
CO5	Explain various file allocation methods and directory structures and different advanced operating systems	V	K2

HOD/AI&DS

24OE402	INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamentals of data models and to depict a database system using ER diagrams
- To study relational database and to write SQL queries to store/retrieve data to/from database
- To understand the fundamental concepts of transaction processing- concurrency control techniques and recovery procedures for real time applications
- To understand working procedures of query processing and query optimization techniques
- To understand the internal storage structures using different file and indexing techniques which will help in physical DB design
- To study concepts of advanced databases

UNIT – I DATABASE FUNDAMENTALS 8

Purpose of Database System – Views of data – Database System Architecture – Introduction to Data Models –Introduction to Relational Model – Constraints – keys – Entity Relationship Model – Entity Sets – Attributes - Extended E-R features – ER reduction to Relational Schemas.

UNIT – II RELATIONAL DATABASE 10

Structure of Relational Database –SQL Fundamentals – Basic Queries – Set Operations – Aggregate Functions – Clauses – Sub queries – Correlated Sub queries – Joins – Views – Authorization – Advanced SQL – Triggers – Cursors – Procedure – Functions – Embedded SQL – Dynamic SQL

UNIT – III DATABASE DESIGN 9

Need for Database Design – Functional Dependencies – Closure of Functional Dependencies – Attribute Closure – Dependency Preservation – Decomposition – Canonical Cover – First Normal Form – Second Normal Form – Third Normal Form – Second Normal Form – Third Normal Form – Boyce Codd Normal Form – Multivalued Dependencies - Fourth Normal Form – Join Dependencies – Fifth Normal Form.

UNIT – IV TRANSACTIONS 9

Transaction Concepts – ACID properties – Transaction States – Serializability – Conflict Serializability – View Serializability – Concurrency Control – Lock Based Protocols – Deadlocks – Time Based Protocols – Stamp Based Protocols – Validation Based Protocols – Recovery System

UNIT –V STORAGE AND QUERY PROCESSING 9

RAID – File Organization – Organization of Records in Files – Indexing and Hashing – Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for SELECT and JOIN operations

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, Tata McGraw Hill, 2019.
2. RamezElmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2016.

REFERENCES:

1. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
2. Raghu Ramakrishnan, "Database Management Systems", Fourth Edition, McGraw-Hill College Publications, 2015.
3. G.K.Gupta, "Database Management Systems", Tata McGraw Hill, 2011.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Introduction to Database Management Systems		Course Code : 24OE402	
CO	Course Outcomes	Unit	K –CO
CO1	Explain the fundamental elements of relative database management systems.	I	K2
CO2	Formulate SQL queries for the given relational tables.	II	K3
CO3	Apply normal forms to identify the redundancy in database tables.	III	K3
CO4	Explain various protocols in transaction processing.	IV	K2
CO5	Discuss file organization in database storage system and apply algorithms for SELECT and JOIN operations.	V	K2

HOD/AI&DS

24OE403	COMPUTER COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the protocol layering and physical level communication.
- To analyze the performance of a network.
- To understand the various components required to build different networks.
- To learn the functions of network layer and the various routing protocols.
- To familiarize the functions and protocols of the Transport layer.

UNIT – I INTRODUCTION AND PHYSICAL LAYER 9

Networks – Network Types – Classification of computer Networks LAN, WAN, MAN, Network Topology: BUS, STAR, RING, MESH- Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit Switching, Packet Switching.

UNIT – II DATA-LINK & MEDIA ACCESS LAYER 9

Introduction – Link Layer Addressing – Framing, Physical Addressing, Flow control-noisy and noiseless channels, Error Control – Error detection and Error correction codes- Access control ALOHA, CSMA, CSMA/CD, TDMA, FDMA- Ethernet - Wireless LANs -IEEE 802.11, Bluetooth – Connecting Devices.

UNIT – III NETWORK LAYER 9

Network Layer Services – Performance – Logical Addressing- IPV4, IPV6- Network Layer Protocols- IP, ICMP, IGMP – Unicast Routing Algorithms - Distance Vector, Link state algorithms, Multicasting Basics Routing

UNIT – IV TRANSPORT LAYER 9

Introduction – Transport Layer Protocols-. TCP, UDP – Services – Port Numbers -Flow control- TCP congestion control, Congestion avoidance mechanisms, Quality of service

UNIT – V APPLICATION LAYER 9

WWW and HTTP– FTP – Email –Telnet –SSH – DNS.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Behrouz A. Forouzan, "Data Communications and Networking", Fifth Edition TMH, 2013.
2. William Stallings, "Data and Computer Communications", Tenth Edition, Pearson Education, 2013.

REFERENCES:

1. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
2. Nader F. Mir, "Computer and Communication Networks", Second Edition, Prentice Hall,

2014.

3. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill Publisher, 2011.
4. James F. Kurose, Keith W. Ross, "Computer Networking, A Top-Down Approach Featuring the Internet", Sixth Edition, Pearson Education, 2013.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Computer Communication Networks			Course Code : 24OE403	
CO	Course Outcomes	Unit	K –CO	
CO1	Explain the organization of computer networks with the concept of layered approach	I	K2	
CO2	Classify various Media Access Control Protocols techniques	II	K3	
CO3	Apply the error detection and error correction methods for bit streams and compare various routing algorithms	III	K3	
CO4	Describe the functionalities of TCP and UDP	IV	K2	
CO5	Classify different application layer protocols	V	K3	

HOD/AI&DS

24OE404	CLOUD INFRASTRUCTURE AND TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn about the concept of cloud and utility computing.
- To have knowledge on the various issues in cloud computing.
- To be familiar with the lead players in cloud.
- To appreciate the emergence of cloud as the next generation computing paradigm.

UNIT –I INTRODUCTION TO CLOUD COMPUTING 9

Introduction to Cloud Computing – Roots of Cloud Computing – Desired Features of Cloud Computing – Challenges and Risks – Benefits and Disadvantages of Cloud Computing

UNIT –II VIRTUALIZATION 9

Introduction to Virtualization Technology – Load Balancing and Virtualization – Understanding Hypervisor – Seven Layers of Virtualization – Types of Virtualization – Server, Desktop, Application Virtualization.

UNIT –III CLOUD ARCHITECTURE, SERVICES AND STORAGE 9

NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - IaaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage.

UNIT –IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD 9

Inter Cloud Resource Management – Resource Provisioning Methods – Security Overview – Cloud Security Challenges – Data Security –Application Security – Virtual Machine Security.

UNIT –V CASE STUDIES 9

Google App Engine(GAE) – GAE Architecture – Functional Modules of GAE – Amazon Web Services(AWS) – GAE Applications – Cloud Software Environments – Eucalyptus – Open Nebula – Open Stack

TOTAL: 45 PERIODS

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

REFERENCES:

1. Buyya R., Broberg J., Goscinski A., "Cloud Computing: Principles and Paradigm", First Edition, John Wiley & Sons, 2011.
2. RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering Cloud Computing", Tata Mcgraw Hill, 2013.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach", Tata Mcgraw Hill, 2009.

4. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)", O'Reilly, 2009.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Cloud Infrastructure and Technologies		Course Code : 24OE404	
CO	Course Outcomes	Unit	K –CO
CO1	Explain the main concepts, key technologies, strengths and limitations of cloud computing.	I	K2
CO2	Describe the key and enabling technologies that help in virtualization.	II	K2
CO3	Discuss and use the architecture of compute and storage cloud with its service and delivery models.	III	K2
CO4	Explain the core issues of cloud computing such as resource management and security.	IV	K2
CO5	Illustrate the appropriate technologies, algorithms and approaches for implementation and use of cloud	V	K3

HOD/AI&DS

24OE405	DATA SCIENCE USING PYTHON	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Learn the data analysis basics with Python
- Study Data Analysis and interpretation with Numpy on statistical parameters
- Understand various methods of Data Preparation and Manipulation with Pandas
- Learn about the relationship between data.
- Learn Data Visualization using matplotlib and seaborn

UNIT-I INTRODUCTION TO DATA ANALYSIS 9

Data Analysis - Mathematics and Statistics Basic Concepts - The Data Analysis Process - Data Extraction -Data Preparation – Data Exploration / Visualization - Predictive Modeling - Model Validation- Quantitative and Qualitative Analysis

UNIT-II INTRODUCTION TO NUMPY 9

Python data types - NumPy Arrays with Computations - Aggregations: Min, Max, and Everything In Between-Broadcasting - Comparisons, Masks, and Boolean Logic – Sorting Arrays - Structured Data with NumPy's Arrays

UNIT-III DATA MANIPULATION WITH PANDAS 9

Introducing Pandas Objects - Data Indexing and Selection - Operating on Data in Pandas - Handling Missing Data - Hierarchical Indexing - Combining Datasets - Vectorized String Operations - Working with Time Series - High-Performance.

UNIT- IV DESCRIBING RELATIONSHIPS 9

Correlation –correlation coefficient for quantitative data –computational formula, correlation coefficient – Regression –regression line –least squares regression line – Standard error of estimate – interpretation of r^2 –multiple regression equations –regression towards the mean.

UNIT-V VISUALIZATION WITH MATPLOTLIB 9

Various Plots - Simple Line - Scatter Plots - Error Visualization - Density and Contour Plots - Histograms, Binnings, and Density - Customizing Plots-Multiple Subplots – Three Dimensional Plotting in Matplotlib - Geographic Data with Basemap - Visualization with Seaborn.

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Fabio Nelli 2015, Python Data Analytics, Apress, USA.
2. Jake Vander Plas, 2016, Python Data Science Handbook: Essential Tools for Working with Data, O'Reilly Media, Inc
3. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017.

REFERENCES:

1. McKinney, W 2017, Python for Data Analysis, 2nd ed, O'Reilly Media, Inc.
2. John V Guttag 2013, Introduction to Computation and Programming Using Python, Revised and Expanded Edition, MIT Press.
3. Timothy A. Budd 2015, Exploring Python, Mc-Graw Hill Education Private Ltd.
ReemaThareja, "Programming in C", Oxford University Press, Second Edition, 2016

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Data Science Using Python		Course Code : 24OE405	
CO	Course Outcomes	Unit	K –CO
CO1	Determine the various data analysis process in data science	I	K2
CO2	Apply data analysis and interpretation with Numpy on statistical parameters	II	K3
CO3	Demonstrate various methods of Data Preparation and Manipulation with Pandas	III	K3
CO4	Determine the knowledge on relationships between data.	IV	K2
CO5	Apply visualization Libraries in Python to interpret and explore data	V	K3

HOD/AI&DS

24OE406	FOUNDATIONS OF MACHINE LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Machine Learning (ML)
- To understand the concepts of Supervised Learning
- To understand the concepts of Unsupervised Learning
- To understand the concepts of Reinforced Learning
- To evaluate and analysis of Machine Learning Experiments

UNIT-I MACHINE LEARNING BASICS 9

Introduction to Machine Learning (ML) - Essential concepts of ML – Types of learning – Machine learning methods based on Time–Dimensionality–Linearity and Nonlinearity Early trends in Machine learning–Data Understanding Representation and visualization – Confusion Matrix - MSE

UNIT-II SUPERVISED LEARNING 9

Regression: Types – Linear Regression, Polynomial Regression, Bayesian linear regression, Classification – binary classification, Support Vector Machine, Decision Tree, Random Forest, K Nearest Neighbors.

UNIT-III UNSUPERVISED LEARNING 9

Unsupervised learning: K-means clustering, Hierarchical clustering, Anomaly detection, Principal Component Analysis, Independent Component Analysis, Singular value decomposition.

UNIT- IV REINFORCED LEARNING 9

Reinforced Learning terminology, component, working of Reinforcement Learning. Reinforcement Learning Algorithm – Approaches, Types – positive type, negative type. Learning Models – Introduction to Markov decision process (MDP), state and action value functions – Application of Reinforcement Learning.

UNIT-V ANALYSIS OF MACHINE LEARNING 9

Cross Validation (CV) and Resampling – K-fold CV, bootstrapping, measuring classifier performance, assessing a single classification algorithm and comparing two classification algorithms – T test, McNemar's test, K-fold CV paired T test.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ameet V Joshi, Machine Learning and Artificial Intelligence, Springer Publications, 2020
2. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.

REFERENCES:

1. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", Second Edition, MIT Press, 2018.
2. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
3. Sebastain Raschka, Vahid Mirjalili, "Python Machine Learning", Packt publishing, 3rd Edition, 2019.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Foundations of Machine Learning		Course Code : 24OE406	
CO	Course Outcomes	Unit	K –CO
CO1	Explain the basic concept of Machine Learning and its performance matrix	I	K2
CO2	Apply the different Regression and classification algorithms to predict data based on an Independent variable	II	K3
CO3	Apply unsupervised learning techniques and dimensionality reduction to the unlabeled data.	III	K3
CO4	Explain the concepts of reinforced learning algorithm and its application.	IV	K2
CO5	Apply various statistical testing methods in Machine Learning experiments.	V	K3

HOD/AI&DS

24OE407	INTRODUCTION TO ARTTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Introduce the fundamental concepts of Artificial Intelligence and intelligent agents.
- Teach various problem-solving techniques including uninformed, informed, and local search strategies.
- Familiarize learners with game playing methods and constraint satisfaction problem-solving approaches.
- Develop logical reasoning skills using propositional and first-order logic for knowledge representation and inference.
- Enable students to apply probabilistic reasoning techniques for decision-making under uncertainty

UNIT-I	INTELLIGENT AGENTS	9
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Introduction to AI – Agents and Environments – concept of rationality – nature of environments – structure of agents. Problem solving agents – search algorithms – uninformed search strategies

UNIT-II	PROBLEM SOLVING	9
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Heuristic search strategies – heuristic functions. Local search and optimization problems – local search in continuous space – search with non-deterministic actions – search in partially observable environments – online search agents and unknown environments.

UNIT-III	GAME PLAYING AND CSP	9
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Game theory – optimal decisions in games – alpha-beta search – Monte carlo tree search – stochastic games – partially observable games. Constraint satisfaction problems – constraint propagation – backtracking search for CSP – local search for CSP – structure of CSP.

UNIT- IV	LOGICAL REASONING	9
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Knowledge-based agents – propositional logic – propositional theorem proving – propositional model checking – agents based on propositional logic. First-order logic – syntax and semantics – knowledge representation and engineering – inferences in first-order logic – forward chaining – backward chaining – resolution

UNIT-V	PROBABILISTIC REASONING	9
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Acting under uncertainty – Bayesian inference – Naïve Bayes models. Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Fourth Edition, Pearson Education, 2021
2. Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013.

REFERENCES:

1. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007
2. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Introduction to Artificial Intelligence		Course Code : 24OE407	
CO	Course Outcomes	Unit	K –CO
CO1	Explain the fundamentals of intelligent agent frameworks and their role in AI problem-solving.	I	K2
CO2	Apply problem-solving techniques using appropriate search strategies in AI.	II	K3
CO3	Apply game-playing strategies and constraint satisfaction problem (CSP) techniques for solving AI tasks.	III	K3
CO4	Demonstrate logical reasoning using propositional and first-order logic for knowledge Representation and inference	IV	K3
CO5	Apply probabilistic reasoning and Bayesian networks for decision-making under uncertainty	V	K3

HOD/AI&DS

24OE408	CYBER SECURITY FUNDAMENTALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

UNIT - I INTRODUCTION 9

Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage

UNIT - II CYBER LAW AND PROCEDURES TO REPORT CYBER CRIME 9

Introduction, cyber security regulations, roles of International law - Cyber law in India: Need for cyber law in India, History of cyber law in India, Information Technology Act, 2000, Overview of other laws amended by the IT Act, 2000, National Policy on Information Technology 2012. Introduction to cybercrime and procedure to report cybercrime: Procedure to report cyber crime, some basic rules for safe operations of the computer and internet, the criminal law (Amendment) Act, 2013: legislative remedies for online harassment and cyber stalking In India

UNIT - III CYBER CRIME: MOBILE AND WIRELESS DEVICES 9

Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Laptops

UNIT - IV CYBER SECURITY: ORGANIZATIONAL IMPLICATIONS 9

Introduction: cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations

UNIT - V PRIVACY ISSUES AND CYBERCRIME 9

Privacy Issues: Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains - medical, financial, etc. Cybercrime: Examples and Mini-Cases Examples: Official Website of Maharashtra Government Hacked, Indian Banks Lose Millions of Rupees, Parliament Attack, Pune City Police Bust Nigerian Racket, e-mail spoofing instances. .

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley, 2013
2. B.B.Gupta, D.P.Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, 2018.

REFERENCES

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press, 2016
2. Chwan-Hwa (John) Wu, J. David Irwin, Introduction to Computer Networks and Cyber security, CRC Press T&F Group, 2013

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Cyber Security Fundamentals		Course Code : 24OE408	
CO	Course Outcomes	Unit	K –CO
CO1	Apply cyber security concepts to identify and classify harmful cyber activities	1	K3
CO2	Describe the concepts of cyber laws and regulations	II	K2
CO3	Apply mobile and wireless security concepts to identify and security challenges and attacks on mobile devices	III	K3
CO4	Apply knowledge of cyber threats and IPR issues to identify and mitigate risks affecting organizational security and operations.	IV	K3
CO5	Apply policies and procedures to manage privacy issues	V	K3

HOD/AI&DS

24OE409	INFORMATION SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Information Security
- To know the legal, ethical and professional issues in Information Security
- To know the aspects of risk management
- To become aware of various standards in this area
- To know the technological aspects of Information Security

UNIT - I INTRODUCTION 9

History, What is Information Security?, Critical Characteristics of Information, NSTISSC Security Model, Components of an Information System, Securing the Components, Balancing Security and Access, The SDLC, The Security SDLC

UNIT - II SECURITY INVESTIGATION 9

Need for Security, Business Needs, Threats, Attacks, Legal, Ethical and Professional Issues - An Overview of Computer Security - Access Control Matrix, Policy-Security policies, Confidentiality policies, Integrity policies and Hybrid policies

UNIT - III SECURITY ANALYSIS 9

Risk Management: Identifying and Assessing Risk, Assessing and Controlling Risk - Systems: Access Control Mechanisms, Information Flow and Confinement Problem

UNIT - IV LOGICAL DESIGN 9

Blueprint for Security, Information Security Policy, Standards and Practices, NIST Models, VISA International Security Model, Design of Security Architecture, Planning for Continuity

UNIT - V PHYSICAL DESIGN 9

Security Technology, IDS, Scanning and Analysis Tools, Cryptography, Access Control Devices, Physical Security, Security and Personnel

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Michael E Whitman and Herbert J Mattord, —Principles of Information Securityll, Vikas Publishing House, New Delhi, 2003.
2. Micki Krause, Harold F. Tipton, — Handbook of Information Security Management, Vol 1-3 CRC Press LLC, 2004.

REFERENCES

1. Stuart McClure, Joel Scrambray, George Kurtz, —Hacking Exposedll, Tata McGraw-Hill, 2003
2. Matt Bishop, — Computer Security Art and Sciencell, Pearson/PHI, 2002.

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Information Security		Course Code : 24OE409	
CO	Course Outcomes	Unit	K –CO
CO1	Discuss the basics of information security	I	K2
CO2	Implement access control matrix to analyze confidentiality, integrity, and hybrid security requirements in systems.	II	K3
CO3	Apply risk management techniques to identify, assess, and control security risks in information systems	III	K3
CO4	Implement information security policies, standards, and practices to design logical security blueprints.	IV	K3
CO5	Use security assessment and monitoring tools to evaluate the effectiveness of physical and information security controls.	V	K3

HOD/AI&DS

24OE410**INTRODUCTION TO IoT**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the concepts of IoT and its working models
- To know the various IoT protocols
- To understand about various IoT Physical devices and Endpoints
- To know the security and privacy issues connected with IoT

UNIT I FUNDAMENTALS OF IOT**9**

Definition and Characteristics of IoT-Sensors – Actuators- Physical Design of IoT – IoT Protocols- IoT communication models- IoT Communication APIs- IoT enabled Technologies – Wireless Sensor Networks- Cloud Computing- Embedded Systems- IoT Levels and Templates- Domain Specific IoTs – Home, City, Environment, Energy, Agriculture and Industry.

UNI - II IOT PROTOCOLS**9**

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4–BACNet Protocol– Modbus – KNX – Zigbee– Network layer – APS layer – Security

UNIT -III PHYSICAL DEVICES AND ENDPOINTS**9**

Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Programming – Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, and reading input from pins.

UNIT – IV PRIVACY SECURITY AND GOVERNANCE**9**

Overview of Governance- Privacy and Security Issues- Contribution from FP7 Projects- Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities- First Steps Towards a Secure Platform- Smartie Approach- Data Aggregation for IoT in Smart Cities Security

UNIT - V APPLICATIONS OF IOT**9**

IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, IoT Smart Cities and Smart Homes- Connected Vehicles- Smart Grid- Industrial IoT- Case Study-Agriculture- Healthcare-Activity Monitoring Sensor

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. "Make sensors": Terokarvinen, kemo, karvinen and villeyvaltokari, 1st edition, maker media, 2014.

REFERENCES:

1. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry,

"IoT Fundamentals, Networking Technologies, Protocols, and Use cases for the Internet of Things", Cisco Press, First Edition, 2017.

3. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Introduction to IoT		Course Code : 24OE410	
CO	Course Outcomes	Unit	K –CO
CO1	Explain the infrastructure for supporting IoT deployments	I	K2
CO2	Understand the usage of IoT protocols for communication between various IoT devices	II	K2
CO3	Develop portable IoT using Arduino/Raspberry Pi /equivalent boards.	III	K3
CO4	Illustrate the basic concepts of security and governance as applied to IoT	IV	K2
CO5	Analyze and illustrate applications of IoT in real time scenario	V	K4

HOD/AI&DS

MINOR DEGREE

24CSM01	INTRODUCTION TO DATA SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Learn the data analysis basics with Python
- Study Data Analysis and interpretation with Numpy on statistical parameters
- Understand various methods of Data Preparation and Manipulation with Pandas
- Learn Data Visualization using matplotlib and seaborn
- Learn Machine learning fundamentals concepts such as Feature Engineering and various techniques

UNIT-I INTRODUCTION TO DATA ANALYSIS 9

Data Analysis - Mathematics and Statistics Basic Concepts - The Data Analysis Process - Data Extraction - Data Pre-processing/Cleaning - Data Preparation/Visualization - Data Modelling / Visualization - Quantitative and Qualitative Analysis - Errors and Debugging - Profiling and Timing Code

UNIT-II INTRODUCTION TO NUMPY 9

Python data types - NumPy Arrays with Computations - Aggregations: Min, Max, and Everything In Between-Broadcasting - Comparisons, Masks, and Boolean Logic - Sorting Arrays - Structured Data with NumPy's Arrays

UNIT-III DATA MANIPULATION WITH PANDAS 9

Introducing Pandas Objects - Data Indexing and Selection - Operating on Data in Pandas - Handling Missing Data - Hierarchical Indexing - Combining Datasets - Vectorized String Operations - Working with Time Series - High-Performance Pandas: eval() and query()

UNIT- IV VISUALIZATION WITH MATPLOTLIB 9

Various Plots - Simple Line - Scatter Plots - Error Visualization - Density and Contour Plots - Histograms, Binnings, and Density - Customizing Plots-Multiple Subplots - Three-Dimensional Plotting in Matplotlib - Geographic Data with Basemap - Visualization with Seaborn

UNIT-V MACHINE LEARNING FUNDAMENTALS 9

Machine Learning concepts using Scikit-learn- Hyperparameters and Model Validation - Feature Engineering - Basics of Classification, Clustering - Support Vector Machines - Decision Trees and Random Forests- Principal Component Analysis

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Jake VanderPlas, 2016, Python Data Science Handbook: Essential Tools for Working with

Data, 1 sted, O'Reilly Media, Inc

REFERENCES:

1. Nelli, F 2015, Python Data Analytics, 1 sted, Apress, USA.
2. McKinney, W 2017, Python for Data Analysis, 2nd ed, O'Reilly Media, Inc.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Introduction to Data Science		Course Code : 24CSM01	
CO	Course Outcomes	Unit	K –CO
CO1	Discuss the various analysis methods in Numpy and Pandas	I	K2
CO2	Apply calculations that measure the central tendency and dispersion of data	II	K3
CO3	Apply data manipulation with pandas for analysis data.	III	K3
CO4	Apply various Visualize techniques to statistical quality control charts	IV	K3
CO5	Apply the concepts of various machine learning techniques to solve problems.	V	K3

HOD/AI&DS

24CSM02

DATA MINING

L	T	P	C
3	0	0	3

- To understand data warehouse concepts, architecture, and tools
- To understand data mining system and pre-processing techniques
- To study algorithms for finding hidden and interesting patterns in data
- To understand and apply various classification and clustering techniques using tools.

UNIT - I DATA WAREHOUSING

9

Basic Concepts - Data Warehousing Components – Building a Data Warehouse – Database Architectures for Parallel Processing –Multidimensional Data Model –, Concept Hierarchies - Characteristics of OLAP Systems – Typical OLAP Operations, OLAP and OLTP

UNIT - II DATA MINING

9

Introduction– Data – Types of Data – Data Mining Functionalities – Interestingness of Patterns. Introduction to Data Mining Systems – Knowledge Discovery Process – Data Mining Techniques – Issues – applications- Data Objects and attribute types, Data Preprocessing – Cleaning, Integration, Reduction, Transformation and discretization

UNIT - III FREQUENT PATTERN MINING

9

Mining Frequent Patterns, Associations and Correlations – Mining Methods- Pattern Evaluation Method – Pattern Mining in Multilevel, Multidimensional Space – Constraint Based Frequent Pattern Mining, Association–rule learners.

UNIT - IV CLASSIFICATION

9

Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification by Back Propagation – Support Vector Machines – Support Vector Machine – K-NN algorithm

UNIT - V CLUSTERING

9

Clustering Techniques – Cluster Analysis-Partitioning Methods - Hierarchical Methods – Density Based Methods - Grid Based Methods – Evaluation of clustering – Clustering high dimensional data- Clustering with constraints, Outlier analysis, WEKA, R tool – Learning algorithms, Clustering algorithms

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jiawei Han and MichelineKamber, Data Mining Concepts and Techniques, Third Edition, Elsevier, 2012.
2. Alex Berson and Stephen J.Smith, Data Warehousing, Data Mining & OLAP, Tata McGraw – Hill Edition,5th Reprint 2016.

REFERENCES:

1. K.P. Soman, Shyam Diwakar and V. Ajay, Insight into Data Mining Theory and Practice, Eastern Economy Edition, Prentice Hall of India, 2006.
2. Ian H.Witten and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, Elsevier, Second Edition.
3. Daniel T.Larose, "Data Mining Methods and Models", Wiley-Interscience, 2006.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Data Mining		Course Code : 24CSM02	
CO	Course Outcomes	Unit	K –CO
CO1	Discuss data warehouse system with OLAP tools	I	K2
CO2	Describe data mining system and pre-processing for data analysis	II	K2
CO3	Apply frequent pattern and association rule mining techniques	III	K3
CO4	Select and apply an appropriate classification algorithm for labeled data Data set.	IV	K3
CO5	Select and apply an appropriate Clustering algorithm for Unlabeled Data set.	V	K3

HOD/AI&DS

24CSM03**DATA VISUALIZATION**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To outline an overview of exploratory data analysis
- To perform univariate data exploration and analysis.
- To apply bivariate data exploration and analysis.
- To use Data exploration and visualization techniques for multivariate and time series data

UNIT- I EXPLORATORY DATA ANALYSIS 9

EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA - Visual Aids for EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques - Grouping Datasets - data aggregation

UNIT- II UNIVARIATE ANALYSIS 9

Introduction to Single variable: Distributions and Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality - Smoothing Time Series.

UNIT- III BIVARIATE ANALYSIS 9

Relationships between Two Variables - Percentage Tables - Analyzing Contingency Tables - Handling Several Batches - Scatterplots and Resistant Lines – Transformations.

UNIT- IV MULTIVARIATE AND TIME SERIES ANALYSIS 9

Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond - Longitudinal Data – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time-based indexing – Visualizing – Grouping – Resampling.

UNIT- V DATA VISUALIZATION 9

Loading Data into R -Transforming Data - Creating Tidy Data - Basic Data Exploration Techniques - Data Visualization Techniques – Visualizing Geographic Data with ggmap - R Markdown.

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python”, Packt Publishing, 2020.
2. Catherine Marsh, Jane Elliott, “Exploring Data: An Introduction to Data Analysis for Social Scientists”, Wiley Publications, 2nd Edition, 2008.

REFERENCES:

1. Eric Pimpler, “Data Visualization and Exploration with R”, Geo Spatial Training service, 2017
2. Claus.O.Wlike, Fundamentals of Data Visualization, A primer on making informative and compelling Figures, O'Reilly Publications, 2019.
3. Eric Pimpler, “Data Visualization and Exploration with R”, Geo Spatial Training service, 2017

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Data Visualization		Course Code : 24CSM03	
CO	Course Outcomes	Unit	K –CO
CO1	Discuss the fundamentals of exploratory data analysis.	I	K2
CO2	Apply univariate data exploration and analysis for dataset.	II	K3
CO3	Apply bivariate data exploration and analysis for given data.	III	K3
CO4	Apply multivariate and time series analysis.	IV	K3
CO5	Apply data analysis and visualization techniques.	V	K3

HOD/AI&DS

24CSM04**BIG DATA TECHNOLOGIES**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand what big data is and how Big Data Technologies can help organizations achieve a competitive advantage.
- To provide an overview of Apache Hadoop and its ecosystem components.
To understand Map Reduce Jobs and Processing of Big Data with advanced architectures like Spark.
- To understand practical machine learning scalable and easy.

UNIT- I INTRODUCTION TO BIG DATA ANALYTICS**9**

Introduction to Big Data Analytics: Big Data, Scalability and Parallel Processing, Designing Data Architecture, Data Sources, Quality, Pre-Processing and Storing, Data Storage and Analysis, Big Data Analytics Applications and Case Studies.

UNIT -II OVERVIEW OF HADOOP**9**

Introduction to Hadoop: Introduction, Hadoop and its Ecosystem, Hadoop Distributed File System, MapReduce Framework and Programming Model, Hadoop Yarn, Hadoop Ecosystem Tools. Hadoop Distributed File System Basics: HDFS Design Features, Components, HDFS User Commands. Hadoop Ecosystem Components: Using Apache Pig, Hive, Sqoop, Flume, Oozie, HBase.

UNIT - III MAPREDUCE, HIVE AND PIG**9**

MapReduce, Hive and Pig: Introduction, MapReduce Map Tasks, Reduce Tasks and MapReduce Execution, Composing MapReduce for Calculations and Algorithms, Hive, HiveQL, Pig.

UNIT - IV LARGE-SCALE DATA PROCESSING WITH PYSPARK**9**

Apache Spark, Spark programming. RDDs, Data Frames, Spark SQL, PySpark, NumPy, SciPy, Code Optimization, Cluster Configurations, Linear Algebra Computation in Large Scale, Distributed File Storage Systems.

UNIT -V MACHINE LEARNING WITH SPARK**9**

Basic statistics, Data sources, Pipelines, Extracting, transforming and selecting features, Classification and Regression, Clustering, Collaborative filtering, Frequent Pattern Mining, Model selection and tuning.

TOTAL:45 PERIODS**TEXT BOOKS:**

1. Raj Kama! and Preeti Saxena, "Big Data Analytics Introduction to Hadoop, Spark, and Machine-Learning", McGraw Hill Education, 2018 ISBN: 9789353164966, 9353164966
2. Douglas Eadline, "Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem", 1st Edition, Pearson Education, 2016. ISBN13: 978-9332570351

REFERENCES:

1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media, 2015. ISBN-13: 978-9352130672
2. Perrin, J. (2020). Spark in action (2nd ed.). (Covers Apache Spark 3 with examples in Java, Python, and Scala) O'Reilly Media Inc.
3. Arshdeep Bahga, Vijay Madisetti, "Big Data Analytics: A Hands-On Approach", 1st Edition, VPT Publications, 2018. ISBN-13: 978-0996025577
4. Damji, J., Wenig, B., Das, T., Lee, D. (2020). Learning spark (2nd ed.) O'Reilly Media Inc.

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Big Data Technologies		Course Code : 24CSM04	
CO	Course Outcomes	Unit	K –CO
CO1	Understand fundamentals of Big Data Technologies.	I	K2
CO2	Investigate Hadoop framework and Hadoop Distributed File system.	II	K3
CO3	Demonstrate the MapReduce programming model to process the big data along with Hadoop	III	K3
CO4	Implement Big Data code in Apache Spark (in PySpark).	IV	K3
CO5	Run Supervised and Unsupervised machine learning on Large-Scale Data.	V	K3

HOD/AI&DS

24CSM05**INTRODUCTION TO CLOUD COMPUTING****L T P C****3 0 0 3****Course Objectives:**

- To learn Taxonomy of Virtualization Techniques.
- To learn Cloud Computing Architecture.
- To learn resource management and security challenges
- To acquire knowledge on Aneka Cloud Application Platform.
- To learn Industry Cloud Platforms.

UNIT -I CLOUD ENABLING TECHNOLOGIES**9**

Introduction to Cloud Computing – Definition, Characteristics and Benefits, Evolution of cloud computing, Underlying Principles of Parallel and Distributed Computing. Virtualization- Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU –Memory – I/O Devices, Cloud applications

UNIT -II CLOUD ARCHITECTURE AND SERVICES**9**

NIST Cloud Computing Reference Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Cloud Storage – Storage-as-a-Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds and Community Clouds, Economics of the Cloud, Architectural design Challenges, Cloud Interoperability and Standards, Scalability and Fault Tolerance.

UNIT -III CLOUD MODELS AND DISASTER MANAGEMENT**9**

Storage as a service, Database as a service, Process as a service, Information as a service, Integration as a service and Testing as a service. Scaling a cloud infrastructure - Capacity Planning, Cloud Scale, disaster Recovery-Disaster Recovery Planning, Disaster Management in cloud.

UNIT- IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD**9**

Inter Cloud Resource Management – Resource Provisioning and Methods – Security Overview – Cloud Security Challenges –Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM –Security Standards.

UNIT -V CLOUD PLATFORM AND SERVICE PROVIDERS IN INDUSTRY**9**

Aneka- Framework Overview, Anatomy of the Aneka Container, Building Aneka Clouds, Aneka SDK, Management Tools. Amazon Web Services- Compute Services, Storage Services, Communication Services. Google AppEngine-Architecture and Core Concepts, Application Life-Cycle, Microsoft Azure- Azure Core Concepts

TOTAL:45 PERIODS

TEXT BOOKS:

1. Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi from TMH 2013.
2. George Reese Cloud Application Architectures, First Edition, O'Reilly Media 2009.

REFERENCES:

1. Cloud Computing and SOA Convergence in Your Enterprise *A Step-by-Step Guide* by David S. Linthicum from Pearson 2010.
2. Cloud Computing 2nd Edition by Dr. Kumar Saurabh from Wiley India 2012.
3. Cloud Computing – web based Applications that change the way you work and collaborate Online – Micheal Miller. Pearson Education.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Introduction to Cloud Computing		Course Code : 24CSM05	
CO	Course Outcomes	Unit	K –CO
CO1	Understand the concept of virtualization and how this has enabled the development of Cloud Computing	I	K2
CO2	Know the fundamentals of cloud, cloud Architectures and types of services in cloud	II	K2
CO3	Understand scaling, cloud models and disaster management	III	K2
CO4	Understand Resource Management and Security challenges in cloud	IV	K2
CO5	Explore some important cloud computing driven commercial systems	V	K2

HOD/AI&DS

24CSM06	BUSINESS INTELLIGENCE SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the Analytics Life Cycle.
- To comprehend the process of acquiring Business Intelligence
- To understand various types of analytics for Business Forecasting
- To model the supply chain management for analytics.
- To apply analytics for different functions of a business

UNIT - I INTRODUCTION TO BUSINESS ANALYTICS 9

Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation –Deployment and Iteration

UNIT II BUSINESS INTELLIGENCE 9

Data Warehouses and Data Mart - Knowledge Management – Types of Decisions – Decision Making Process- Decision Support Systems –Business Intelligence –OLAP–, Analytic functions

UNIT III BUSINESS FORECASTING 9

Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models – Data Mining and Predictive Analysis Modeling–Machine Learning for Predictive analytics.

UNIT IV HR & SUPPLY CHAIN ANALYTICS 9

HumanResources–PlanningandRecruitment–TrainingandDevelopment-Supplychainnetwork - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR &Supply Chain

UNIT V MARKETING& SALES ANALYTICS 9

Marketing Strategy, Marketing Mix, Customer Behavior– selling Process – Sales Planning – Analytics applications in Marketing and Sales

TOTAL:45 PERIODS**TEXT BOOKS:**

1. R. EvansJames, Business Analytics, 2017
2. RNPrasad, SeemaAcharya, Fundamentals of Business Analytics, 2016
3. PhilipKotler and KevinKeller, Marketing Management, 15thedition,PHI,2016

REFERENCES:

1. R. EvansJames, Business Analytics, 2017
2. RNPrasad, Seema Acharya, Fundamentals of Business Analytics, 2016
3. PhilipKotler and KevinKeller, Marketing Management, 15thedition,PHI,2016
4. VSPRAO, Human Resource Management, 3rdEdition, ExcelBooks,2010.
5. MahadevanB,“OperationsManagement-TheoryandPractice”,3rdEdition,PearsonEducation, 2018.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Business Intelligence System		Course Code : 24CSM06	
CO	Course Outcomes	Unit	K –CO
CO1	Explain the real world business problems and model with analytical solutions.	I	K2
CO2	Identify the business processes for extracting Business Intelligence	II	K3
CO3	Apply predictive analytics for business fore-casting	III	K3
CO4	Apply analytics for supply chain and logistics management	IV	K3
CO5	Use analytics for marketing and sales.	V	K3

HOD/AI&DS

24CSM07	ARTIFICIAL INTELLIGENCE ESSENTIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the various characteristics of Intelligent agents
- To learn the different search strategies in AI
- To learn to represent knowledge in solving AI problems
- To understand the different ways of designing software agents
- To know about the various applications of AI.

UNIT - I INTRODUCTION 8

Introduction–Definition - Future of Artificial Intelligence – Characteristics of Intelligent Agents– Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.

UNIT - II 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

UNIT - III KNOWLEDGE REPRESENTATION 10

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.

UNIT - IV SOFTWARE AGENTS 9

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

UNIT - V APPLICATIONS 9

AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing - Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning – Moving.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition, 2011.
2. I. Bratko, Prolog: Programming for Artificial Intelligence, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.

REFERENCES:

1. M. Tim Jones, Artificial Intelligence: A Systems Approach (Computer Science), Jones and Bartlett Publishers, Inc.; First Edition, 2008
2. Nils J. Nilsson, The Quest for Artificial Intelligence, Cambridge University Press, 2009.
3. William F. Clocksin and Christopher S. Mellish, Programming in Prolog: Using the ISO Standard, Fifth Edition, Springer, 2003.
4. Gerhard Weiss, Multi Agent Systems, Second Edition, MIT Press, 2013.
5. David L. Poole and Alan K. Mackworth, Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010.

OUTCOMES:**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

Course Name : Artificial Intelligence Essentials		Course Code : 24CSM07	
CO	Course Outcomes	Unit	K –CO
CO1	Describe various characteristics of Intelligent agents	I	K2
CO2	Demonstrate different search strategies in AI	II	K3
CO3	Apply represent knowledge in solving AI problems	III	K3
CO4	Apply different ways of designing software agents	IV	K3
CO5	Illustrate various applications of AI.	V	K2

HOD/AI&DS

24CSM08	NEURAL NETWORKS AND DEEP LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics in deep neural networks
- To understand the basics of associative memory and unsupervised learning networks
- To apply CNN architectures of deep neural networks
- To analyze the key computations underlying deep learning, then use them to build and train deep neural networks for various tasks.
- To apply generative models for suitable applications.

UNIT-I	INTRODUCTION	9
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Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction Evolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs-Supervised Learning Network

UNIT-II	ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS	9
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Training Algorithms for Pattern Association-Auto associative Memory Network-Hetero associative Memory Network-Bidirectional Associative Memory (BAM)-Iterative Auto associative Memory Networks-Fixed Weight Competitive Nets(MAXNET, Hamming Network)-Kohonen Self-Organizing Feature Maps.

UNIT-III	THIRD-GENERATION NEURAL NETWORKS	9
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Convolutional Neural Networks-Deep Learning Neural Networks-Extreme Learning Machine Model Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Efficient Convolution Algorithms.

UNIT- IV	DEEP FEED FORWARD NETWORKS	9
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A Probabilistic Theory of Deep Learning- Gradient Learning – Chain Rule and Back propagation Regularization: Dataset Augmentation – Noise Robustness -Early Stopping, Bagging and Dropout.

UNIT-V	RECURRENT NEURAL NETWORKS	9
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Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ian Good fellow, Yoshua Bengio, Aaron Courville, "DeepLearning", MIT Press, 2016.
2. Francois Chollet, "Deep Learning with Python", Second Edition, Manning Publications, 2021

REFERENCES:

1. Josh Patterson, Adam Gibson, "DeepLearning: A Practitioner's Approach", O'Reilly Media, 2017.
2. Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 1st Edition, 2018.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Neural Networks and Deep Learning		Course Code : 24CSM08	
CO	Course Outcomes	Unit	K –CO
CO1	Describe the scope of the neural network and explain the basic models of Artificial Neural Network	I	K2
CO2	Illustrate the different types of associative memory networks	II	K3
CO3	Apply conventional neural network model and its algorithms	III	K3
CO4	Apply deep learning components to build and train deep neural networks for various tasks	IV	K3
CO5	Apply Recurrent Neural Network and its variants for text analysis.	V	K3

HOD/AI&DS