ಸ್ಥಾಪನೆ: ೨೦೧೭ Centenary Celebrated Sharnbasveshwar Vidya Vardhaka Sangha's Estd. : 2017

ಶರಣಬಸವ ವಿಶ್ವವಿದ್ಯಾಲಯ
SHARNBASVA UNIVERSITY
ಕಲಬುರಗಿ – ೫೮೫ ೧೦೩
KALABURAGI -585 103

A State Private University approved by Govt. of Karnataka vide Notification No. ED 144 URC 2016 dated 29-07-2017
Recognised by UGC under Section 2f vide No. F.8-29/2017 (CPP-I/PU), dated 20-12-2017 & AICTE, CoA, PCI New Delhi

CURRICULUM

Outcome Based Education

2021 – 2022

ARTIFICIAL INTELLIGENCE
AND
MACHINE LEARNING

V& VI SEMESTER B. Tech.

FACULTY OF ENGINEERING ANF TECHNOLOGY (EXCLUSIVELY FOR WOMEN)

SHARNBASVA UNIVERSITY, KALABURAGI

About Sharnbasva University

Sharnbasva University established in the year 2017, is the first private multi-disciplinary university in the entire North Karnataka providing avenues for students to pursue higher education in almost all fields of education such as Engineering, Management, Science, commerce, Architecture, Pharmaceutical Sciences, Humanities, and Social Sciences. Providing quality education at an affordable cost has been the hallmark of the university. The university has set itself on the path to one of the emerging centres of excellence and a world-class University, which is the dream of Poojya Dr. Sharnbaswappa Appa, the visionary chancellor of the youngest private university in the entire state.

The Sharnbasva University is backed by the rich legacy of more than 100 years of providing quality education to the deprived sections of the people in the educationally backward Kalaburagi and neighbouring districts. The Sharnabasaveshwar Vidya Vardak Sangha, under whose aegis the Sharnbasva University is functioning, has the honor of starting the first school exclusively for girls way back in 1934 opening doors of learning to the girls. The legacy of providing optimum importance to girl education has continued to this day and the Sangha was the first to start an exclusive engineering college for women in the entire North Karnataka and the second in the entire Karnataka. This College is now part of Sharnbasva University. The university houses five Center of Excellence (CoE) in Artificial Intelligence, Machine Learning, the Internet of Things, Drone Technology, 5G and 6G Technology Lab.

The institution offers:

- 4-year undergraduate program - Bachelor of Technology (in Artificial Intelligence & Data Science, Civil, Computer Science, Computer System Design, Energy Engineering, Electronics & Communication, Electrical & Electronics, Mechanical).

- 4-year undergraduate program (Exclusively for Women) - Bachelor of Technology (in Artificial Intelligence & Machine Learning, Civil, Computer Science, Electronics & Communication, Electrical & Electronics, Mechanical).

- 2-Year Post Graduate Programs - Master of Technology (Structural Engineering, VLSI Design & Embedded Systems, Machine Design, Computer Science and Engineering, Computer Network Engineering, Artificial Intelligence and Data Science, Digital Electronics) and Ph. D Programs

- 2-Year Post Graduate Programs - Master of Technology (Exclusively for Women) (Computer Science and Engineering, Digital Communication and Networking) and Ph. D Programs

- 5 Years Under program – Bachelor of Architecture (B. Arch.)

- 3-Year undergraduate programs – Bachelor of Computer Applications (BCA), – Co-Education and Exclusively for Women, Bachelor of Business Administration (BBA) BBA (HR, Finance and Marketing)– Co-Education and Exclusively for Women, BBA (Logistics), BBA (Tourism & Travel Mgmt.), BBA (Aviation and Air cargo) for Exclusively for Women.

- 2-Year Post Graduate programs - Master of Computer Application (MCA) and Ph. D Programs.

- 2-Year Post Graduate programs - Master of Business Administration (MBA) – Co-Education and Exclusively for Women, MBA (Tourism), MBA (Hospital Administration). Master of Commerce and Ph. D programs.

- 2-Year Post Graduate Programs – Master of Arts (MA) – MA (Kannada, English), MA (Fine Arts), MA (Journalism and Mass Comm.), MA (Music), MA (Visual Arts) and Ph. D Programs.

- 2 Year Post Graduate Programs – Master of Science (M. Sc.) – M. Sc. (Physics), M. Sc. (Mathematics), M. Sc. (Botany), M. Sc. (Zoology) and Ph. D Programs.

University Vision:

- Enhancing the horizon of world knowledge by promoting international understanding through imparting quality education and creating value added skill based human resource.
- We aspire to become top ranking National and International Centre of Excellence producting high caliber leaders and captains of Industry.
- Inculcating the spirit of "VasudaivaKudumbakam" (The world is one family).
- "SakalaJeevathmarigeLesaneBayasuva" (Wishing the worldly good and betterment of all the living beings) is our moto.

University Mission

- Achieving academic excellence through innovatively designed, research intensive, industry-oriented education.
- Imbibing the culture of independent thinking, independent writing, independent speaking and independent living among the students in all the activities.
- Foster the spirit of National development and develop global competencies. Nurture creativity and encourage entrepreneurship and provide an education with rigor and relevance.
- Provide academically excellent, time efficient, and cost-effective higher education. Provide an education which enhances the ability of students to learn throughout the life.
- Ensure freedom of thought and expression and a campus without discrimination. Encourage the spirit of questioning and ensure close inter-relationship between Teaching, Scholarship and Research.
- Develop and deliver distinctive and value driven academic programme that are flexible and responsible to Local, National and International needs.
- Cultivate academic, business and community driven partnership that positions the University as a leading choice for adult learners.
- To work effectively with other institutions and organisations, where such partnerships can lead to understanding research and teaching.

About Faculty of Engineering and Technology (Exclusively for Women):

The Faculty of Engineering and Technology (Exclusively for Women) (FETW), formerly known as Godutai Engineering College for Women, was established in 2017. It is the only women's engineering college in the entire northern backward part of Karnataka state, meeting the rapidly growing need for women professionals in technology. Nurturing young minds in an innovative and progressive learning environment, we are committed to promoting technical education as a catalyst for the country's and society's growth and development, a dream of our Chancellor and President, Poojya Dr. Sharnbaswappa Appa. With world-class infrastructure and experienced faculty, the Faculty of Engineering and Technology is the preferred destination for technocrats shaping the future.

FETW offers the following B.Tech. (Undergraduate) programs:

- Artificial Intelligence and Machine Learning (AI & ML) – 60 seats
- Civil Engineering (CV) – 60 seats
- Computer Science and Engineering (CSE) – 150 seats
- Electrical and Electronics Engineering (EEE) – 60 seats
- Electronics and Communication Engineering (ECE) – 120 seats

M. Tech. (Postgraduate) programs:

- Computer Science and Engineering (CSE) – 18 seats
- Digital Communication and Networking (DCN) – 18 seats

Research Programs (Ph.D.):

- Computer Science and Engineering
- Electronics and Communication Engineering
- Electrical and Electronics Engineering
- Basic Sciences (Physics, Chemistry, Mathematics)

Vision of the FETW

We aspire to become global model for women professional through quality education and ethical values in the field of engineering and technology.

Mission of the FETW

- To inspire a research culture, encourage entrepreneurial efforts and empower globally to be great leaders.
- To create technical women's power to meet the current and future demand of the industry.
- To develop women professionals with good academic knowledge, technical skills, strong ethics and above all good human being.

About the Department:

The Department of B. Tech. in Artificial Intelligence and Machine Learning (AI and ML) at the Faculty of Engineering and Technology (Exclusively for Women) was established in the year 2021 with an intake of 60 students. It is a four-year full-time undergraduate program recognized by the All-India Council for Technical Education (AICTE). Artificial Intelligence and Machine Learning aim to develop a strong foundation by using principles and technologies that consist of many facets of Artificial Intelligence, including logic, knowledge representation, probabilistic models, and machine learning.

To nourish the young minds, the department has a team of dedicated and experienced faculty with good infrastructure, curriculum, comprehensive hands-on experience, and conducting research in the field of Artificial Intelligence & Machine Learning.

The department has well-equipped laboratories with higher configuration systems along with a smartboard available in the laboratory to provide the best to the students. The department has a wide technical spectrum through the centre of excellence, special labs, industrial tie-ups, collaborations, MOUs, and online forums.

Vision

To train women professionals to create sustainable, intelligent solutions that work with natural intelligence to empower future generations digitally while protecting social ethics.

Mission

1. To provide female students with the necessary foundational skills to pursue a successful career in the field of computer science and engineering, with a focus on artificial intelligence and machine learning.
2. To Improve academic outcomes through location-based education and relationships with established research laboratories and enterprises.
3. To Inspire young women to pursue entrepreneurial endeavours and help them grow into influential leaders.

Program Educational Outcomes (PEOs)

After a few years of graduation with a B. Tech. in Artificial Intelligence and Machine Learning, the girl graduates will be able:

- PEO-1: To analyse the problems by applying the principles of computer science, mathematics, and scientific investigation to build intelligent machines, software, or applications using the latest technologies to solve problems of the real world.
- PEO-2: To start an enterprise to improve the economy of the country by providing support to the customer for a lifelong learning attitude.

- PEO-3: To Pursue higher studies with research potential in the field of Artificial intelligence, Engineering in allied areas and continue to learn by participating in conferences, and seminars, etc.

Program Outcomes (POs)

On successful completion of the program, the graduates of the B. Tech. in Artificial Intelligence and Machine Learning program will be able to:

- **PO 1: Engineering knowledge:** Apply the knowledge of mathematics, science, and engineering fundamentals for the solution of complex problems in Artificial Intelligence and Machine Learning.
- **PO 2: Problem analysis:** Identity, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using the first principles of mathematics, nature, and engineering sciences.
- **PO 3: Design/development of solution:** Design solutions for complex engineering problems and design system components, and processes to meet the specifications with consideration for public health and safety, and cultural, societal, and environmental considerations.
- **PO 4: Conduct Investigation of a complex problem:** Use research-based knowledge including design of experiments, analysis, and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO 5: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **PO 6: Engineering and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO 7: Environment and sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO 8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
- **PO 9: Individual and Teamwork:** Function effectively as an individual, and as a member or leader in teams, and multidisciplinary settings.
- **PO 10: Communication:** Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective report documentation. Make effective presentations and give and receive clear instructions.
- **PO 11: Project management and finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to

one's work, as a member and leader in a team. Manage projects in multidisciplinary environments.

- **PO 12: Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program-Specific Outcomes (PSOs)

Upon successful completion of the B. Tech. in Artificial Intelligence and Machine Learning (AI and ML) program, graduates will possess the following abilities:

PSO 1: Understand, analyze, and develop vital skills in areas related to computer science and artificial intelligence, with a focus on underlying statistical and computational principles. Apply this knowledge to solve practical problems.

PSO 2: Demonstrate the ability to implement AI and ML techniques, including search algorithms, neural networks, machine learning, and data analytics, for solving problems and designing novel algorithms. Develop skills essential for a successful career and entrepreneurship.

PSO 3: Utilize modern tools and techniques in computer science, artificial intelligence, and data science.

Semester wise Credit Breakdown for B. Tech. Degree Curriculum Batch 2021-24

	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eight	Total Credits
Basic Sciences (BSC)	7	7	3	3	-	-	-	-	20
Engineering Sciences (ESC)	10	10	-	-	-	-	-	-	20
Humanities, Social Sciences andManagement (HSMC)	1	1	1	1	-	4	1	-	9
Ability Enhancement Course (AEC)	1	1	1	1	1	1	-	-	6
Professional Core Courses(PCC)	-	-	15	15	12	5	12	-	59
Professional Elective Courses (PEC)	-	-	-	-	3	6	3	-	12
Institutional Open Elective Courses(IOE)	-	-	-	-	4	4	4	-	12
Internship (INT)	-	-	-	-	-	-	-	7	7
Mini Project / Project Work (PW)	1	1	1	1	1	1	1	8	15
Total Credits	**20**	**20**	**21**	**21**	**21**	**21**	**21**	**15**	**160**

Sharnbasva University, Kalaburagi
Scheme of Teaching and Examination 2021-22
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021-22)

Programme: B. Tech.: Artificial Intelligence and Machine Learning

V SEMESTER

Sl. No	Course Code		Course Title	Teaching Department	Teaching Hours/week			Examination				
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	21AM51	Computer Networks	CSE/AIML	3	1		3	50	50	100	04
2	PCC	21AM52	Machine Learning	CSE/AIML	2	1		3	50	50	100	03
3	PCC	21AM53	Database Management Systems	CSE/AIML	2	1		3	50	50	100	03
4	PEC	21AM54X	Professional Elective Course-I	CSE/AIML	2	1		3	50	50	100	03
5	OEC	21AM55X	Open Elective Course-I	CSE/AIML	2	1		3	50	50	100	03
6	PCC	21AML56	Machine Learning Lab	CSE/AIML			2	3	50	50	100	01
7	PCC	21AML57	Database Management Systems Lab	CSE/AIML			2	3	50	50	100	01
8	PEC	21AML58	Networks And Internet of Things Lab	CSE/AIML			2	3	50	50	100	01
9	PW	21PRJ59	Project-V	CSE/AIML			2	3	50	50	100	01
10	AEC	21AAM510X	Ability Enhancement Course-V	CSE/AIML			2	3	50	50	100	01
Total					**11**	**5**	**10**	**30**	**500**	**500**	**1000**	**21**

Note: PCC- Programme Core Course, PEC- Professional Elective Course, PW-Project Work, HSS-Humanity and Social Science, OEC- Open Elective Course, AEC- Ability Enhancement Course.

Project (PRJ): Based on the ability /abilities of the student/s and recommendations of the mentor, a single discipline or multidisciplinary mini project can beassigned to an individual student or to a group having not more than 4 students

Open Elective Course-I (offered by the Department to other Department students)	
Course code under 21XX55X	**Course Title**
21AM551	Principles of Artificial Intelligence
21AM552	Artificial Intelligence & Machine learning
Course code under 21AM54X	**Course Title**
21AM541	IOT Technology & Applications
21AM542	Pattern Recognition
21AM543	DATA WAREHOUSE AND DATA MINING
21AM544	Statistical Technique for Data Science

Ability Enhancement Course-V	
Course code under 21AEC510X	**Course Title**
21AAM5101	Generative AI
21AAM5102	Document Preparation Using Latex

AICTE Activity Points: In case students fail to earn the prescribed activity points, eighth semester Grade Card shall be issued only after earning theRequired activity points. Student shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.

Sharnbasva University, Kalaburagi,
Scheme of Teaching and Examination 2021-22
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021-22)

Programme: B. Tech. : Artificial Intelligence and Machine Learning

VI SEMESTER

Sl. No.	Course Code		Course Title	Teaching Department	Teaching Hours/week			Examination				Credits
					L	T	P	Duration in Hours	CIE Mark	SEE Mark	Total Marks	
1	HSS	21AM61	Software Engineering and Project Management	CSE/AIML	2	1		3	50	50	100	03
2	PCC	21AM62	Deep Learning and its Applications	CSE/AIML	2	1		3	50	50	100	03
3	PEC	21AM63X	Professional Elective Course-II	CSE/AIML	2	1		3	50	50	100	03
4	PEC	21AM64X	Professional Elective Course-III	CSE/AIML	2	1		3	50	50	100	03
5	OEC	21AM65X	Open Elective Course-II	CSE/AIML	3	1		3	50	50	100	04
6	PCC	21AML66	Deep Learning Lab	CSE/AIML			2	3	50	50	100	01
7	PEC	21AML67	Software Engineering and Testing Lab	CSE/AIML			2	3	50	50	100	01
8	PW	21PRJ68	Project-VI	CSE/AIML			2	3	50	50	100	01
9	HSC	21AU69	Research methodology and Intellectual Property Rights	Humanities	1		2	2	50	50	100	02
10	AEC	21AM610	AWS Framework	CSE/AIML			2	3	50	50	100	01
11	Internship	--	Internship	To be carried out during vacation *								
Total					**11**	**5**	**10**	**29**	**500**	**500**	**1000**	**21**

Note: PCC-Professional Core Course, PEC-Professional Elective Course, OEC-Open Elective Course, PW-Project Work, HSS-Humanity and Social Science, AEC- Ability Enhancement Course. Internship-To be carried out during the vacation/s of VI and VII semesters or VII and VIII semesters

Project(PRJ): Based on the ability /abilities of the student/s and recommendations of the mentor, a single discipline or multidisciplinary mini project can be Assigned to an individual students or to a group having not more than 4 students.	
Course code under 21XX6X	**Course Title**
21AM61	Software Engineering Project Management
21AM62	Deep Learning And Its Applications
Open Elective Course-II (offered by the Department to other Department students)	
Course code under 21XX65X	**Course Title**
21AM651	Data Science
21AM652	Machine Learning
AICTE Activity Points: In case students fail to earn the prescribed activity points, -eighth semester Grade Card shall be issued only after earning the required activity points. Student shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.	
Course code under 21XX63X	**Course Title**
21AM631	Cryptography & Network Security Principles
21AM632	Business Intelligence
21AM633	Social Network Analysis
21AM634	Virtual & Augmented Reality
Course code under 21XX64X	**Course Title**
21AM641	Distributed And Cloud Computing
21AM642	Multiagent System
21AM643	Predictive Analysis
21AM644	Multimedia Computing

B.Tech. in Artificial Intelligence & Machine Learning (2021-Scheme)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
V Semester, w.e.f 2023-24

Computer Networks

Course Code	**21AM51**	**CIE Marks**	**50**
Number of Lecture Hours/Week (L: T:P)	**2:1:0**	**SEE Marks**	**50**
Total Number of Lecture Hours	**40**	**Exam Hours**	**3**

CREDITS – 4

Course Learning objectives: This course will enable students to:

- To equip the students with basic concepts of Computer Networks.
- To understand the working principle of various communication protocols.
- Explain routers, IP and Routing Algorithms in network layer.
- Discuss transport layer services and understand UDP and TCP.
- Understanding the effects of the channel on signal propagation for broadcast and line-of sight wireless systems.

Module I	**8 Hours**

Introduction – Data communication, Networks, Protocols and Protocol Standards, Layered Architecture, Layers in the OSI model, TCP/IP Protocol Suite, Addressing, Physical Layer**:** Introduction: Multiplexing, Spread Spectrum, Switching: Introduction, Circuit-Switched Networks, Packet Switching.

Module II	**8 Hours**

Data link Layer-1: Introduction, Data Link Control: Framing, Flow and Error Control, Protocols, Noiseless Channels, Noisy Channels, HDLC, Point to Point Protocol: Framing, Transition Phases, Multiple Access: Random Access, Controlled Access and Channelization.

Module III	**8 Hours**

Network and Transport Layer: Introduction: Internet Protocol: Internetworking, IPV4, IPV6, Transition from IPV4 to IPV6, ICMP, Forwarding of IP packets, Unicast Routing Protocol.

Module IV	**8 Hours**

Transport Layer and Application Layer: Introduction, User Datagram Protocol, Transmission Control Protocol, Standard Client-server protocols: and HTTP, Electronic Mail, File Transfer Protocol, Electronic mail, Domain Name Server.

Module V	**08 Hours**

Mobile Ad Hoc Networks and Wireless Sensor Networks: Overview of Wireless Ad-Hoc Networks, Routing in Ad Hoc Networks, Routing Protocols Ad Hoc Networks, Clustering Protocols: Classification of Clustering Protocols, Leach, Deep Clustering Protocol, Routing Protocols, Sensor Networks and Protocol Structures, ZigBee Technology and 802.15.4.

Course Outcomes: After studying this course, students will be able to:

CO1:*Explain* network communication fundamentals using OSI and TCP/IP layered models.
CO2:*Analyze* flow control, error control and MAC protocols in the data link layer.
CO3:*Apply* routing algorithms and *compare* unicast routing protocols for packet delivery.
CO4:*Examine* transport-layer operations and *evaluate* application-layer protocols such as HTTP, DNS, SMTP.
CO5:*Analyze* challenges and *assess* routing/MAC protocols in wireless ad hoc and sensor networks.

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 questions from each module.
- Each question -will have questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Behrouz A. Forouzan (2006), Data communication and Networking, 4th Edition, Mc Graw-Hill, India.
2. Nader F Mir, Computer and Communication Networks, 2nd Edition, Pearson, 2014.

Reference Books:

1.Kurose, Ross (2010), Computer Networking: A top down approach, Pearson Education, India.
2. A. S. Tanenbaum (2003), Computer Networks, 4th edition, Pearson Education/ PHI, New Delhi, India.
3. Behrouz A Forouzan, Data and Communications and Networking, Fifth Edition, McGraw Hill, Indian Edition.
4. Larry L Peterson and Brusce S Davie, Computer Networks, fifth edition, ELSEVIER.

Web links and Video Lecture:

1. https://archive.nptel.ac.in/courses/106/105/106105183/
2. Computer Networking Links (rutgers.edu)
3. computer networks video lectures - Google Search

B.Tech. in Artificial Intelligence & Machine Learning (2021-Scheme)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
V Semester, w.e.f 2023-24

Machine Learning

Course Code	**21AM52**	**CIE Marks**	**50**
Number of Lecture Hours/Week (L: T:P)	**2:1:0**	**SEE Marks**	**50**
Total Number of Lecture Hours	**40**	**Exam Hours**	**3**

CREDITS – 03

Course objectives: This course will enable students

- Define machine learning and problems relevant to machine learning.
- Differentiate supervised, unsupervised and reinforcement learning
- Apply neural networks; Bayes classifier and k nearest neighbor, for problems appear in machine learning.
- Perform statistical analysis of machine learning techniques.

Module I	8 Hours

Introduction: What Is Machine Learning (ML)? Uses and Applications with examples, Types of Machine Learning, Main Challenges of Machine Learning Well posed learning problems, Designing a Learning system, Perspective and Issues in Machine Learning. Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Version space, Candidate Elimination algorithm, Inductive Bias.

Module II	8 Hours

Supervised Learning: Decision Tree Learning: Decision tree representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm, hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning.

Module III	8 Hours

Artificial Neural Networks: Introduction, Neural Network representation, Appropriate problems, Perceptrons, Backpropagation algorithm.

Module IV	8 Hours

Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting probabilities, MDL principle, Naive Bayes classifier, Bayesian belief networks, EM algorithm

Module V	8 Hours

Evaluating Hypothesis: Motivation, Estimating hypothesis accuracy, Basics of sampling theorem, General approach for deriving confidence intervals, Difference in error of two hypotheses, Comparing learning algorithms. Instance-Based Learning: Introduction, k-nearest neighbor learning, locally weighted regression, radial basis function, cased-based reasoning, Reinforcement Learning: Introduction, Learning Task, Q Learning

Course Outcomes: After studying this course, students will be able to:

CO1:*Classify* ML problems and *select* appropriate supervised / unsupervised / reinforcement algorithms.
CO2:*Apply* statistical and probabilistic concepts to formulate ML models.

CO3:*Implement* perceptron and backpropagation algorithms for neural network learning.
CO4:*Analyze* concept learning, Bayesian learning and EM algorithm for ML tasks.
CO5:*Evaluate* hypotheses and *apply* k-NN, LWR, RBF and Q-learning for decision-making.

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 questions from each module.
- Each question -will have questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education.

Reference Books:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, h The Elements of Statistical Learning, 2nd edition, springer series in statistics.
2. Introduction to Machine Learning, EthemAlpaydin, PHI Learning Pvt. Ltd, 3rd Edition, 2018.
3. Hands-on machine learning with Scikit-Learn and TensorFlow: concepts, tools, and techniques to build intelligent systems, Aurelien Geron, O'Reilly Media, 2019.

Web links and Video Lecture:

1. **https://onlinecourses.nptel.ac.in/noc23_cs18/preview**
2. **https://unicornplatform.com/blog/9-best-websites-for-machine-learning-resources/**
3. **https://www.kaggle.com/**

B.Tech. in Artificial Intelligence & Machine Learning (2021-Scheme)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
V Semester, w.e.f 2023-24

Database Management Systems

Course Code	21AM53	**CIE Marks**	50
Number of Lecture Hours/Week (L: T:P)	2:1:0	**SEE Marks**	50
Total Number of Lecture Hours	**40**	**Exam Hours**	3

CREDITS – 3

Course Learning objectives: This course will enable students to:

- Provide a strong foundation in database concepts, technology, and practice.
- Practice SQL programming through a variety of database problems.
- Demonstrate the use of concurrency and transactions in database
- Design and build database applications for real world problems.

Module I — 8 Hours

Introduction to Databases: Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications.
Overview of Database Languages and Architectures: Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment.
Conceptual Data Modelling using Entities and Relationships: Entity types, Entity sets, attributes, roles, and structural constraints, Weak entity types, ER diagrams, Examples.

Module II — 8 Hours

Relational Model: Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations.
Relational Algebra: Unary and Binary relational operations, additional relational operations (aggregate, grouping, etc.) Examples of Queries in relational algebra.
Mapping Conceptual Design into a Logical Design: Relational Database Design using ER-to-Relational mapping.

Module III — 8 Hours

SQL: SQL data definition and data types, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL.
Advances Queries: More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL, Schema change statements in SQL.
Database Application Development: Accessing databases from applications, An introduction to JDBC, JDBC classes and interfaces, SQLJ, Stored procedures, Case study: The internet Bookshop.

Module IV — 8 Hours

Normalization: Database Design Theory – Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and

Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. Examples on normal forms.
Normalization Algorithms: Inference Rules, Equivalence, and Minimal Cover, Properties of Relational Decompositions, Algorithms for Relational Database Schema Design, Nulls, Dangling tuples, and alternate Relational Designs, Further discussion of Multivalued dependencies and 4NF, Other dependencies and Normal Forms

Module V	8 Hours

Transaction Processing: Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Transaction support in SQL.
Concurrency Control in Databases: Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering, Multiversion Concurrency control techniques, Validation Concurrency control techniques, Granularity of Data items and Multiple Granularity Locking.

Course Outcomes: After studying this course, students will be able to:

CO1:*Identify* and *define* database objects and *apply* constraints in relational schemas.
CO2:*Use* SQL commands to retrieve, manipulate, and manage database data effectively.
CO3:*Design* normalized databases and *explain* transaction, concurrency, and recovery concepts.
CO4:*Develop* database applications using SQL, RA expressions, JDBC/PL-SQL.
CO5:*Construct* tuple/domain relational expressions and *evaluate* query outputs.

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 questions from each module.
- Each question -will have questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill

Reference Books:

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan's Database System Concepts 6th EditionTataMcgraw Hill Education Private Limited.

Web links and Video Lecture:

1. https://onlinecourses.nptel.ac.in/noc22_cs91/preview
2. https://www.geeksforgeeks.org/dbms/

3. **https://www.spiceworks.com/tech/cloud/articles/database-management-systems-dbms/**

B.Tech. in Artificial Intelligence & Machine Learning (2021-Scheme)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
V Semester, w.e.f 2023-24

IoT Technology & Applications

Course Code	**21AM541**	**CIE Marks**	**50**
Number of Lecture Hours/Week (L:T:P)	**2:1:0**	**SEE Marks**	**50**
Total Number of Lecture Hours	**40**	**Exam Hours**	**3**

CREDITS – 3

Course Learning objectives: This course will enable students to:

- Assess the genesis and impact of IoT applications, architectures in real world.
- Illustrate diverse methods of deploying smart objects and connect them to network.
- Compare different Application protocols for IoT.
- Infer the role of Data Analytics and Security in IoT.
- Identify sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry.

Module I	8 Hours

What is IoT : What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.

Module II	8 Hours

Smart Objects:
The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies.

Module III	8 Hours

IP as the IoT Network Layer: IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods.

Module IV	8 Hours

Data and Analytics for IoT: An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment.

Module V	8 Hours

IoT Physical Devices and Endpoints - Arduino UNO:
Introduction to Arduino, Arduino UNO, Installing the Software, Fundamentals of Arduino Programming. IoT Physical Devices and Endpoints - RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi with Python, Wireless Temperature Monitoring System Using Pi, DS18B20 Temperature Sensor, Connecting Raspberry Pi via SSH, Accessing Temperature from DS18B20 sensors, Remote access to RaspberryPi, Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City IoT Architecture, Smart City Security Architecture, Smart City Use-Case Examples.

Course Outcomes: After studying this course, students will be able to:

CO1:*Explain* IoT architectures, challenges and the impact of IoT in digital ecosystems.
CO2:*Analyze* the deployment of sensors, actuators and smart objects in IoT networks.
CO3:*Apply* IoT communication and application protocols for efficient networking.
CO4:*Assess* the role of analytics, ML, and security frameworks in IoT systems.
CO5:*Demonstrate* sensor technologies and *evaluate* IoT applications across industries.

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 questions from each module.
- Each question -will have questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1.David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)

2. Srinivasa K G, "Internet of Things",CENGAGE Leaning India, 2017.

Reference Books:

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1 stEdition, VPT, 2014. (ISBN: 978-8173719547)
2. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1 st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224)

Web links and Video Lecture:

1. **https://onlinecourses.nptel.ac.in/noc22_cs53/preview**
2. **https://www.javatpoint.com/internet-of-things-applications**
3. **https://www.geeksforgeeks.org/top-applications-of-iot-in-the-world/**

Pattern Recognition

[As per NEP, Outcome Based Education, and Choice Based Credit System (CBCS) Scheme]

SEMESTER-VII

Subject Code	21AM542	CIE Marks	50
Number Lecture Hour/Week	03	SEE Marks	50
Number of Lecture Hours	40	Exam Hours	03

CREDITS-03

Course Objectives The objectives of the course is to enable students to:

- Understand basic skills of Pattern recognition
- Understand the algorithms of decision making and its classification
- Identify the non-parametric decision-making techniques
- Distinguish and understand clustering and partitioning.
- Understand Pattern preprocessing and feature extraction for various applications of pattern recognition

Module -1	**Teaching Hours**
Introduction: Basic concepts, Applications, Fundamental problems in pattern Recognition system design, Design concepts and methodologies, Simple pattern recognition model. **Text 2: 1.2-1.6**	08 Hours
Module -2	
Statistical Decision Making: Introduction, Baye's theorem, Multiple features, Conditionally independent features, Decision boundaries, Unequal cost of error, estimation of error rates, the leaving-one-out-techniques, characteristic curves, estimating the composition of populations. **Text 1: 3.1-3.10**	08 Hours
Module -3	
Non Parametric Decision Making: Histogram, kernel and window estimation, nearest neighbour classification techniques. Adaptive decision boundaries, adaptive discriminant functions, Minimum squared error discriminant functions, choosing a decision making techniques **Text 1: 4.1-4.8**	08 Hours
Module -4	
Clustering and Partitioning: Hierarchical Clustering: Introduction, agglomerative clustering algorithm, the single linkage, complete-linkage and average-linkage algorithm. Ward's method Partition clustering - Forg's algorithm, K-means's algorithm, Isodata algorithm. **Text 2: 1.2-1.6, Text 1: 5.1-5.3,**	08 Hours
Module -5	
Pattern Pre-Processing and Feature Selection: Introduction, distance measures, clustering transformation and feature ordering, clustering in feature selection through entropy minimization, features selection through orthogonal expansion, binary feature selection, Applications of Pattern Recognition in bio-metric, facial recognition, Finger prints, etc. **Text 2: 7.1-7.10**	08 Hours

Course Outcomes: After studying this course, students will be able to:

CO1: Explain the fundamental concepts and terminology of pattern recognition.
CO2: Classify and compare decision-making algorithms used in pattern recognition.
CO3: Illustrate various decision-making techniques applied in pattern recognition systems.
CO4: Apply hierarchical and partition-based clustering techniques to pattern recognition problems.
CO5: Analyze and evaluate feature selection algorithms for pattern recognition applications.

Text Books:

1. Gose. Johnsonbaugh, Jost. Pattern recognition and Image Analysis, PHI. 1996
2. 2. Tou. Rafael. Gonzalez. Pattern Recognition Principle, Pearson Education. 1975

Reference Books:

1. Richard duda, Hart., David Strok, Pattern Classification, John Wiley ,2nd Edition 2000.
2. Theodoridis, S. and K. Koutroumbas, Pattern recognition, 4th Ed. 2009, San Diego, CA: Academic Press.

Data Warehouse and Data Mining

[As per NEP, Outcome Based Education, and Choice Based Credit System (CBCS) Scheme]
SEMESTER-V

Subject Code	**21AM543**	CIE Marks	50
Number Lecture Hour/Week	03	SEE Marks	50
Number of Lecture Hours	40	Exam Hours	03

CREDITS-03

Course Objectives The objectives of the course is to enable students to:
1.Define Data warehousing Architecture and Implementation
2.Explain Data mining principles and techniques and Introduce DM as a cutting edge business intelligence
3.Interpret association rule mining for handling large data
4.Classification for the retrieval purposes •
5.Explain clustering techniques in details for better organization and retrieval of data

Module -1	**Teaching Hours**
Data Warehousing & modeling: Basic Concepts: Data Warehousing: A multitier Architecture, Data warehouse models: Enterprise warehouse, Data mart and virtual warehouse, Extraction, Transformation and loading, Data Cube: A multidimensional data model, Stars, Snowflakes and Fact constellations: Schemas for multidimensional Data models, Dimensions: The role of concept Hierarchies, Measures: Their Categorization and computation, Typical OLAP Operations	08 Hours
Module -2	
Data warehouse implementation& Data mining: Efficient Data Cube computation: An overview, Indexing OLAP Data: Bitmap index and join index, Efficient processing of OLAPQueries, OLAP server Architecture ROLAP versus MOLAP Versus HOLAP:Introduction: What is data mining, Challenges, Data Mining Tasks, Data: Types of Data, Data Quality, DataPreprocessing, Measures of Similarity and Dissimilarity	08 Hours
Module -3	
Association Analysis: Association Analysis: Problem Definition, Frequent Item set Generation, Rule generation. Alternative Methods for Generating Frequent Item sets, FPGrowth Algorithm, Evaluation of Association Patterns.	08 Hours
Module -4	
Classification: Decision Trees Induction, Method for Comparing Classifiers, Rule BasedClassifiers, Nearest Neighbor Classifiers, Bayesian Classifiers.	08 Hours
Module -5	
Clustering Analysis: Overview, K-Means, Agglomerative Hierarchical Clustering, DBSCAN, Cluster Evaluation, Density-Based Clustering, GraphBased Clustering, , Scalable Clustering Algorithms.	08 Hours

Course Outcomes: After studying this course, students will be able to:
CO1: Explain and analyze the architecture, models, and operations of data warehousing systems.

CO2: Apply data cube computation, OLAP operations, indexing techniques, and data preprocessing methods for analytical processing.
CO3: Analyze and implement association rule mining techniques, including FP-Growth, and evaluate discovered patterns.
CO4: Apply classification techniques to build effective data classification models.
CO5: Implement and evaluate clustering techniques for exploratory data analysis.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full question consisting of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Pearson, Firstimpression,2014.
2. Jiawei Han, Micheline Kamber, Jian Pei: Data Mining -Concepts and Techniques, 3rd Edition,Morgan Kaufmann Publisher, 2012.

Reference Books:

1. Sam Anahory, Dennis Murray: Data Warehousing in the Real World, Pearson,Tenth Impression,2012.
2. MichaelJ Berry, Gordon S Linoff: Mastering Data Mining , Wiley Edition, second edtion,2012.

Statistical Technique for Data Science						
Course Code	**21AM544**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	3	**0**	**0**	**3**		
Number of Lecture Hours	**40**				**Exam Hours**	**03**
Credits-03						

Course Objectives: This course will enable students to
➢ Understand the fundamental concepts of probability, statistics, and their applications in data science.
➢ Apply descriptive and inferential statistical techniques to analyze datasets.
➢ Implement hypothesis testing, regression analysis and ANOVA for data-driven decisions.
➢ Utilize statistical software/tools for real-world problem-solving.
➢ Interpret statistical outputs and present findings effectively.

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVEL
1	**Introduction to Statistics & Data Representation:** Role of statistics in data science, types of data, graphical & tabular data representation, descriptive statistics (mean, median, mode, variance, standard deviation, skewness, kurtosis).	**8**	L1,L2,L3
2	**Probability & Random Variables:** Probability rules, conditional probability, Bayes theorem, discrete & continuous random variables, probability distributions (Binomial, Poisson, Normal).	**8**	L1,L2,L3
3	**Sampling & Estimations:** Sampling techniques, sampling distributions, central limit theorem, point & interval estimation, properties of estimators.	**8**	L1,L2,L3
4	**Hypothesis Testing & ANOVA:** Null & alternative hypothesis, Type I & II errors, t-test, chi-square test, F-test, one-way ANOVA.	**8**	L1,L2,L3
5	**Correlation, Regression & Statistical Tools in Data Science:** Correlation analysis, simple & multiple regression, coefficient of determination, residual analysis, introduction to statistical tools (R, Python's stats models & scipy).	**8**	L1,L2,L3

COURSE OUTCOMES: At the end of the course the student will be able to:

CO1	Explain the fundamental statistical concepts and their role in data science
CO2	Apply descriptive statistics and probability distributions to analyze data.
CO3	Design and interpret hypothesis tests and confidence intervals.
CO4	Build and evaluate regression and ANOVA models for data interpretation.
CO5	Implement advanced statistical methods such as clustering and factor analysis in real datasets.

TEXT BOOKS:

1. S. C. Gupta & V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
2. Ronald E. Walpole et al., Probability & Statistics for Engineers & Scientists, Pearson.
3. Applied Statistic-IBM ICE Publications

REFERENCE BOOKS:

1. Richard A. Johnson & Dean W. Wichern, Applied Multivariate Statistical Analysis, Pearson.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer.
3. Alan Agresti, Statistical Methods for the Social Sciences, Pearson.
4. Wes McKinney, Python for Data Analysis, O'Reilly Media.

B.Tech. in Artificial Intelligence & Machine Learning (2021-Scheme)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
V Semester, w.e.f 2023-24

Automata Theory and Computability

Course Code	**21CS553**	**CIE Marks**	**50**
Number of Lecture Hours/Week (L:T:P)	**3:1:0**	**SEE Marks**	**50**
Total Number of Lecture Hours	**48**	**Exam Hours**	**3**

CREDITS – 4

Course Learning objectives: This course will enable students to:

- Introduce the fundamental concepts of Automata Theory, Formal Languages and compiler design
- Principles Demonstrate Application of Automata Theory and Formal Languages in the field of compiler design
- Develop understanding of computation through Push Down Automata and Turing Machines
- Introduce activities carried out in different phases of Phases compiler
- Identify the Decidability problems.

Module I	10 Hours

Why study the Theory of Computation, Languages and Strings: Strings, Languages. A Language Hierarchy, Computation.

Finite State Machines (FSM): Deterministic FSM, Regular languages, Designing FSM, Nondeterministic FSMs, From FSMs to Operational Systems, Simulators for FSMs, Minimizing FSMs.

Module II	10 Hours

Regular Expressions (RE): what is a RE? Kleene's theorem, Applications of REs, Manipulating and Simplifying REs. Regular Grammars: Definition, Regular Grammars and Regular languages.Proving that the language is not regular and applications of pumping lemma.

Module III	10 Hours

Context-Free Grammars(CFG): Introduction to Rewrite Systems and Grammars, CFGs and languages, designing CFGs, simplifying CFGs, proving that a Grammar is correct, Derivation and Parse trees, Ambiguity, Normal Forms. Pushdown Automata (PDA): Definition of non-deterministic PDA, Deterministic and Non-deterministic PDAs, Nonyg determinism and Halting, alternative equivalent definitions of a PDA, alternatives that are not equivalent to PDA.

Module IV	10 Hours

Algorithms and Decision Procedures for CFLs: Simplification of CFG, Elimination of ε-production and Unit Symbol.

Turing Machine: Turing machine model, Representation, Language acceptability by TM, design of TM, Techniques for TM construction. Extension to the basic Turing Machine

Module V	8 Hours

Program techniques for Turing machine, The model of Linear Bounded automata, Multi-stack Machines, TM with semi-infinite tape.
Decidability: Definition of an algorithm, decidability, decidable languages, Undecidable languages, halting problem of TM, post correspondence problem. Complexity: Growth rate of functions, the classes of P and NP, Quantum Computation: quantum computers, Church- Turing thesis.

Course Outcomes: After studying this course, students will be able to:

CO1:*Design* deterministic and nondeterministic FSMs and *minimize* regular languages.
CO2:*Construct* regular expressions and *analyze* regular grammars using pumping lemma.
CO3:*Design* CFGs, PDAs and *explain* equivalence between PDA and CFG.
CO4:*Construct* Turing Machines and *analyze* TM-based problem solving.
CO5:*Evaluate* decidable/undecidable problems and *classify* them using complexity concepts.

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 questions from each module.
- Each question -will have questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Elaine Rich, Automata, Computability and Complexity, 1st Edition, Pearson education,2012 /2013.
2. K L P Mishra, N Chandrasekaran , 3rd Edition, Theory of Computer Science, PhI, 2012

Reference Books:

1. John E Hopcroft, Rajeev Motwani, Jeffery D Ullman, Introduction to Automata Theory, Languages, and Computation, 3rd Edition, Pearson Education, 2013
2. Michael Sipser : Introduction to the Theory of Computation, 3rd edition, Cengage learning,2013
3. John C Martin, Introduction to Languages and The Theory of Computation, 3rd Edition, Tata McGraw –Hill Publishing Company Limited, 2013
4. Peter Linz, "An Introduction to Formal Languages and Automata", 3rd Edition, Narosa Publishers, 1998
5. Basavaraj S. Anami, Karibasappa K G, Formal Languages and Automata theory, Wiley India, 2012 6. C K Nagpal, Formal Languages and Automata Theory, Oxford University press, 2012.

Web links and Video Lecture:

1. https://onlinecourses.nptel.ac.in/noc19_cs79/preview

2. https://link.springer.com/chapter/10.1007/978-3-030-61115-6_10
3. https://onlinecourses.nptel.ac.in/noc21_cs83/preview

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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
V Semester, w. e. f. 2023-24

Machine Learning Lab

Course Code	**21AML56**	**CIE Marks**	**50**
Number of Lecture Hours/Week (L:T:P)	**0:0:2**	**SEE Marks**	**50**
Total Number of Lecture Hours	**28**	**Exam Hours**	**03**

CREDITS – 01

Objectives:

- Make use of Data sets in implementing the machine learning algorithms
- Implement the machine learning concepts and algorithms in any suitable language of choice.

Description (If any):

1. The programs can be implemented in either JAVA or Python.
2. For Problems 1 to 6 and 10, programs are to be developed without using the built-in classes or APIs of Java/Python.
3. Data sets can be taken from standard repositories (https://archive.ics.uci.edu/ml/datasets.html) or constructed by the students.

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples.
2. Implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm.
4. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
7. Write a program to construct a Bayesian network considering medical data.
8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering.
9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set and print both correct and wrong predictions.
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Course Outcomes: At the end of the course students will be able to

CO1:*Implement* machine learning algorithms using programming constructs.
CO2:*Develop* ML programs in Python/Java without inbuilt libraries where required.
CO3:*Apply* appropriate datasets for training, testing, and validating ML models.
CO4:*Use* ML algorithms to solve real-world problems and *interpret* outputs.

B.Tech. in Artificial Intelligence & Machine Learning (2021-Scheme) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) V Semester, w.e.f 2023-24			
Database Management Systems Lab			
Subject Code	**21AML57**	**CIE Marks**	**50**
Number of Lecture Hours/Week	**02**	**SEE Marks**	**50**
Total Number of Lecture Hours	**28**	**Exam Hours**	**03**
CREDITS – 01			

Objectives: The objectives of the

- Provide a strong foundation in database concepts, technology, and practice
- Practice SQL programming through a variety of database problems.
- Provide skills in retrieving and manipulating data stored in databases using SQL queries.
- Design and build database applications for real world problems
- Learn techniques for generating reports from databases, including the use of SQL queries and reporting tools.

No.	**Title of the experiment**
1.	Aim: Demonstrating creation of tables, applying the view concepts on the tables. ProgramConsider the following schema for a Library Database: BOOK(Book_id, Title, Publisher_Name, Pub_Year) BOOK_AUTHORS(Book_id, Author_Name) PUBLISHER(Name, Address, Phone) BOOK_COPIES(Book_id, Programme_id, No-of_Copies) BOOK_LENDING(Book_id, Programme_id, Card_No, Date_Out, Due_Date) LIBRARY_PROGRAMME(Programme_id, Programme_Name, Address) Write SQL queries to 1. Retrieve details of all books in the library – id, title, name of publisher, authors, number of copies in each Programme, etc. 2. Get the particulars of borrowers who have borrowed more than 3 books, but from Jan 2017 to Jun 2017. 3. Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation. 4. Partition the BOOK table based on year of publication. Demonstrate its working with a simple query. 5. Create a view of all books and its number of copies that are currently available in the Library.
2.	Aim: Discuss the various concepts on constraints and update operations. Program: Consider the following schema for Order Database: SALESMAN(Salesman_id, Name, City, Commission) CUSTOMER(Customer_id, Cust_Name, City, Grade, Salesman_id) ORDERS(Ord_No, Purchase_Amt, Ord_Date, Customer_id, Salesman_id) Write SQL queries to 1. Count the customers with grades above Bangalore's average. 2. Find the name and numbers of all salesman who had more than one customer. 3. List all the salesman and indicate those who have and don't have customers in their cities (Use UNION operation.) 4. Create a view that finds the salesman who

	has the customer with the highest order of a day. 5. Demonstrate the DELETE operation by removing salesman with id 1000. All his orders must also be deleted.
3.	Aim: Demonstrate the concepts of JOIN operations. Program: Consider the schema for Movie Database: ACTOR(Act_id, Act_Name, Act_Gender) DIRECTOR(Dir_id, Dir_Name, Dir_Phone) MOVIES(Mov_id, Mov_Title, Mov_Year, Mov_Lang, Dir_id) MOVIE_CAST(Act_id, Mov_id, Role) RATING(Mov_id, Rev_Stars) Write SQL queries to 1. List the titles of all movies directed by 'Hitchcock'. 2. Find the movie names where one or more actors acted in two or more movies. 3. List all actors who acted in a movie before 2000 and also in a movie after 2015(use JOIN operation). 4. Find the title of movies and number of stars for each movie that has at least one rating and find the highest number of stars that movie received. Sort the result by movie title. 5. Update rating of all movies directed by 'Steven Spielberg' to 5.
4.	Aim: Introduce concepts of PLSQL and usage on the table. Program: Consider the schema for College Database: STUDENT(USN, SName, Address, Phone, Gender) SEMSEC(SSID, Sem, Sec) CLASS(USN, SSID) COURSE(Subcode, Title, Sem, Credits) IAMARKS(USN, Subcode, SSID, Test1, Test2, Test3, FinalIA) Write SQL queries to 1. List all the student details studying in fourth semester 'C' section. 2. Compute the total number of male and female students in each semester and in each section. 3. Create a view of Test1 marks of student USN '1BI15CS101' in all Courses. 4. Calculate the FinalIA (average of best two test marks) and update the corresponding table for all students. 5. Categorize students based on the following criterion: If FinalIA = 17 to 20 then CAT = 'Outstanding' If FinalIA = 12 to 16 then CAT = 'Average' If FinalIA< 12 then CAT = 'Weak' Give these details only for 8th semester A, B, and C section students
5.	Aim: Demonstrate the core concepts on table like nested and correlated nesting queries and also EXISTS and NOT EXISTS keywords. Program: Consider the schema for Company Database: EMPLOYEE(SSN, Name, Address, Sex, Salary, SuperSSN, DNo) DEPARTMENT(DNo, DName, MgrSSN, MgrStartDate) DLOCATION(DNo,DLoc) PROJECT(PNo, PName, PLocation, DNo) WORKS_ON(SSN, PNo, Hours) Write SQL queries to 1. Make a list of all project numbers for projects that involve an employee whose last name is 'Scott', either as a worker or as a manager of the department that controls the project. Show the resulting salaries if every employee working on the 'IoT' project is given a 10 percent raise.

	3. Find the sum of the salaries of all employees of the 'Accounts' department, as well as the maximum salary, the minimum salary, and the average salary in this department 4. Retrieve the name of each employee who works on all the projects controlled by department number 5 (use NOT EXISTS operator). 5. For each department that has more than five employees, retrieve the department number and the number of its employees who are making more than Rs.6,00,000.
6.	Develop PL/SQL program using PROCEDURE.
7.	Develop PL/SQL program using FUNCTIONS
8.	Develop PL/SQL program using CURSOR
9.	Develop PL/SQL Programs using TRIGGERS.
10.	Develop PL/SQL programs using PACKAGES
COURSE OUTCOMES:	
• **CO1:***Apply* SQL commands for data definition, manipulation and retrieval. **CO2:***Demonstrate* DBMS concepts through joins, views, triggers, indexing, PL/SQL. **CO3:***Develop* mini-project applications interacting with databases. **CO4:***Analyze* and *generate* reports using queries and stored procedures.	

B.Tech. in Artificial Intelligence & Machine Learning (2021-Scheme)
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V Semester, w.e.f 2023-24

Networks and Internet of Things Lab

Subject Code	21AML58	**CIE Marks**	50
Number of Lecture Hours/Week	02	**SEE Marks**	50
Total Number of Lecture Hours	28	**Exam Hours**	3

CREDITS – 01

PART-A (Computer Network Programs)

1. Write a program to implement error-detecting code using CRC.
2. Write a program to archive Traffic management at Flow level by implementing Closed Loop Control technique. (Leaky Bucket Algorithm)
3. Write a program to implement dynamic routing strategy in finding optimal path for data transmission. (Bellman ford algorithm).
4. Write a program to implement Link State Routing (Dijkstra Algorithm).
5. Write a program for providing security for transfer of data in the network. (RSA Algorithm)
6. Write a program for encrypting 64 bit playing text using DES algorithm.
7. Simulate a 3-node point to point network with duplex links between them. Set the Queue size and vary the bandwidth and find the number of packets dropped.
8. Simulate a four-node point-to-point network, and connect the links as follows: n0->n2, n1- >n2 and n2->n3. Apply TCP agent changing the parameters and determine the number of packets sent/received by TCP/UDP.

PART – B (IoT) Programs

1. Getting started with raspberry Pi and ESP32 controller downloading OS, connecting to PC monitor and initial setup.
2. Study of various sensors- i) GAS Sensor ii) Soil Moisture Sensor iii) Light Sensor iv) Ultrasonic Distance Sensor v) Temperature and Humidity Sensor.
3. Interfacing GAS sensor to the Respberry pi/ESP 32 Controller and test the working of the following:
   a. GAS sensor and make the buzzer on.
   b. soil moisture sensor and send the data to cloud.
   c. light sensor and send the data to the cloud.
4. Interfacing Ultrasonic distance to the Respberry pi/ESP 32 and test the working of ultrasonic distance senor and Temperature & Humidity sensor.
5. Live weather broadcasting using DHT11 and Things Speak cloud
6. Smart gas leakage email alerts using Things Speak.
7. Weather display system using DHT11 and LCD.
8. Object distance display using the 7-segment display and Ultrasonic sensor and Read the sensor data when the specified key is pressed.

Course Outcomes: After studying this course, students will be able to :
CO1:*Implement* network algorithms (CRC, routing, DES/RSA) using programming tools.
CO2:*Simulate* wired/wireless networks and *evaluate* packet-level performance.

CO3:*Interface* sensors with IoT devices (ESP32/Raspberry Pi). **CO4:***Develop* cloud-enabled IoT applications and *interpret* sensor data analytics.

<table>
<tr><td colspan="6">GENERATIVE AI</td></tr>
<tr><td>Course Code:PCC</td><td colspan="4">Subject code:22CS743</td><td>CIE Marks</td><td>50</td></tr>
<tr><td rowspan="2">Number Lecture Hour/Week</td><td>L</td><td>T</td><td>P</td><td>TOTAL</td><td rowspan="2">SEE Marks</td><td rowspan="2">50</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>3</td></tr>
<tr><td>Number of Lecture Hours</td><td colspan="4">40</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="6">Credits-03</td></tr>
<tr><td colspan="6">Course Learning Objectives: This course will enable students to</td></tr>
<tr><td colspan="6">Explain the core principles of generative AI models.
Illustrate different generative model architectures (e.g., VAEs, GANs).
Demonstrate generative models for tasks like text generation, image synthesis, and music creation.
Discuss the ethical considerations and potential societal impacts of generative AI.</td></tr>
</table>

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVEL
1	***Introduction to Generative AI:*** Deep Learning Concepts: Data – Structured and unstructured, Deep learning – building blocks of deep neural networks (architecture, activation functions, optimization algorithms, parameter initialization), multilayer perceptron and back propagation, Generative modelling –The rules of probability, what is generative modelling, generative vs discriminative modelling.	8	L1, L2
5			
2	***Variational Autoencoders (VAEs) and Generative Adversarial Networks (GANs):*** Variational Autoencoders (VAE): VAE architecture, loss function design in VAE – reconstruction loss, divergence loss, Techniques for training and evaluating VAEs, Applications of VAEs.Generative Adversarial Networks (GAN): GAN architecture, training a GAN, GAN Challenges – Oscillating Loss, Mode collapse, Uninformative Loss, Large number of Hyperparameters,	8	L1, L2, L3
3	***Transformer Architecture and Large Language Models:*** Converting text to numbers, Text Embeddings, Attention mechanism, Transformer architecture, Positional Encoding, BERT, GPT-2Autoregressive Models, Language Modelling, Large Language models, Pretraining and fine tuning, few shot learning, Challenges with large language models, prompt engineering - the principles of writing effective promp	8	L1, L2, L3
4	**Ethical Consideration and Applications of Generative AI:** Challenges with generative AI – data privacy, safety, bias in output, hallucinations, jailbreaks. Ethical considerations for responsible development and use of generative AI models, societal impact of generative AI Applications of generative ai for text generation, image synthesis, music generation, video creation, in drug discovery, material science, engineering design, entertainment.	8	L1, L2, L3

5	Advanced Generative AI Topics: Generative models for multimodal data (images, text, audio, etc.), Generative models for sequential data (time series, videos, etc.), Advanced techniques: Style transfer, CycleGAN, etc	**8**	**L1, L2, L3**

COURSE OUTCOMES: At the end of the course the student will be able to:

CO1	illIllustrate the architectural concepts in deep neural networks and generative modeling
CO2	make use of the GAN concepts to learn image generation
CO3	Inspect the transformer architecture for its superior performance for generative tasks
CO4	U Analyze the ethical challenges of generative AI and its applications.
CO5	Understanding the advanced A I concepts& generative models

QUESTION PAPER PATTERN:

- The question paper will have ten questions.
- Each full question consisting of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- The students will have to answer 5 full questions, selecting one full question from each module.

TEXT BOOKS:

1.Generative Deep Learning, Teaching Machines to Paint, Write, Compose and Play, David Foster, Oreilly, 2019.

2. Generative AI with Python and TensorFlow, Joseph Babcock, Raghav Bali, Packt, 2021

- **REFERENCE BOOKS:**

1. Introduction to Generative AI, Numa Dhamani, Maggie Engler, Manning Publications Co., 2024,
2. Generative Deep Learning" by David Foster
3. Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville
4. Generative Adversarial Networks" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville
5. Natural Language Processing (almost) from Scratch" by Collobert et al.

6. Neural Network Methods for Natural Language Processing" by Yoav Goldberg

7. Deep Learning for Computer Vision with Python" by Adrian Rosebrock

B.Tech. in Artificial Intelligence & Machine Learning (2021-Scheme)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
V Semester, w.e.f 2023-24

Documentation Preparation Using Latex

Course Code	**21AAM5102**	**CIE Marks**	50
Number of Lecture Hours/Week (L: T:P)	0:0:1	**SEE Marks**	50
Total Number of Lecture Hours	**20**	**Exam Hours**	3

CREDITS – 01

Course Learning objectives: This course will enable students to:

- UnderstandLaTeX, adocument preparationsystem forhigh-quality typesetting.
- GettingFamiliarized withthefeaturesofLaTeX.
- Gaininghands-onexperienceinbecomingauser of LaTeX.

Module I

Installation of MikeTeX, Online Overleaf access, TEX and its offspring, Creating a Title, Sections, Command names, and arguments, Labelling Table of Contents, Font Effects, Coloured Text, Font Sizes, Comments & Spacing Special Characters, Line breaking.

Programming Examples

Module II

Lists, Tables, Figures - List of figures, Equations: Inserting Equations and Mathematical Symbols, Inserting References: Inserting the Bibliography Styles, Technical Report: Writing Thesis/project/report, Classes: article, book, report, beamer, slides. IEEtran.

Programming Examples

Module III

Document Layout and Organization- Page Layout – Titles, Abstract Chapters, Sections, References, Equation References, citation. List-making environments, Table of contents, Generating new commands, Figure handling numbering, Generating index, Loading packages. Parts of the document: Abstract, Chapters, Appendix, Customized head and foot lines, Page numbering, Paragraph formatting, Single and double column pages.

Programming Examples

Module IV

Introductionto Beamer, Main features: How to set the document class tobeamer,its title, subtitle, author, institute, and date information, Bold, italics and underlining, Highlightingimportantsentences/words,Customizingpresentation:themes(rows) and colorthemes (columns), Fonts and columns

Programming Examples
Module V
Insert Graphs and Diagrams in documents. **Programming Examples**
Course Outcomes: After studying this course, students will be able to:
CO1:*Typeset* mathematical expressions and formulas using LaTeX. **CO2:***Construct* structured tables, lists and arrays. **CO3:***Create* documents with imported graphics and advanced formatting. **CO4:***Prepare* technical reports, research papers and presentations in LaTeX. **CO5:***Generate* bibliographies, indexes, ToC and automated document structures.
Question paper pattern: • The question paper will have ten questions. • There will be 2 questions from each module. • Each question -will have questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module.
Textbooks: 1. GuidetoLATEX,fourthedition,HelmutKopka,Patrick W.Daly
Web links and Video Lecture: 1. https://www.overleaf.com/learn/latex/Beamer#Reference_guide 2. https://mirror.niser.ac.in/ctan/macros/latex/contrib/beamer/doc/beameruserguide.pdf.

SOFTWARE ENGINEERING& PROJECT MANAGEMENT
(Effective from the academic year 2021-2022)

SEMESTER – VI

Course Code	21AM61	**CIE Marks**	50
Number of Lecture Hours/Week (L:T:P)	2:1:0	**SEE Marks**	50
Total Number of Lecture Hours	40	**Exam Hours**	3

CREDITS – 3

Course Learning objectives: This course will enable students to:
1.Outline software engineering principles and activities involved in building large software programs. Identify ethical and professional issues and explain why they are of concern to Software Engineers.
2.Describe the process of requirement gathering, requirement classification, requirement specification and requirements validation.
3.Explain the role of DevOps in Agile Implementation. Discuss various types of software testing practices and software evolution processes.
4.Recognize the importance Project Management with its methods and methodologies.
5.Identify software quality parameters and quantify software using measurements and metrics. List software quality standards and outline the practices involved.

Module I	**08 Hours**

Introduction: Need for Software Engineering, Professional Software Development, Software Engineering Ethics. Case Studies.

Software Evolution: The evolving role of software, Software, The changing nature of software, Software engineering, A Process Framework, Process Patterns, Process Assessment, Personal and Team Process Models, Process Technology, Product and Process.

Software Processes: Models: Waterfall Model, Incremental Model and Spiral Model, Process activities.

Module II	**08 Hours**

Requirements Engineering: Requirements Engineering Processes**,** Functional and non-functional requirements**,** The software Requirements Document, Requirements Specification, Requirements validation, Requirements Management.
System Models: Context models, Interaction models, Structural models, Behavioural models, Model-driven engineering, cost estimation models.
Architectural Design: Architectural design decisions, Architectural patterns.

Module III	**08 Hours**
Software Testing: A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Test Strategies for Object -Oriented Software, Validation Testing, System Testing, The Art of Debugging. **Software Evolution**: Evolution processes, Program evolution dynamics, Software maintenance, Legacy system management. **Agile Methodology & DevOps:** Before Agile – Waterfall, Agile Development.	
Module IV	**08 Hours**
Introduction to Project Management: Introduction, Project and Importance of Project Management, Contract Management, Methods and Methodologies, some ways of categorizing Software Projects, Stakeholders, Setting Objectives, Business Case, Project Success and Failure, Management and Management Control, Project Management lifecycle, Traditional versus Modern Project Management Practices.	
Module V	**08 Hours**
Activity Planning: Objectives of Activity Planning, when to Plan, Project Schedules, Sequencing and Scheduling Activities, Network Planning Models, Forward Pass– Backward Pass, identifying critical path, Activity Float, Shortening Project Duration, Activity on Arrow Networks. **Software Quality:** Introduction, The Place of Software Quality in Project Planning, Importance of Software Quality, Software Quality Models, ISO 9126, Quality Management Systems, Process Capability Models, Techniques to Enhance Software Quality, Quality Plans.	
Course Outcomes: After studying this course, students will be able to:	
CO1:*Explain* software engineering processes and *analyze* lifecycle models. **CO2:***Model* system requirements using structured and object-oriented design tools. **CO3:***Apply* software testing methods and *evaluate* Agile/DevOps practices. **CO4:***Demonstrate* project management principles including cost, schedule & risk. **CO5:***Assess* software quality, metrics and standards for engineering projects.	
Question paper pattern: • The question paper will have ten questions. • There will be 2 questions from each module. • Each question -will have questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module.	
Text Books: 1. Roger S. Pressman: Software Engineering-A Practitioners approach, 7th Edition, Tata McGraw Hill.	

2. Michael Blaha, James Rumbaugh: Object Oriented Modelling and Design with UML, 2nd Edition, Pearson Education, 2005.
3. Bob Hughes, Mike Cotterell, Rajib Mall: Software Project Management, 6th Edition, McGraw Hill Education, 2018.
4. Deepak Gaikwad, Viral Thakkar, DevOps Tools from Practitioner's Viewpoint, Wiley.
5. Ian Sommerville: Software Engineering, 9th Edition, Pearson Education, 2012..

Reference Books: 1. Pankaj Jalote: An Integrated Approach to Software Engineering, Wiley India.

Web links and Video Lecture:

1. https://onlinecourses.nptel.ac.in/noc20_cs68/preview
2. https://www.youtube.com/watch?v=WxkP5KR_Emk&list=PLrjkTql3jnm9b5nr-ggx7Pt1G4UAHeFlJ
3. http://elearning.vtu.ac.in/econtent/CSE.php

DEEP LEARNING AND ITS APPLICATIONS
(Effective from the academic year 2021-2022)

SEMESTER – VI

Course Code	21AM62	**CIE Marks**	50
Number of Lecture Hours/Week (L:T:P)	2:1:0	**SEE Marks**	50
Total Number of Lecture Hours	40	**Exam Hours**	3

CREDITS – 3

Course Learning objectives: This course will enable students to:

- Know the theory behind Convolutional Neural Networks, Autoencoders, RNN.
- Illustrate the strength and weaknesses of many popular deep learning approaches.
- Introduce major deep learning algorithms, the problem settings, and their applications to solve real world problems.
- Learn the open issues in deep learning, and have a grasp of the current research directions.

Module I	**08 Hours**

Introduction to Deep Learning: Introduction, Deep learning Model, Historical Trends in Deep Learning, Machine Learning Basics: Learning Algorithms, Supervised Learning Algorithms, Unsupervised Learning Algorithms.

Module II	**08 Hours**

Feedforward Networks: Introduction to feedforward neural networks, Gradient-Based Learning, BackPropagation and Other Differentiation Algorithms. Regularization for Deep Learning

Module III	**08 Hours**

Optimization for Training Deep Models: Empirical Risk Minimization, Challenges in Neural Network Optimization, Basic Algorithms: Stochastic Gradient Descent, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates: The AdaGrad algorithm, The RMSProp algorithm, Choosing the Right Optimization Algorithm.

Module IV	**08 Hours**

Convolutional Networks: The Convolution Operation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features- LeNet, AlexNet

Module V	**08 Hours**

Recurrent and Recursive Neural Networks: Unfolding Computational Graphs, Recurrent Neural Network, Bidirectional RNNs, Deep Recurrent Networks, Recursive Neural Networks, The Long ShortTerm Memory and Other Gated RNNs. Applications: Large-Scale Deep Learning, Computer, Speech Recognition, Natural Language Processing and Other Applications.

Course Outcomes: After studying this course, students will be able to:

CO1:*Explain* deep learning concepts, learning challenges and model complexities.
CO2:*Apply* feedforward networks and gradient-based optimization algorithms.
CO3:*Implement* CNN and RNN architectures for real-time applications.

CO4:*Analyze* challenges in designing deep neural models.
CO5:*Apply* DL algorithms to solve domain-specific problems (NLP, CV, Speech).

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 questions from each module.
- Each question -will have questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

4. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.

Reference Books: 1. Bengio, Yoshua. "Learning deep architectures for AI." Foundations and trends in Machine Learning, 2009.
2. N. D. Lewis, "Deep Learning Made Easy with R: A Gentle Introduction for Data Science", January 2016.
3. Nikhil Buduma, "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms", O'Reilly publications.

Web links and Video Lecture:

https://nptel.ac.in/courses/106106184

CRYPTOGRAPHY AND NETWORK SECURITY PRINCIPLES
(Effective from the academic year 2021-2022)

SEMESTER – VI

Course Code	21AM631	**CIE Marks**	50
Number of Lecture Hours/Week (L: T: P)	2:1:0	**SEE Marks**	50
Total Number of Lecture Hours	40	**Exam Hours**	3

CREDITS – 3

Course Learning objectives: This course will enable students to:

- To Define Three Security goals, to define security services and how they are related to the three security goals, to review integer arithmetic, modular arithmetic.
- To review short history of DES, define the basic structure of DES, to define the basic structure of AES.
- To introduce prime numbers and their applications in cryptography, to discuss some primarily test algorithm to describe CRT and its application, to discuss RSA system.
- To explain need for KDC, to describe kerbores as a KDC, to discuss how PGP can provide security services for email.
- To discuss the need for security services at the transport layer of the internet model, to discuss the application of IPSec in transport and tunnel modes.

Module I	**08 Hours**
Introduction: Security goals, Cryptographic Attacks, Services and Mechanism, technique Mathematics of Cryptography: Integer Arithmetic, Modular Arithmetic, Matrices Traditional Symmetric-Key Ciphers: Introduction, Substitution Ciphers, Transposition Ciphers, Stream and Block Ciphers	
Module II	**08 Hours**
Data Encryption Standard: Introduction, DES Structure, DES Analysis, Security of DES, IDEA Advanced Encryption Standard: Introduction ,Transformations ,Key Expansion, Analysis of AES.	
Module III	**08 Hours**
Mathematics of Asymmetric Key Cryptography: Primes, Primality testing, Factorization, Cinese remainder theorem, Asymmetric key cryptography: RSA Cryptosystem, Rabin Cryptosystem, Message Authentication	
Module IV	**08 Hours**
Key management: Symmetric Key Distribution, Kerberos, Symmetric Key Agreement, Security at the Application Layer: Email, PGP: scenarios, key rings, PGP certificate, Trust model in PGP, PGP Packet, PGP Messages ,S/MIME:MIME,S/MIME.	
Module V	**08 Hours**
Security at the Transport Layer : SSL Architecture, Services, Key Exchange Algorithm, Encryption/Decryption Algorithm, Hash Algorithm SSL Message Formats, Security At the Network Layer: Two Modes, Two Security Protocols, ISAKMP	

Course Outcomes: After studying this course, students will be able to:

CO1:*Explain* security goals, attacks and classical cryptographic mechanisms.
CO2:*Analyze* the structure and functionality of DES, AES and IDEA.

CO3:*Apply* number-theoretic concepts to implement RSA and authentication schemes.
CO4:*Evaluate* key distribution mechanisms, Kerberos, PGP & S/MIME.
CO5:*Interpret* SSL, IPSec and network-layer security protocols.

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 questions from each module.
- Each question -will have questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Behrouz A. Forouzan and Debdeep Mukhopadhyay, "Cryptography and Network Security", 2nd Edition, McGrawHill Education, 2014.

Reference Books:

1. Cryptography and Network Security: Principles and Practice , 2013 by William Stallings 2. Cryptography and Network Security (UPTU) Paperback – 2012 by V S Bagad and I A Dhotre.

Web links and Video Lecture:

https://onlinecourses.nptel.ac.in/noc22_cs90/preview

BUSINESS INTELLIGENCE
(Effective from the academic year 2021-2022)

SEMESTER – VI

Course Code	21AM632	**CIE Marks**	50
Number of Lecture Hours/Week (L:T:P)	2:1:0	**SEE Marks**	50
Total Number of Lecture Hours	40	**Exam Hours**	3

CREDITS – 3

Course Learning objectives: This course will enable students to:

- To understand the fundamentals of Business Intelligence
- To identify the appropriateness and need Analysis the data
- To learn the preprocessing, mining and post processing of the data
- To understand various methods, techniques and algorithms in Business Intelligence

Module I	**08 Hours**

Basics of Data Mining: Effective and timely decisions, Data, information and knowledge, Role of mathematical models, Business intelligence architectures: Cycle of a business intelligence analysis, enabling factors in business intelligence projects, Development of a business intelligence system, Ethics and business intelligence

Module II	**08 Hours**

Knowledge Delivery: The business intelligence user types, Standard reports, Interactive Analysis and Ad Hoc Querying, Parameterized Reports and Self-Service Reporting, dimensional analysis.
Visualization: Charts, Graphs, Widgets, Scorecards and Dashboards, Geographic Visualization

Module III	**08 Hours**

Decision Making Concepts: Concepts of Decision Making, Techniques of Decision Support System (DSS), Types of Decision Support System (DSS), Development of Decision Support System (DSS), Applications of DSS, Role of Business Intelligence in DSS

Module IV	**08 Hours**

Data Pre-processing: Discovery, Data preparation, Preprocessing requirements, data cleaning, data integration, data reduction, data transformation, Data discretization and concept hierarchy generation, Model Planning, Model building, Communicating Results & Findings, Operationalizing, Introduction to OLAP

Module V	**08 Hours**

Classification & Unsupervised Learning: Classification: Classification Problem, Classification Models, Classification Trees, Bayesian Method; Association Rule: Structure of Association Rule, Apriori Algorithm, General Association; Clustering: Clustering Methods, Partition Methods, Hierarchical Methods
BI Applications: Data analytics, business analytics, ERP and Business Intelligence, BI Applications in CRM, BI Applications in Marketing, BI Applications in Logistics and Production, Role of BI in Finance, BI Applications in Banking, BI Applications in Telecommunication.

Course Outcomes: After studying this course, students will be able to:

CO1:*Apply* BI concepts to analyze organizational data.
CO2:*Interpret* dashboarding, reporting and visualization outputs.
CO3:*Mine* hidden patterns using BI techniques and models.
CO4:*Optimize* BI processes using suitable algorithms.
CO5:*Analyze* classification, clustering and association methods in BI applications.

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 questions from each module.
- Each question -will have questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1.R. Sharda, D. Delen, & E. Turban, Business Intelligence and Analytics. Systems for Decision Support,10th Edition. Pearson/Prentice Hall, 2015. ISBN-13: 978-0-13-305090-5, ISBN-10: 0-13-305090-42.

2.Introduction to business Intelligence and data warehousing, IBM, PHI

Reference Books: 1. Business Intelligence – Data Mining and Optimization for Decision Making– Carlo Vercellis– Wiley Publications.

2.Big Data & Analytics– Seema Acharya & Subhashini Chellappan– Wiley Publications

3.David Dietrich, Barry Hiller, "Data Science & Big Data Analytics", EMC education services, Wiley publications, 2012 .

4.Data mining concepts and techniques, Jawai Han, MichellineKamber, JiranPie,Morgan Kaufmann Publishers 3rd edition.

Web links and Video Lecture:

1. **https://onlinecourses.nptel.ac.in/noc20_mg11/preview**

SOCIAL NETWORK ANALYSIS
(Effective from the academic year 2021-2022)

SEMESTER – VI

Course Code	21AM633	**CIE Marks**	50
Number of Lecture Hours/Week (L:T:P)	2:1:0	**SEE Marks**	50
Total Number of Lecture Hours	40	**Exam Hours**	3

CREDITS – 3

Course Learning objectives: This course will enable students to:

- To understand the concept of semantic web and related applications.
- To learn knowledge representation using ontology.
- To understand human behavior in social web and related communities.
- To learn visualization of social networks.

Module I	**08 Hours**

INTRODUCTION: Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis.

Module II	**08 Hours**

MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION: Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - Modelling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Advanced representations.

Module III	**08 Hours**

EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS: Extracting evolution of Web Community from a Series of Web Archive - Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection and mining - Applications of community mining algorithms - Tools for detecting communities social network infrastructures and communities - Decentralized online social networks - Multi-Relational characterization of dynamic social network communities.

Module IV	**08 Hours**

PREDICTING HUMAN BEHAVIOUR AND PRIVACY ISSUES: Understanding and predicting human behaviour for social communities - User data management - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons - Attack spectrum and countermeasures

Module V	**08 Hours**

VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS: Graph theory - Centrality - Clustering - Node-Edge Diagrams - Matrix representation - Visualizing online social networks, Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams - Hybrid representations - Applications - Cover networks - Community welfare - Collaboration networks - Co-Citation networks.

Course Outcomes: After studying this course, students will be able to:

CO1:*Explain* semantic web concepts and the foundations of social network analysis.
CO2:*Apply* ontology-based knowledge representation techniques.
CO3:*Analyze* community detection methods and social network mining.
CO4:*Predict* human behavior and *evaluate* privacy/security issues in social platforms.
CO5:*Visualize* social network structures and *interpret* analytical insights.

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 questions from each module.
- Each question -will have questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Peter Mika, ―Social Networks and the Semantic Web‖, First Edition, Springer 2007.
2. Borko Furht, ―Handbook of Social Network Technologies and Applications‖, 1st Edition, Springer, 2010.

Reference Books:

1. GuandongXu ,Yanchun Zhang and Lin Li, ―Web Mining and Social Networking – Techniques and applications‖, First Edition, Springer, 2011.
2. Dion Goh and Schubert Foo, ―Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively‖, IGI Global Snippet, 2008.
3. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, ―Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling‖, IGI Global Snippet, 2009.
4. John G. Breslin, Alexander Passant and Stefan Decker, ―The Social Semantic Web‖, Springer, 2009.

Web links and Video Lecture:

https://www.notesforgeeks.in/2021/08/cs8085-social-network-analysis-syllabus-2017-regulation.html

VIRTUAL & AUGMENTED REALITY
(Effective from the academic year 2021-2022)

SEMESTER – VI

Course Code	21AM634	**CIE Marks**	50
Number of Lecture Hours/Week (L:T:P)	2:1:0	**SEE Marks**	50
Total Number of Lecture Hours	40	**Exam Hours**	3

CREDITS – 3

Course Learning objectives: This course will enable students to:

- To understand geometric modelling and Virtual environment.
- To study about Virtual Hardware and Software
- To develop Virtual Reality applications

Module I	**08 Hours**
Introduction to Virtual Reality Fundamental Concept and Components of Virtual Reality, Primary Features and Present Development on Virtual Reality, Multiple Modals of Input and Output Interface in Virtual Reality, Input -- Tracker, Sensor, Digital Glove, Movement Capture, Videobased 3D Menus & 3DScanner etc; Output -- Visual / Auditory / Haptic Devices	
Module II	**08 Hours**
Visual Computation in Virtual Reality (1) Fundamentals of Computer Graphics; Real time rendering technology; Principles of Stereoscopic Display; Software and Hardware Technology on Stereoscopic Display	
Module III	**08 Hours**
Environment Modeling in Virtual Reality Geometric Modeling; Behavior Simulation; Physically Based Simulation, Haptic & Force Interaction in Virtual Reality Concept of haptic interaction; Principles of touch feedback and force feedback; Typical structure and principles of touch/force feedback facilities in applications.	
Module IV	**08 Hours**
Augmented Reality System Structure of Augmented Reality; Key Technology in AR; General solution for calculating geometric & illumination consistency in the augmented environment.	
Module V	**08 Hours**
VR Development Tools Frameworks of Software Development Tools in VR; Modeling Tools for VR; X3D Standard; Vega, MultiGen, Virtoolsetc	

Course Outcomes: After studying this course, students will be able to:

CO1: Describe the basic concept and framework of virtual reality.
CO2: Interpret the principles and multidisciplinary features of virtual reality.
CO3: Use the technology for multimodal user interaction and perception in VR, in particular the visual, audial and haptic interface and behavior.
CO4: Use the technology for managing large scale VR environment in real time.
CO5: Work with the VR system framework and development tools.

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 questions from each module.
- Each question -will have questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbook(s) and other required material:

1. Burdea, G. C. and P. Coffet. Virtual RealityTechnology, Second Edition. Wiley-IEEE · Press, 2003/2006.

Reference Books:

1. Sherman, William R. and Alan B. Craig. Understanding Virtual Reality – Interface, Application, and Design, Morgan Kaufmann, 2002.
2. Fei GAO. Design and Development of Virtual Reality Application System, Tsinghua Press, March 2012

Web links and Video Lecture:

1. https://www.coursera.org/learn/ar
2. https://nptel.ac.in/courses/106/106/106106138/
3. https://www.coursera.org/learn/introduction-virtual-reality
4. http://lavalle.pl/vr/book.html
5. https://www.amazon.in/Augmented-Reality-Virtual-Business-Progress/dp/3030062457
6. https://www.amazon.in/Beginning-iOS-Game-Development-Developing ebook/dp/B07G2LT4PW

DISTRIBUTED AND CLOUD COMPUTING
(Effective from the academic year 2021-2022)

SEMESTER – VI

Course Code	21AM641	**CIE Marks**	50
Number of Lecture Hours/Week (L:T:P)	2:1:0	**SEE Marks**	50
Total Number of Lecture Hours	40	**Exam Hours**	3

CREDITS – 3

Course Learning objectives: This course will enable students to:

- Explain distributed system and cloud models
- Apply distributed computational model and understand the need for cloud computing.

Module I	**10 Hours**
Distributed System Models & Enabling technology: Scalable computing over the internet, Technologies for network-based system, System models for distributed & cloud, Software environments for distributed & Cloud. Computer Clusters for Scalable Parallel Computing: Clustering for Massive Parallism, Computer Clusters and MPP Architectures: Cluster Organization and Resource Sharing, Node Architecture and MPP Packing, Design Principles of Computer Clusters.	
Module II	**08 Hours**
Virtual Machines and Virtualization of Cluster and Data Centres: Levels of Virtualization, Virtualization structures/Tools and Mechanism, Virtualization of CPU, Memory and I/O Devices, Virtual Clusters and Resources Management, Virtualization Data-Centre Automation	
Module III	**08 Hours**
Service Oriented Architecture for Distributed Computing: Services & SOA, Message Oriented Middleware. Cloud Programming & Software Environments: Features of Cloud & Grid, Parallel & Distributed programming paradigms: Parallel Computing and programming paradigms, MapReduce, Twister, and Iterative Map Reduce, Hadoop Library from Apache. Programming support of Google Cloud: Google App Engine, GFS.	
Module IV	**08 Hours**
Cloud Security, Data Security in the Cloud: An Introduction to the Idea of Data Security, The Current State of Data Security in the Cloud CryptDb: Onion Encryption layers- DET, RND, OPE, JOIN, SEARCH, HOM, and Homomorphism Encryption, FPE.	
Module V	**08 Hours**
Trust Management & Green Cloud Trust, Reputation and Security Management in P2P Systems, Load Balancing: HAProxy, Container based Virtualization-Docker, Green Cloud - Energy Consumption Models and Energy-aware Data Centers and Clouds	

Course Outcomes: After studying this course, students will be able to:

CO1: Explain distributed system models and cloud service & deployment models.
CO2: Analyse the need for virtualization in a cloud environment and apply it in compute, memory and storage levels
CO3: Explain distributed computation model on large datasets using parallel and distributed programming approaches over cloud platforms.

CO4: Analyze the security issues in cloud.
CO5: Explain the role of trust and energy efficiency in cloud.CO5: Explain the role of trust and energy efficiency in cloud.

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 questions from each module.
- Each question -will have questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, DISTRIBUTED SYSTEMS Concepts and Design, Fifth Edition, AddisonWesley, 2012.
2. Kai Hwang. Geoffrey C. Fox, Jack J. Dongarra, "Distributed and Cloud Computing from parallel processing to the internet of things", Elsevier, 2012.

Reference Books: 1.Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, "Cloud Computing: principles and paradigms (Wiley Series on Parallel and Distributed Computing), Wiley Publishing (c) 2011.

2.Raluca Ada Popa, Catherine M.S. Redfiled, Nickolai Zeldovich, and Hari Balakrishnan, "Crypt DB" Protecting confidentiality with encrypted Query Processing" 23rd ACM Symposium on Operating Systems principles (SOSP 2011), Cascais, Portugal October 2011.

Web links and Video Lecture:

- https://www.virtualbox.org/wiki/Documentation
- https://cloud.google.com/docs
- https://docs.aws.amazon.com/
- https://docs.microsoft.com/en-us/azure/?product=featured.
  https://wiki.openstack.org/wiki/Documentation
- http://www.manjrasoft.com/aneka_architecture.html
- https://www.docker.com/resources/what-container
- http://www.haproxy.org

MULTIAGENT SYSTEM
(Effective from the academic year 2021-2022)

SEMESTER – VI

Course Code	21AM642	**CIE Marks**	50
Number of Lecture Hours/Week (L:T:P)	2:1:0	**SEE Marks**	50
Total Number of Lecture Hours	40	**Exam Hours**	3

CREDITS – 3

Course Learning objectives: This course will enable students to:

- To introduce the concept of a multiagent systems and Distributed Constraints
- To explore the main issues surrounding the 93computer and extended form games.
- To understand learning in Multiagent Systems.
- To introduce a contemporary platform for implementing agents and multiagent systems

Module I	**08 Hours**
Multiagent Problem Formulation: Utility, Markov Decision Processes, Planning Distributed Constraints: Distributed Constraint Satisfaction, Distributed Constraint Optimization.	

Module II	**08 Hours**
Standard and Extended Form Games: Games in Normal Form, Games in Extended Form, Self-interested agents, Characteristic Form Games, Coalition Formation.	

Module III	**08 Hours**
Learning in Multiagent Systems: The Machine Learning Problem, Cooperative Learning, Repeated Games, Stochastic Games, General Theories for Learning Agents, Collective Intelligence.	

Module IV	**08 Hours**
Negotiation: The Bargaining Problem, Monotonic Concession Protocol, Negotiation as Distributed Search, Ad-hoc Negotiation Strategies, The Task Allocation Problem. Protocols for Multiagent Resource Allocation: Auctions: Simple Auctions, Combinatorial Auctions	

Module V	**08 Hours**
Voting and Mechanism Design: The Voting Problem, Mechanism Design. Nature-Inspired Approaches: Ants and Termites, Immune System**.**	

Course Outcomes: After studying this course, students will be able to:

CO1: Explain the concept of a multiagent systems and Distributed Constraints.

CO2: Explore the applications of Computer and extended form games.
CO3: Understand learning in Multiagent Systems.
CO4: Introduce a contemporary platform for implementing agents and multiagent systems.
CO5: Able to solve the real world problems.

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 questions from each module.
- Each question -will have questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.
-

Text Books:

1) Fundamentals of Multiagent Systems by Jose M. Vidal, 2006, available online http://jmvidal.cse.sc.edu/papers/mas.pdf
2) Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, By Yoav Shoham, Kevin Leyton-Brown, Cambridge University Press, 2008, 2nded http://www.masfoundations.org/mas.pdf

Reference Books: 1 Multiagent Systems: A Modern Approach to Distributed Artificial Intelligence Gerhard Weiss The MIT Press 2000.

Web links and Video Lecture:

1. **https://www.coursera.org/lecture/modeling-simulation-natural-processes/multi-agent-systems-kAKyC**

PREDICTIVE ANALYSIS
(Effective from the academic year 2021-2022)

SEMESTER – VI

Course Code	21AM643	**CIE Marks**	50
Number of Lecture Hours/Week (L:T:P)	2:1:0	**SEE Marks**	50
Total Number of Lecture Hours	40	**Exam Hours**	3

CREDITS – 3

Course Learning objectives: This course will enable students to:
- Explore various classification and regression models.
- Explore working of supervised and unsupervised algorithms.
- Identify the best working models to solve real world problems.

Module I	**08 Hours**

Overview of Supervised Learning: Introduction, Variable Types and Terminology, Two Simple Approaches to Prediction: Linear Methods for Regression and Classification: Introduction, Linear regression models and least squares, , Subset selection , Shrinkage Methods, A Comparison of the Selection and Shrinkage Methods, Linear Discriminant Analysis, Logistic regression.

Module II	**08 Hours**

Model Assessment and Selection: Bias, Variance, and model complexity, The Bias-variance Decomposition, Optimism of the training error rate, Estimate of In-sample prediction error, The Effective number of parameters, Bayesian approach and BIC, Cross- validation, Boot strap methods, Conditional or Expected Test Error.

raphic Visualization

Module III	**08 Hours**

Additive Models, Trees, and Related Methods: Generalized additive models, Tree-Based Methods, Boosting and Additive Trees: Boosting Methods, Exponential Loss and AdaBoost, Example: Spam Data, Numerical Optimization via Gradient Boosting , Illustrations (California Housing , New Zealand Fish, Demographic Data)

Module IV	**08 Hours**

Neural Networks: Introduction, Fitting Neural Networks, Some Issues in Training Neural Networks Support Vector Machines: Introduction, The Support Vector Classifier, Support Vector Machines and Kernels Unsupervised Learning and Random forests: Association rules, Cluster analysis, Details of Random Forests, Random forests and analysis.

Module V	**08 Hours**

Assessing Performance of a classification Algorithm (t-test, McNemar's test, Paired t-test, F-test), Analysis of Variance, Creating data for analytics through designed experiments.

Course Outcomes: After studying this course, students will be able to:

CO1: Apply Regression and classification models to solve real world problems

CO2: Identify and analyze different analytical models

CO3 :Identify and apply Additive models to different data science related problems

CO4 :Apply Supervised and Unsupervised learning techniques

CO5 :Choose appropriate assessment evaluation criterion for different analytical methods

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 questions from each module.
- Each question -will have questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. The Elements of Statistical Learning-Data Mining, Inference, and Prediction Trevor Hastie, Robert Tibshirani, Jerome Friedman Springer 2009.
2. Introduction to Machine Learning, E. Alpaydin PHI 2010.

Reference Books: 1. Pattern Recognition and Machine Learning, Christopher M. Bishop Springer 2007.

2. All of statistics, L.Wasserman Springer 2004.
3. An Introduction to statistical learning with applications in R, G. James, D. Witten, T. Hastie, R. Tibshirani Springer 2017

Web links and Video Lecture:

●https://www.udemy.com/tutorial/become-a-python-data-analyst/introduction-to-predictiveanalytics-models/

● https://intellipaat.com/blog/what-is-predictive-analytics/

● https://www.youtube.com/watch?v=Kd0C-8q0HkI

MULTIMEDIA COMPUTING
(Effective from the academic year 2021-2022)

SEMESTER – VI

Course Code	21AM644	**CIE Marks**	50
Number of Lecture Hours/Week (L:T:P)	2:1:0	**SEE Marks**	50
Total Number of Lecture Hours	40	**Exam Hours**	3

CREDITS – 3

Course Learning objectives: This course will enable students to:

- Understand the characteristics of multimedia systems and how to address issues.
- To equip the students with the differences among multimedia authoring systems.
- Be familiar with the software development process as practiced in a multimedia development environment.
- Able to design, write, document, debug and evaluate a non-trivial multimedia system.
- Understand the legal and ethical issues associated with developing multimedia systems, particularly in regard to use of media clips developed by others.

Module I	**08 Hours**

Introduction: Media and Data Streams, Audio Technology: Multimedia Elements; Multimedia Applications; Multimedia Systems Architecture; Evolving Technologies for Multimedia Systems; Defining Objects for Multimedia Systems; Multimedia Data Interface Standards; The need for Data Compression; Multimedia Databases, Media: Perception Media, Representation Media, Presentation Media, Storage Media, Transmission Media, Information Exchange Media, Presentation Spaces & Values, and Presentation Dimensions; Key Properties of a Multimedia System: Discrete & Continuous Media, Independence Media, Computer Controlled Systems, Integration; Characterizing Data Streams, Characterizing Continuous Media Data Streams. Sound; Audio Representation on Computers; Three Dimensional Sound Projection; Music and MIDI Standards; Speech Signals; Speech Output; Speech Input; Speech Transmission.

Module II	**08 Hours**

Graphics and Images, Video Technology, Computer-Based Animation: Capturing Graphics and Images Computer Assisted Graphics and Image Processing; Reconstructing Images; Graphics and Image Output Options. Basics; Television Systems; Digitalization of Video Signals; Digital Television; Basic Concepts; Specification of Animations; Methods of Controlling Animation; Display of Animation; Transmission of Animation;Virtual Reality Modeling Language.

Module III	**08 Hours**

Data Compression: Storage Space; Coding Requirements; Source,Entropy, and Hybrid Coding; Basic Compression Techniques; JPEG: Image Preparation, Lossy Sequential DCT-based Mode, Expanded Lossy DCT-based Mode, Lossless Mode, Hierarchical Mode, H.261 (Px64) and H.263: Image Preparation, Coding Algorithms, Data Stream, H.263+ and H.263L; MPEG: Video Encoding,Audio Coding

Module IV	**08 Hours**

Optical Storage Media: History of Optical Storage; Basic Technology;Video Discs and Other WORMs; Compact Disc Digital Audio; Compact Disc Read Only Memory; CD-ROM Extended Architecture

Content Analysis: Simple Vs. Complex Features; Analysis of Individual Images; Analysis of Image Sequences, Applications

Module V	**08 Hours**

Data and File Format Standards: Rich-Text Format; TIFF File Format;Resource Interchange File Format (RIFF); MIDI File Format; JPEG DIB File Format for Still and Motion Images; AVI Indeo File Format; MPEG Standards; TWAIN
Multimedia Application Design: Multimedia Application Classes; Types of Multimedia Systems; Virtual Reality Design; Components of Multimedia Systems;

Course Outcomes: After studying this course, students will be able to:

CO1: To Critically and analyze the key components of multimedia technologies including text, graphics, voice, video and animation and the broad principles associated with multimedia concepts used in computer graphics.

CO2: Design and Draw customized GUI components and create an animation using the tools panel.

CO3: Apply data compression techniques & tools in real time applications

CO4: To make use of fundamental concepts and formulate best practices.

CO5: Apply acquired knowledge in the field of multimedia for the good cause like advertisement in practice and independently continue to expand knowledge in this field.

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 questions from each module.
- Each question -will have questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. . Multimedia computing, communications Applications. Ralf Steinmetz & Klara Nahrstedt Pearson Edition.
2.Multimedia Systems John.F. koegel Buford Pearson Edition.

Reference Books: 1. Multimedia Systems, By John.F, Koegel Buford.
2. Virtual Reality Systems, John Vince, ACM Press.

Web links and Video Lecture:

1. http://www.cs.sfu.ca/ CC/165/.
2. https://www.youtube.com/watch?v=LWs7m5a7iuM

DATA SCIENCE

(Effective from the academic year 2021-2022)

SEMESTER – VI

Course Code	21AM651	**CIE Marks**	50
Number of Lecture Hours/Week (L:T:P)	3:1:0	**SEE Marks**	50
Total Number of Lecture Hours	48	**Exam Hours**	3

CREDITS – 04

Course Learning objectives: This course will enable students to:

- To provide a comprehensive knowledge of data science using Python.
- To learn the essential concepts of data analytics and data visualization.

Module I	10 Hours

Data science: definition, Datafication, Exploratory Data Analysis, The Data science process, A data scientist role in this process. NumPy Basics: The NumPy ndarray: A Multidimensional Array Object, Creating ndarrays ,Data Types for ndarrays, Operations between Arrays and Scalars, Basic Indexing and Slicing, Boolean Indexing, Fancy Indexing, Data Processing Using Arrays, Expressing Conditional Logic as Array Operations, Methods for Boolean Arrays , Sorting , Unique

Module II	08 Hours

Getting Started with pandas: Introduction to pandas, Library Architecture, Features, Applications, Data Structures, Series, DataFrame, Index Objects, Essential Functionality Reindexing, Dropping entries from an axis, Indexing, selection, and filtering),Sorting and ranking, Summarizing and Computing Descriptive Statistics, Unique Values, Value Counts, Handling Missing Data, filtering out missing data.

Module III	08 Hours

Data Loading, Storage, and File Formats : Reading and Writing Data in Text Format, Reading Text Files in Pieces, Writing Data Out to Text Format, Manually Working with Delimited Formats, JSON Data, XML and HTML: Web Scraping, Binary Data Formats,Using HDF5 Format, Reading Microsoft Excel Files, Interacting with Databases, Storing and Loading Data in MongoDB .

Module IV	08 Hours

Data Wrangling: Combining and Merging Data Sets, Database style DataFrame Merges, Merging on Index, Concatenating Along an Axis, Combining Data with Overlap , Reshaping and Pivoting, Reshaping with Hierarchical Indexing, Data Transformation, Removing Duplicates, Replacing Values.

Module V	08 Hours

Plotting and Visualization: A Brief matplotlib API Primer, Figures and Subplots, Colors, Markers, and Line Styles, Ticks, Labels, and Legends, Annotations and Drawing on a Subplot, Saving Plots to File,Plotting Functions in pandas, Line Plots, Bar Plots, Histograms and Density Plots, Scatter Plots.

Course Outcomes: After studying this course, students will be able to:

CO1: students will become proficient in working with Numpy, Pandas, Matplot library for multi dimension array.

CO2: Ability to program in python language.
CO3: working knowledge with data's, datasets & data analysis.
CO4: Develop in depth understanding of visualization techniques, predictive modeling and statistics.
CO5: Apply principles of data science to analysis of business of real world problems.

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 questions from each module.
- Each question will have questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Wes McKinney, "Python for Data Analysis",O'REILLY, ISBN:978-1-449-31979-3, 1st edition, October 2012.

2. Rachel Schutt &O'neil, "Doing Data Science", O'REILLY, ISBN:978-1-449-35865-5, 1st edition, October 2013

Reference Books:

1. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media, 2015
2. Matt Harrison, "Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization O'Reilly, 2016.

Web links and Video Lecture:

https://onlinecourses.nptel.ac.in/noc21_cs69/preview

MACHINE LEARNING

(Effective from the academic year 2021-2022)

SEMESTER – VI

Course Code	21AM652	**CIE Marks**	50
Number of Lecture Hours/Week (L:T:P)	3:1:0	**SEE Marks**	50
Total Number of Lecture Hours	48	**Exam Hours**	3

CREDITS – 04

Course Learning objectives: This course will enable students to:

- Define machine learning and problems relevant to machine learning.
- Differentiate supervised, unsupervised and reinforcement learning
- Apply neural networks; Bayes classifier and k nearest neighbor, for problems appear in machine learning.
- Perform statistical analysis of machine learning techniques.

Module I	10 Hours

Introduction: What Is Machine Learning (ML)? Uses and Applications with examples, Types of Machine Learning, Main Challenges of Machine Learning Well posed learning problems, Designing a Learning system, Perspective and Issues in Machine Learning. Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Version space, Candidate Elimination algorithm, Inductive Bias.

Module II	08 Hours

Supervised Learning: Decision Tree Learning: Decision tree representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm, hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning.

Module III	08 Hours

Artificial Neural Networks: Introduction, Neural Network representation, Appropriate problems, Perceptrons, Backpropagation algorithm.

Module IV	08 Hours

Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting probabilities, MDL principle, Naive Bayes classifier, Bayesian belief networks, EM algorithm

Module V	08 Hours

Evaluating Hypothesis: Motivation, Estimating hypothesis accuracy, Basics of sampling theorem, General approach for deriving confidence intervals, Difference in error of two hypotheses, Comparing learning algorithms. Instance Based Learning: Introduction, k-nearest neighbor learning, locally weighted regression, radial basis function, cased-based reasoning, Reinforcement Learning: Introduction, Learning Task, Q Learning

Course Outcomes: After studying this course, students will be able to:

CO1: Identify the problems for machine learning. And select the either supervised, unsupervised or reinforcement learning.

CO2: Explain theory of probability and statistics related to machine learning

CO3: Investigate Perceptron's, Back Propagation Algorithms.

CO4: Investigate Concept Learning, Bayes classifier, EM Algorithm.

CO5: Illustrate Hypothesis, k nearest neighbour, Q Learning.

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 questions from each module.
- Each question will have questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

2. 1. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education.

Reference Books:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, h The Elements of Statistical Learning, 2nd edition, springer series in statistics.
2. Introduction to Machine Learning, EthemAlpaydin, PHI Learning Pvt. Ltd, 3rd Edition, 2018.
3. Hands-on machine learning with Scikit-Learn and TensorFlow: concepts, tools, and techniques to build intelligent systems, Aurelien Geron, O'Reilly Media, 2019.

Web links and Video Lecture:

1. https://onlinecourses.nptel.ac.in/noc23_cs18/preview
2. https://unicornplatform.com/blog/9-best-websites-for-machine-learning-resources/
3. https://www.kaggle.com/

DEEP LEARNING LAB

(Effective from the academic year 2021-2022)

SEMESTER – VI

Course Code	21AML66	**CIE Marks**	50
Number of Lecture Hours/Week	02	**SEE Marks**	50
Total Number of Lecture Hours	30	**Exam Hours**	3

CREDITS – 01

Course Learning objectives: This course will enable students to:

- 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

PART-A

1.	Write a program to convert speech into text
2.	Write a program to convert text into speech.
3.	Write a program to convert video into frames.
4.	Write a program for Time-Series Forecasting with the LSTM Model.
5.	Build a feed forward neural network for prediction of logic gates.
6.	Write a program to implement deep learning Techniques for image segmentation.

PART-B

1.	Write a program for object detection using image labelling tools.
2.	Write a program to predict a caption for a sample image using LSTM.
3.	Write a program for character recognition using CNN.
4.	Write a program to predict a caption for a sample image using CNN.
5.	Write a program for character recognition using RNN and compare it with CNN.

Course Outcomes: After studying this course, students will be able to:

CO1: Make use of deep learning APIs like Keras
CO2: Implement multiple conversions for Analysis
CO3: Apply deep learning techniques for object identification and segmentation
CO4: Implement RNN and CNN for multiple problems
CO5: Implement LSTM models.

Conduct of Practical Examination:

- Experiment distribution
  a) For laboratories having only one part: Students are allowed to pick one experiment from the lot with equal opportunity.
  b) For laboratories having PART A and PART B: Students are allowed to pick one experiment from PART A and one experiment from PART B, with equal opportunity.
- Marks Distribution
  b) For laboratories having only one part – Procedure + Execution + Viva-Voce: 8+35+7 = 50 Marks
  c) For laboratories having PART A and PART B
     i. Part A – Procedure + Execution + Viva = 3 + 14+ 3 = 20 Marks
     ii. Part B – Procedure + Execution + Viva = 5 + 21 + 4 = 30 Marks

SOFTWARE ENGINEERING AND TESTING LAB (Effective from the academic year 2021-2022) SEMESTER – VI			
Course Code	21AML67	**CIE Marks**	50
Number of Lecture Hours/Week	02	**SEE Marks**	50
Total Number of Lecture Hours	30	**Exam Hours**	3
CREDITS – 01			

Course Learning objectives: This course will enable students to:

- Discuss test cases for any given problem
- Compare the different testing techniques
- Illustrate the problem into suitable testing model
- Understand the appropriate technique for the design of flow graph.
- Design and develop appropriate document for the software artefact.

PART-A

1.	Implement the Decision table approach for solving triangle Problem to design and develop a program in a language of your choice to solve the triangle problem defined as follows: Accept three integers which are supposed to be the three sides of a triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Assume that the upper limit for the size of any side is 10. Derive test cases for your program based on boundary-value analysis, execute the test cases and discuss the results.
2.	Implement Boundary value analysisn approach to design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of boundary value testing, derive different test cases, execute these test cases and discuss the test results.
3.	Implement the equivalence class partitioning program todesign, develop, code and run the program in any suitable language to implement the Next Date function. Analyze it from the perspective of boundary value testing, derive different test cases, execute these test cases and discuss the test results.
4.	Implement the Datafl+ow testing approach for data flow testing for commission calculation to design and develop a program in a language of your choice to solve the triangle problem defined as follows: Accept three integers which are supposed to be the three sides of a triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Assume that the upper limit for the size of any side is 10. Derive test cases for your program based on equivalence class partitioning, execute the test cases and discuss the results.
5.	Implement the Boundary , Equivalence and decision Test Case for Commission Problem .Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of

	equivalence class testing, derive different test cases, execute these test cases and discuss the test results.
6.	Implement equivalence class approach for commission problem for design, develop, code and run the program in any suitable language to implement the NextDate function. Analyze it from the perspective of equivalence class value testing, derive different test cases, execute these test cases and discuss the test results.
7.	Implement the Decision Table for Commission Problem **to** design and develop a program in a language of your choice to solve the triangle problem defined as follows: Accept three integers which are supposed to be the three sides of a triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Derive test cases for your program based on decision-table approach, execute the test cases and discuss the results.
8.	Implement the binary search-path Testing to design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of decision table-based testing, derive different test cases, execute these test cases and discuss the test results.

Course Outcomes: After studying this course, students will be able to:

CO1: Understand requirements for the given problem
CO2: Design and implement the solution for given problem in any programming language(C,C++,JAVA)
CO3: Discuss test cases for any given problem
CO4: Apply the appropriate technique for the design of flow graph.
CO5: Create appropriate document for the software artefact.

Conduct of Practical Examination:

- Experiment distribution
  c) For laboratories having only one part: Students are allowed to pick one experiment from the lot with equal opportunity.
  d) For laboratories having PART A and PART B: Students are allowed to pick one experiment from PART A and one experiment from PART B, with equal opportunity.
- Change of experiment is allowed only once and marks allotted for the procedure to be made zero of the changed part only.
- Marks Distribution
  d) For laboratories having only one part – Procedure + Execution + Viva-Voce: 8+35+7 = 50 Marks
  e) For laboratories having PART A and PART B
     iii. Part A – Procedure + Execution + Viva = 3 + 14+ 3 = 20 Marks
     iv. Part B – Procedure + Execution + Viva = 5 + 21 + 4 = 30 Marks

AWS FRAMEWORK

(Effective from the academic year 2021-2022)

SEMESTER – VI

Course Code	21ACS610	**CIE Marks**	50
Number of Lecture Hours/Week	02	**SEE Marks**	50
Total Number of Lecture Hours	30	**Exam Hours**	3

CREDITS – 01

Course Learning objectives: This course will enable students to:

Implement and evaluate the algorithms in and AWS programming language.
• Understand the evaluation of different algorithms.

PART-A

Illustration of the following services.

- ❖ Application Auto Scaling
  Amazon Dynamo DB
- ❖ Amazon Aurora
  Amazon EC2Auto Scaling
- ❖ AWSCloud9
  Elastic Beanstalk
- ❖ Amazon Cloud Formation
  Amazon Elastic Block Store (EBS)
- ❖ Amazon Cloud Front
  Amazon Elastic Compute Cloud (EC2)

AWS

- ❖ AWS Cloud Shell
  Amazon ElasticContainerRegistry(ECR)
- ❖ AWS CloudTrail
  AmazonElasticFileSystem(EFS)
- ❖ Amazon CloudWatch
  AmazonElasticInference
- ❖ AWS Code Commit
  ElasticLoadBalancing
- ❖ Amazon Cognito
  AmazonEventBridge
- ❖ Amazon Comprehend
  AmazonForecast
- ❖ AWS Deep Racer
  AWS Glue
- ❖ AWS Identity and Access Management
- ❖ AWS Glue Data Brew
  (IAM)

PART B

1. Introduction to AWS IAM
2. Build Your VPC and Launch a Web Server
3. Introduction to Amazon EC2
4. Working with Amazon EBS

Course Outcomes: After studying this course, students will be able to:

CO1:Demonstrate comprehensive understanding of the foundational services provided by AmazonWebServices (AWS) including compute, storage, networking, database, and identity & access management(IAM).
CO2:Apply theoretical knowledge and practical skills to effectively utilize a wide range of AWS services such as Amazon EC2, Amazon S3, Amazon RDS, AWS IAM,etc.

CO3:Develop proficiency in deploying, managing, and scaling applications using AWS infrastructure services to meet business requirements.

CO4: Implement security best practices, compliance standards, and ensure high availability and reliability of applications deployed on the AWS platform.

CO5: Gain hands-on experience in designing, building, and managing cloud-based solutions using AWS,while adhering to industry standards and best practices.

RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS
(Effective from the academic year 2022-2023)
SEMESTER – VI

Course Code	21AU69	**CIEMarks**	50
Number of Lecture Hours/Week	01	**SEEMarks**	50
Total Number of Lecture Hours	16	**ExamHours**	3

CREDITS–01

Course objectives: This course will enable students

- To Understand the knowledge on basics of research and its types.
- To Learn the concept of Literature Review ,Technical Reading, Attributions and Citations.
- To learn Ethics in Engineering Research.
- To Discuss the concepts of Intellectual Property Rights in engineering.

	Teaching Hours
ModuleI	03Hours

Introduction: Meaning of Research, Objectives of Engineering Research, and Motivation in Engineering Research, Types of Engineering Research, Finding and Solving a Worthwhile Problem. Ethics in Engineering Research, Ethics in Engineering Research Practice,Types of Research Misconduct, Ethical Issues Related to Authorship.

ModuleII	03Hours

Literature Review and Technical Reading, New and Existing Knowledge, Analysis and Synthesis of Prior Art Bibliographic Databases, Web of Science, Google and Google Scholar.
Effective Search: The Way Forward Introduction to Technical Reading Conceptualizing Research, Critical and Creative Reading, Taking Notes While Reading, Reading Mathematics and Algorithms, Reading a Datasheet. Attributions and Citations :Giving Credit Wherever Due,
Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Acknowledgments and Attributions, What Should Be Acknowledged, Acknowledgments in, Books Dissertations, Dedication or Acknowledgments.

ModuleIII	04Hours

Introduction To Intellectual Property: Role of IP in the Economic and Cultural Development of the Society ,IP Governance, IP as a Global Indicator of Innovation.

Patents: Conditions for Obtaining a Patent Protection ,To Patent or Not to Patent an Invention. Rights Associated with Patents. Enforcement of Patent Rights. Inventions Eligible for Patenting. Non-Patentable Matters. Patent Infringements. Avoid Public **Disclosure of an Invention before patenting**
Process of Patenting. Choice of Application to be Filed. Patent Application Forms. Jurisdiction of Filing Patent Application. Publication. Examination. Grant of a Patent. Validity of Patent Protection. Commercialization of a Patent. Need for a Patent Attorney/Agent. Cana Worldwide Patent be Obtained. Do I Need First to File a Patent in India. Patent Related Forms. Fee Structure. Types of Patent Applications. Commonly Used Terms in Patenting. National

Bodies Dealing with Patent Affairs. Utility Models. Prior Art Search.

ModuleIV	03Hours

Copy rights and Related Rights:

Classes of Copyrights. Criteria for Copyright. Ownership of Copyright. Copyrights of the Author.Copyright Infringements. Copyright Infringement is a Criminal Offence. Copyright Infringement is aCognizable Offence. Fair Use Doctrine. Copyrights and Internet. Non-Copyright Work. Copyright Registration. Judicial Powers of the Registrar of Copyrights. Fee Structure. Copyright Symbol. Validity of Copyright. Copyright Profile of India. Copyright and the word 'Publish'. Transfer of Copyrights to a Publisher. Copyrights and the Word 'Adaptation'. Copyrights and the Word 'IndianWork'.Joint Authorship. Copyright Society. Copyright Board. Copyright Enforcement Advisory Council(CEAC). International Copyright Agreements, Conventions and Treaties.

Trademarks: Eligibility Criteria. Who Can Apply for a Trademark. Acts and Laws. Designation of Trademark Symbols. Classification of Trademarks. Registration of a Trademark is Not Compulsory. Validity of Trademark. Types of Trademarks Registered in India. Trademark Registry. Process for Trademarks Registration.

ModuleV	3Hours

Industrial Designs:

Eligibility Criteria. Acts and Laws to Govern Industrial Designs. Design Rights. Enforcement of Design Rights. Non-Protectable Industrial Designs India. Protection Term. Procedure for Registration of Industrial Designs. Prior Art Search. Application for Registration. Duration of the Registration of a Design. Importance of Design Registration. Cancellation of the Registered Design. Application Forms. Classification of Industrial Designs. Designs Registration Trend in India. International Treaties.

Geographical Indications: Acts, Laws and Rules Pertaining to GI. Ownership of GI. Rights Granted to the Holders. Registered GI in India. Identification of Registered GI. Classes of GI. Non-Registerable GI. Protection of GI. Collective or Certification Marks. Enforcement of GI Rights. Procedure for GI

Registration Documents Required for GI Registration. GI Ecosystem in India.

Course Outcomes: After studying this course, students will be able to:

After studying this course, students will be able to:

CO1: To know the meaning of engineering research.

CO2: To know the procedure of Literature Review and Technical Reading.

CO3: To know the fundamentals of patent laws and drafting procedure

CO4: Understanding the copyright laws and subject matters of copyrights and designs

CO5: Understanding the basic principles of design rights.

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 questions from each module.
- Each question will have questions covering all the to pics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

TextBooks:

1. Dipankar Deb • Rajeeb Dey, Valentina E. Balas "Engineering Research Methodology", ISSN 1868-4394 ISSN 1868-4408 (electronic), Intelligent Systems Reference Library, ISBN 978-981-13- 2946-3ISBN978-981-13-2947-0 (eBook),https://doi.org/10.1007/978-981-13-2947-0
2. Intellectual Property A Primer for Academ ia by Prof. Rupinder Tewari Ms.Mamta Bhardwa

ReferenceBook:

1.DavidV.Thiel"Research Methods for Engineers"Cambridge University Press, 978-1-107-03488-4 – 2. Intellectual Property Rights by N.K.Acharya Asia Law House 6th Edition. ISBN: 978-93-81849-30-9

SYSTEM SOFTWARE AND COMPILER DESIGN

(Effectivefromtheacademicyear2022-2023)
SEMESTER –VI

Course Code	**21CS653**	**CIEMarks**	**50**
Number of LectureHours /Week	**3:1:0**	**SEEMarks**	**50**
Total Number of LectureHours	**48**	**ExamHours**	**03**

CREDITS-04

Prerequisites:
Automata Theory and Formal Languages: Understanding finite automata, regular expressions, context-free grammars, and formal language theory provides a foundation for understanding compiler design and parsing techniques.

Course objectives:
This course will enable students to:

- Define System Software.
- Familiarize with source files, object files, and executable file structures and libraries
- Describe the front-end and back-end phases of the compiler and the importance to students

Modules	**Teaching Hours**
Module-1	
Introduction to System Software, Machine Architecture of SIC and SIC/XE. **Assemblers:** Basic assembler functions, machine-dependent assembler features, machine-independent assembler features, and assembler design options. Basic Loader Functions **Textbook1:Chapter1: 1.1,1.2,1.3.1,1.3.2, Chapter2:2.1to2.4,Chapter3,3.1** **RBT:L1, L2, L3**	10Hours
Module-2	
Introduction to Compiler: Language Processors, The structure of a compiler, The evolution of Programming Language, The Science of Building Compilers, Applications of Compiler Technology. **Lexical Analysis:** The role of lexical analyzer, Input buffering, Specifications of token, Recognition of tokens. **Textbook 2: Chapter 1: 1.1-1.5 Chapter 3: 3.1 – 3.4RBT: L1, L2, L3**	10Hours
Module-3	

Syntax Analysis: Introduction, Writing a Grammar, Top-Down Parsing: RD Parsing, First and Follow, LL(1) Grammar, Error Recovery in Predictive Parsing, Bottom-Up Parsers: Parsing, Handle Pruning, Shift Reduce Parsing, Conflicts During Shift Reduce Parsing, Why LR Parsers?, Items and LR(0) Automaton. **Textbook 2: Chapter 4 4.1, 4.3, 4.4.1-4.4.4, 4.4.6, 4.5,4.6.1,** **4.6.2RBT: L1, L2, L3**	10Hours
Module-4	
LexandYacc–The Simplest Lex Program, Grammars, Parser-Lexer Communication, A YACC Parser, The Rules Section, Running LEX and YACC, LEX and Hand-Written Lexers, Using LEX – Regular Expression, Examples of Regular Expressions, A Word Counting Program, Using YACC–Grammars, Recursive Rules, Shift/Reduce Parsing, What YACC Cannot Parse, A YACC Parser -The Definition Section, The Rules Section, The LEXER, Compiling and Running a Simple Parser, Arithmetic Expressions and Ambiguity. **Textbook 3: Chapters 1,2 and** **3.RBT: L1, L2, L3**	10Hours
Module-5	
Syntax Directed Translation: SDD, Evaluation Orders for SDDs, Application of Syntax Directed Translation, Intermediate code generation:Variants of Syntax Tree, Three Address Code, Code generation: Issuein the Design of a Code Generator. **Textbook2:Chapters 5.1,5.2,5.3,6.1, 6.2,8.1** **RBT:L1, L2, L3**	08Hours

Course outcomes:

At the end of the course, the student will be able to:

CO1: Understand the concepts of assemblers, loaders, and linkers.

CO2: Describe the front-end and back-end phases of the compiler and the importance to students.

CO3: Understand the concepts of compilers and design top-down and bottom-up parsers.

CO4: Utilize Lex and Yacc tools for implementing different concepts of system software.

CO5: Design and develop lexical analyzers, parsers, and code generators.

Textbooks:

1. System Software by Leland. L.Beck, DManjula,3rdedition,2012
2. AlfredVAho,MonicaS.Lam,RaviSethi,JeffreyD.Ullman,Compilers-Principles,Techniquesand Tools, Pearson, 2nd edition, 2007
3. DougBrown,JohnLevine,TonyMason,Lex&YACC,O'ReillyMedia, October2012.

ReferenceBooks:

1. Systems programming–Srimanta Pal, OxfordUniversityPress,2016
2. System programming and Compiler Design, KCLouden, Cengage Learning
3. System software and operating system byD. M. DhamdhereTMG
4. Compiler Design, KMuneeswaran, OxfordUniversityPress2013.