DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHHATRAPATI SAMBHAJINAGAR.

NAAC- 'A $^+$' Grade

CIRCULAR NO.SS/Engg./AI&ML/CBC&GS/15/2025

It is hereby inform to all concerned that, the syllabus prepared by the Board of Studies and recommended by the Dean, Faculty of Science & Technology, *the Academic Council at it's meeting held on 21th July 2025 has been accepted the New syllabus of B. E. Artificial Intelligence & Machine Learning - Third and Fourth Year (Vth to VIIIth semester)* under the Faculty of Science & Technology as per Choice Based Credit Grading System run at all Affiliated Colleges Dr. Babasaheb Ambedkar Marathwada University as appended herewith.

This is effective from the Academic Year 2025-26 & onwards progressively.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Chhatrapati Sambhajinagar-431004.
Ref.No.SS/Engg./AI&ML/CBC&GS/
2025/ 1423 - 28
Date:- 31.07.2025.

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Deputy Registrar
Syllabus Section

Copy forwarded and necessary action to :-

1] **The Principal, All Affiliated Colleges,**
2] The Director, Board of Examinations & Evaluation,
3] The Director, University Network & Information Centre, UNIC,
   with a request to upload this Circular on University Website.
   Dr. Babasaheb Ambedkar Marathwada University,
   Chhatrapati Sambhajinagar.

Copy to :-

1] PA to the Hon'ble Vice-Chancellor, Office
2] PA to the Pro. Vice-Chancellor, Office
3] PA to the Registrar, Office
   Dr. Babasaheb Ambedkar Marathwada University,
   Chhatrapati Sambhajinagar.

JD*31072025/-

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DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHHATRAPATI SAMBHAJINAGAR

Curriculum under Choice Based Credit & Grading System

Revised Syllabus of Bachelor of Engineering

Final Year

Artificial Intelligence and Machine learning Under the Faculty of Science &Technology

[Effective from the Academic Year 2025-26 & onwards/-]

PROF. (DR). R.R.DESHMUKH
DIRECTOR
INTERNATIONAL CENTRE OF EXCELLENCE
IN ENGG. & MGMT. CHH.SAMBHAJINAGAR.

HEAD OF DEPARTMENT
Computer Science & Engineering
MIT, Aurangabad
Incharge . Chairperson

Faculty of Engineering and Technology
Board of Studies in Artificial Intelligence & Machine Learning Curriculum structure of
BE (Artificial Intelligence & Machine Learning)
PART-I

Sub Code	Part-I	Contact Hrs/Week				Examination Scheme					credits	Duration of The Theory Examination
		L	T	P	Total	CT	TH	TW	PR	Total		
AIM401	Soft Computing	4	--	--	4	20	80	--	--	100	4	3 Hrs
AIM402	Principles of Compiler Design	4	--	--	4	20	80	--	--	100	4	3 Hrs
AIM403	Deep Learning	4	--	--	4	20	80	--	--	100	4	3 Hrs
AIM404	Cloud Computing	4	--	--	4	20	80	--	--	100	4	3 Hrs
AIM441 AIM442 AIM443	Elective– III	4	--	--	4	20	80	--	--	100	4	3 Hrs
AIM421	Lab1:Soft Computing	--	--	2	2	--	--	--	50	50	1	
AIM422	Lab2:Principles of Compiler Design	--	--	2	2	--	--	--	50	50	1	
AIM423	Lab3:Cloud Computing	--	--	2	2	--	--	--	50	50	1	
AIM424 AIM425 AIM426	Lab4:Elective– III	--	--	2	2	--	--	50	--	50	1	
AIM427	Project Part-I	--	--	4	4	--	--	25	--	25	2	
AIM428	Seminar	--	--	4	4	--	--	25	--	25	2	
	Total	20	--	16	36	100	400	100	150	750	28	

Elective–III:

Code	Subject(Elective–III)
AIM441	Cyber Security
AIM442	Computer Vision
AIM443	Augmented Reality &Virtual Reality

L: Lecture hours per week   T: Tutorial hours per week   P: Practical hours per week
CT: Class Test TH: University Theory Examination, TW: Work, PR: Practical/Oral Examination

Sub Code	Part-II Subject	Contact Hrs/Week				Examination Scheme					Credits	Duration of The Theory Examination
		L	T	P	Total	CT	TH	TW	PR	Total		
AIM451	Data Engineering	4	--	--	4	20	80	--	--	100	4	3 Hrs
AIM452	Ethics of AI	4	--	--	4	20	80	--	--	100	4	3 Hrs
AIM453	Generative AI	4	--	--	4	20	80	--	--	100	4	3 Hrs
AIM491 AIM492 AIM493	Elective-IV	4	--	--	4	20	80	--	--	100	4	3 Hrs
AIM471	Lab5:Data Engineering	--	--	2	2	--	--	--	50	50	1	
AIM472	Lab6:Ethics of AI	--	--	2	2	--	--	--	50	50	1	
AIM473	Lab7:Generative AI	--	--	2	2	--	--		50	50	1	
AIM474 AIM475 AIM476	Lab8(Elective-IV)	--	--	2	2	--	--	50	--	50	1	
AIM477	Project Part–II	--	--	8	8	--	--	50	100	150	4	
	Total	16	--	16	32	80	320	100	250	750	24	
	Total of Semester I & II	36	--	32	68	180	720	200	400	1500	52	

Elective-IV:

Code	Subject(Elective– IV)
AIM491	Graph Theory
AIM492	Internet of Things
AIM493	Robotics Process Automation

L: Lecture hours per week   T: Tutorial hours per week   P: Practical hours per week
CT: Class Test   TH: University Theory Examination, TW: Term Work, PR: Practical /Oral Examination

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FACULTY OF SCIENCE AND TECHNOLOGY
Final Year Engineering (AI &ML)
Semester – I

Course Code: AIM401

Teaching Scheme

Theory: 04 Hours/Week

Credits: 4

Title: Soft Computing

Examination Scheme

Class Test: 20 Marks

Theory Examination (Marks):80Marks

Theory Examination (Duration):03 Hours

Objectives:

1. To introduce the fundamental principles and techniques of soft computing, including fuzzy logic, neural networks, and genetic algorithms.
2. To enable students to design intelligent systems using soft computing approaches for solving real-world problems.
3. To develop skills for modelling and analysis of uncertain and imprecise systems using fuzzy and neural models.
4. To explore the integration of soft computing techniques in hybrid systems and their applications in optimization and decision-making.

CONTENTS
SECTION-A

Unit1: Introduction to Soft Computing: [10Hrs]

Definition and Importance of Soft Computing, Comparison with Hard Computing, Components of Soft Computing, Applications and Scope in Real-World Problems, Introduction to Machine Learning and Heuristics

Unit2:Fuzzy Logic and Fuzzy Systems: [10Hrs]

Classical vs. Fuzzy Sets, Membership Functions and Fuzzy Set Operations, Fuzzy Relations, Fuzzification and Defuzzification, Fuzzy Inference System (FIS): Mamdani and Sugeno Models Applications of Fuzzy Logic in Control Systems and Decision Making

Unit3: Artificial Neural Networks (ANN) [10Hrs]

Biological Neurons and Artificial Neurons, Types of Neural Networks: Feed forward, Feedback, Recurrent, Learning Algorithms: Hebbian, Perceptron, Delta Rule, Multilayer Perceptron (MLP), Back propagation Algorithm, Applications of ANN in Pattern Recognition, Forecasting

SECTION-B

Unit4: Genetic Algorithms (GA): [10hrs]

Fundamentals of Evolutionary Computing, Genetic Algorithm Operators: Selection, Crossover, Mutation, Fitness Functions and GA Cycle, Applications of Genetic Algorithms in Optimization Comparison of GA with Traditional Optimization Techniques

Unit5: Hybrid Systems and Applications [10Hrs]

Neuro-Fuzzy Systems: Architecture and Learning, Genetic-Fuzzy Systems, Soft Computing in Real-Time Systems, Case Studies: Engineering, Healthcare, Finance, Image Processing, Introduction to Software Tools: MATLAB, SciLab, Python Libraries

Unit 6: Swarm Intelligence & Evolutionary Computing [10Hrs]

Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), Applications of Swarm Algorithms, Introduction to Other Bio-Inspired Techniques (BFO, ABC)

Textbooks:
1. S.N. Sivanandam & S.N. Deepa – Principles of Soft Computing, Wiley India
2. J.S.R. Jang, C.T. Sun, E. Mizutani – Neuro-Fuzzy and Soft Computing, Pearson

Reference Books:

1. Rajasekaran & G.A. VijayalakshmiPai – Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI
2. Timothy J. Ross – Fuzzy Logic with Engineering Applications, Wiley
3. Goldberg D.E. – Genetic Algorithms in Search, Optimization, and Machine Learning, Pearson

Pattern of Question Paper:

The six units in the syllabus shall be divided into two equal parts, i.e., three units in each part. The question paper shall consist of two sections: Section A and Section B. Section A will contain questions from the first part, and Section B will contain questions from the second part. The question paper should cover the entire syllabus.

For 80 Marks Paper:

1. A minimum of ten questions.
2. Five questions in each section.
3. Question No. 1 from Section A and Question No. 6 from Section B will be compulsory, carrying 10 marks each.
4. From the remaining questions in Sections A and B, students are required to solve any two questions from each section, carrying 15 marks each.

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FACULTY OF SCIENCE AND TECHNOLOGY
Final Year Engineering (AI &ML)
Semester – I

Course Code: AIM402	**Title: Principles of Compiler Design**
Teaching Scheme	**Examination Scheme**
Theory: 04 Hours/Week	**Class Test: 20 Marks**
Credits: 4	**Theory Examination (Marks):80Marks**
	Theory Examination (Duration):03 Hours

Prerequisite:
1. Understanding of Data structure, Discrete Mathematics and Algorithms.
2. Basic Knowledge of subject 'Theory of Computation'.
3. Programming skills in basic programming language like C.

Objectives:
1. To get working knowledge of them a jor phases of compilation, like lexical analysis, parsing, semantic analysis and code generation.
2. Those formal attributed grammars for specifying the syntax and semantics of programming languages.
3. To learn and use tools for compiler construction.
4. To understand the structure of a compiler, and how the source and target languages influence various choices in the design.

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CONTENS
SECTIONA

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Unit1: Introduction to Compilers: [8Hrs]

Compilers translators structure of compilers, boot strapping, compiler construction tools. Programming language basics.

Unit2: Lexical Analysis: [10Hrs]

Role of LA, Input buffering, Specification of tokens, Recognition of tokens, Finite automata, Design of a lexical analyzer generator.

Unit3: Syntax Analysis: [12Hrs]

Role of Parser, shift reduce parsing, top down parsing, Predictive parsing – Computation of FIRST & FOLLOW functions and construction of parsing table, LR parsers, the canonical collection of LR (0) items, LALR parser, Automatic parser Generator YACC, YACC programs, Error detection and correction with YACC.

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SECTIONB

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Unit 4: Syntax Directed Translation (SDT): [8Hrs]

Syntax-Directed Definitions, Construction of Syntax Trees, Bottom-Up Evaluation of S-Attributed Definitions, L-Attributed Definitions, Top Down Translation, Bottom-Up Evaluation of Inherited Attributes, Type Checking: Type Systems, Specification of a Simple Type Checker, Equivalence of Type Expressions, Type conversions.

Unit5: Intermediate Code Generation, Symbol Table, Error detection and Recovery: [10Hrs]

Intermediate Code: Postfix notation, parser trees and syntax trees, three address codes – Quadruples and triples, indirect triples, Contents of Symbol table, data structures for symbol tables, representation scope information, Errors, Lexical-phase errors, syntactic-phase errors, semantic errors.

Unit6: Code Optimization: [12Hrs]

Principal sources of optimization, loop optimization - Basic blocks, flow graphs, loops, code motion, Induction variables, DAG representation of basic blocks, Application of DAGs, Global, Data Flow Analysis, Data Flow equations. Loop unrolling, loop jamming, constant folding, Object programs: the environment of code, generator, run-time addresses for names, Problems in code generation, a machine model, working of a simple code generator in brief, Register allocation and assignments, Peephole optimization.

Text Books:

1. A VAho, R. Sethi, JDUllman,"Compilers:Principles,Techniques,andTools",PearsonEducation
2. D.M. Dhamdhere, "Compiler Construction–Principles & practices".

Reference Books:

1. A.V.Aho, J.D. Ullman,"Principles of Compiler Design"–(NAROSA)
2. V Raghavan,"Principles of Compiler Design"-T MH Publications.

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For 80 marks Paper:

1. Minimum ten questions
2. Five questions in each section
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Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHH. SAMBHAJI NAGAR
FACULTY OF SCIENCE AND TECHNOLOGY
Final Year Engineering (AI &ML)
Semester – I

Course Code: AIM 403	**Title: Deep Learning**
Teaching Scheme	**Examination Scheme**
Theory: 04 Hours/Week	**Class Test: 20 Marks**
Credits: 4	**Theory Examination (Marks):80Marks**
	Theory Examination (Duration):03 Hours

Prerequisite:
Basic Knowledge of Machine learning and Data Structures

Objectives:
1. To understand the basic concepts and methods of Deep learning.
2. To make use of some elementary Deep learning techniques in the design of computer systems.
3. To understand the major Deep learning algorithms, the problem settings and assumptions that underlies them.
4. To possess insights, concerning the relative strengths and weaknesses of various common Deep learning methods.

CONTENTS
SECTIONA

Unit1: History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent..   **[10 hrs]**

Unit2: Feed-forward Neural Networks, Representation Power of Feed-forward Neural Networks, Back-propagation, Gradient Descent Variants: Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMS-Prop, Adam.   **[10hrs]**

Unit3: Eigen-values and Eigenvectors, Eigen-value Decomposition, Basis, Principal Component Analysis   and   its   Interpretations,   Singular   Value   Decomposition. Auto-encoders and relation to PCA, Regularization in Auto-encoders.   **[10hrs]**

Unit 4: Denoising Auto-encoders, Sparse Auto-encoders, Contractive Auto-encoders, Regularization Techniques: Bias Variance Tradeoff, L2 Regularization, Early Stopping, Dataset Augmentation, Parameter Sharing and Tying, Injecting Noise at Input, Ensemble Methods, Dropout. **[10 hrs]**

Unit5: Learning Vectorial Representations of Words, Convolutional Neural Networks, Le-Net, Alex-Net, ZF-Net, VGG-Net, GoogLe-Net, Res-Net. Visualization Techniques: Guided Back-propagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks. **[10hrs]**

Unit6: Recurrent Neural Networks, Back propagation Through Time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, Gated Recurrent Unit (GRU), Long Short-Term Memory (LSTM), Encoder-Decoder Models, Attention Mechanism, Attention over Images. **[10 hrs]**

Text Books:

1. Ian Good fellow and Yoshua Bengio and Aaron Courville, "Deep Learning", An MIT Press book http://www.deeplearningbook.org

2. 2. Ian Good fellow, Yoshua Bengio, Aaron Courville, "Deep Learning", 2016

Reference Books:

1. Michael Nielsen, "Neural Networks and Deep Learning", 2016. 2. Yoshua Bengio, "Learning Deep Architectures for AI", 2009.

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FACULTY OF SCIENCE AND TECHNOLOGY
Final Year Engineering (AI &ML)
Semester – I

Course Code: AIM 404   Titles: Cloud Computing
Teaching Scheme   Examination Scheme
Theory: 04 Hours/Week   Class Test: 20 Marks
Credits: 4   Theory Examination (Marks):80Marks
                                                    Theory Examination (Duration):03 Hours

Prerequisite:
1. Computer Network
2. Parallel & Distributed Computing

Objectives:
1. To learn and understand basic concepts of Cloud Computing & Its Models.
2. To learn and understand Cloud Technologies
3. To design, develop and deploy Cloud applications
4. To get acquainted with the challenges and security aspects of Cloud Computing.
5. To study Mobile Cloud Applications

CONTENTS
SECTION-A

Unit1: Introduction to Cloud Computing   [8Hrs]
Introduction to Mainframe architecture & Client-server architecture, Parallel & Distributed Computing, Cluster & Grid Computing Definition and Evolution of Cloud Computing, the Vision of Cloud Computing, Cloud Deployment Models, Cloud Service Models, Key Characteristics, Benefits, Risks& Challenges Cloud Computing, Service oriented architecture (SOA) and Cloud Computing Reference Architecture by IBM.

Unit 2: Cloud Services & Infrastructure   [12Hrs]
Cloud Services: Model architecture, Benefits and Drawbacks:
Infrastructure-as-a-Service(IaaS), Platform-as-a-Service (PaaS), Software-as-a-Service(SaaS), Identity-as-a-service(IDaaS), Storage-as-a-service. Case Study: Platforms a Service: Google App-Engine
Cloud Infrastructure: Historical Perspective of Data Centers Data center Components: IT Equipment and Facilities Design Considerations: Requirements, Power, Efficiency, &Redundancy, Power and Challenges in Cloud Data Centers

Unit3: Enabling Cloud Technologies   [10Hrs]
Web services: XML, SOAP, RES **Virtualization:** Introduction to Virtualization, Hypervisor: Type-Type-II& Types of Virtualization, Pros and cons of virtualization, Virtualization applications in enterprises, I: **Server** virtualization Desktop and Application Virtualization, Storage and Network Virtualization. Case Study: Amazon

Unit 4: Basics of Hadoop [10Hrs]

Big Data, Concept of Big Data, Challenges in Big Data, Hadoop : Definition, Architecture, Introduction to Storage Systems: Cloud Storage Concepts Distributed File Systems (GFS, HDFS), Cloud Databases(H base, Big Table), Cloud Object Storage(AmazonS3), Map Reduce and extensions: Parallel computing, The Map Reduce model: Parallel efficiency of Map Reduce Projects in Hadoop : Hive, Spark, Pig, Oozie , Flume.

Unit 5: Security in the Cloud [10Hrs]

Cloud Security, cloud Security Challenges, Infrastructure security: Network, Host and Application, VM Security Issues, Data security and storage, Security Management in the cloud, Secure Software Development Life Cycle(Sec SDLC),Security Monitoring and Incident Response, Security Architecture Design, Data Privacy, Life cycle of Data, Key Privacy Concerns in cloud and Disaster Recovery.

Unit 6: Mobile Cloud & Latest Cloud Technology Services [10Hrs]

Mobile Cloud: Adopting mobile cloud applications, Using Smart phones with the cloud: Android, Apple Working with Mobile Web Services: Mobile Interoperability. Performing Service Discovery: Context-aware services, MEMS, Location awareness & its Strategies, Push Services, Defining WAP and Other Protocols. Immerging Cloud Technologies: Impact of AWS in Cloud Computing, Types of AWS Services.

Text Books:

1. Enterprise Cloud Computing: Technology, Architecture, Applications by Gautam Shroff, Cambridge University Press.

2. Cloud Computing Implementation, Management, and Security by John W. Ritting house, James F. Ransome , CRC Press.

3. IBM smart storage cloud Red paper by Larry Coyne Mark Bagley Gaurav Chhaunker

4. Cloud Security and Privacy Tim Mather, Subra Kumar a swamy, ShahedLatif.

Reference Books:

1. Cloud computing Bible by Barrie Sosin sky, Wiley India Pvt Ltd (2011)

2. Mastering Cloud Computing Rajkumar Buyya,Christian Vecchiola, S. Thamarai Selvi

3. Harnessing Green IT Principles & Practices by San Murugesan, G.R. Gangadharan

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FACULTY OF SCIENCE AND TECHNOLOGY
Final Year Engineering (AI &ML)
Semester – I

Course Code: AIM441
Teaching Scheme
Theory: 04 Hours/Week
Credits: 4

Title: Elective-IV: Cyber Security.
Examination Scheme
Class Test: 20 Marks
Theory Examination (Marks):80Marks
Theory Examination (Duration):03 Hours

Objective:

1. To introduce the fundamental concepts and evolution of Robotic Process Automation (RPA), including its architecture, benefits, and applications across industries.
2. To develop the ability to design, build, and manage automation workflows using leading RPA tools and platforms.
3. To equip students with the skills to handle data manipulation, user interface interactions, and exception handling in automated processes.
4. To provide knowledge on deploying, orchestrating, and maintaining RPA solutions effectively, along with insights into industry trends and open-source tools.

CONTENTS
SECTION-A

Unit I: Introduction to Cyber Security [8 Hours]

Definition and Need for Cyber Security, CIA Triad (Confidentiality, Integrity, Availability), Cyber Threats and Vulnerabilities, Types of Attacks: Phishing, Malware, Ransomware, DoS, Social Engineering, Threat Actors and Motivations, Cyber Crime and Real-World Case Studies

Unit II: Network and Communication Security [10 Hours]

Basics of Network Security (TCP/IP, OSI Model), Common Network Attacks: Sniffing, Spoofing, MITM, Session Hijacking, Firewalls and Their Types, IDS/IPS: Concepts and Deployment, VPNs, Secure Network Design, Wireless Network Security (WEP, WPA, WPA2, WPA3)

Unit III: Cryptography [12 Hours]

Introduction to Cryptography, Symmetric Encryption: DES, AES, Asymmetric Encryption: RSA, ECC, Hashing: MD5, SHA Family, Digital Signatures and Certificates, Introduction to Public Key Infrastructure (PKI)

Unit IV: System and Web Application Security [10 Hours]

Operating System Security (Windows/Linux), Patching and Hardening Techniques, Web Security: OWASP Top 10 (XSS, SQLi, CSRF, etc.), Email and Browser Security, Secure Coding Principles, Security Testing Tools and Automation

Unit V: Cyber Laws and Digital Forensics [12 Hours]

IT Act 2000 and Amendments, Indian Cyber Law Framework, Privacy and Intellectual Property Rights, Cyber Ethics and Digital Rights, Basics of Cyber Forensics and Digital Evidence, Ethical Hacking and Hacker Types

Unit VI: Emerging Trends in Cyber Security [8 Hours]

Cloud Security Basics (Risks and Best Practices), IoT Security Challenges, Mobile Device Security (BYOD), Block chain in Cyber security, Artificial Intelligence in Cyber Threat Detection, Zero Trust Architecture & Zero-Day Attacks

Text Books:

1. Cryptography and Network Security — William Stallings
2. Introduction to Computer Security — Michael T. Goodrich & Roberto Tamassia
3. Cyber Security and Cyber Laws — R.K. Chaubey
4. Ethical Hacking and Countermeasures (EC-Council Series) — EC-Council

Reference Books:

1. Computer Security: Principles and Practice — William Stallings & Lawrie Brown
2. Network Security Essentials: Applications and Standards — William Stallings
3. Fundamentals of Network Security — Eric Maiwald
4. Cyber security and Cyber war: What Everyone Needs to Know — P.W. Singer & Allan Friedman

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FACULTY OF SCIENCE AND TECHNOLOGY
Final Year Engineering (AI &ML)
Semester – I

Course Code: AIM442
Teaching Scheme
Theory: 04 Hours/Week
Credits: 4

Title: Elective-IV: Computer Vision
Examination Scheme
Class Test: 20 Marks
Theory Examination (Marks):80Marks
Theory Examination (Duration):03 Hours

Prerequisite:
Image Processing techniques

Objectives:
1. To review image processing techniques for computer vision.
2. To understand shape and region analysis.
3. To understand Hough Transform and its applications to detect lines, circles, ellipses.
4. To understand three-dimensional image analysis techniques.
5. To understand motion analysis.

CONTENTS
SECTION-A

Unit 1: IMAGE PROCESSING FOUNDATIONS [8Hrs]

Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology – texture.

Unit 2: SHAPES AND REGIONS [10Hrs]

Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.

Unit 3: HOUGH TRANSFORM [12Hrs]

Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection – accurate center location – speed problem – ellipse detection – Case study: Human Iris location – hole detection – generalized Hough Transform (GHT) – spatial matched filtering – GHT for ellipse detection – object location – GHT for feature collation.

SECTION-B

Unit 4: 3D VISION   [10Hrs]

Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction

Unit 5: STRUCTURE FROM MOTION AND DENSE MOTION ESTIMATION   [8Hrs]

Introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion.

Unit 6: APPLICATIONS   [12Hrs]

Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces, Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians,

Text Books:

1. Gonzalez, R.C., Woods, R.E., Digital Image Processing, Pearson Education, 4th Edition.
2. Szeliski, R., Computer Vision: Algorithms and Applications, Springer.

Reference Books:

1. Hartley, R., Zisserman, A., Multiple View Geometry in Computer Vision, Cambridge University Press, 2nd Edition.
2. Bishop, C.M., Pattern Recognition and Machine Learning, Springer.

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Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHH. SAMBHAJI NAGAR
FACULTY OF SCIENCE AND TECHNOLOGY
Final Year Engineering (AI &ML)
Semester – I

Course Code: AIM443   Title: Elective-IV: Augmented Reality and Virtual Reality.
Teaching Scheme   **Examination Scheme**
Theory: 04 Hours/Week   **Class Test: 20 Marks**
Credits: 4   **Theory Examination (Marks):80Marks**
                                  Theory Examination (Duration):03 Hours

Prerequisite:

Mathematics, Physics, Programming and Problem Solving, Engineering Graphics, Solid
Modeling and Drafting, Numerical & Statistical Methods, Mechatronics, Artificial Intelligence
&Machine Learning, Computer Aided Engineering

Objective:

1. Learn the fundamental Computer Vision, Computer Graphics and Human-Computer
   Interaction Techniques related to VR/AR
2. Review the Geometric Modeling Techniques

CONTENTS
SECTION-A

Unit 1: Introduction to Virtual Reality (VR)   [8Hrs]

Virtual Reality and Virtual Environment, Computer graphics, Real time computer graphics, Flight Simulation,
Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific
Landmark

Unit 2: Computer Graphics and Geometric Modelling   [10Hrs]

The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo
perspective projection, Color theory, Conversion from 2D to 3D, 3D space curves, 3D boundary
representation, Simple 3D modelling, 3D clipping, Illumination models, Reflection models, shading
algorithms, Geometrical Transformations: Introduction, Frames of reference, 47 | Page Modelling
transformations, Instances, Picking, Flying, Scaling the VE, Collision detection

Unit 3: Virtual Environment: [12Hrs]

Input/output Devices: Input (Tracker, Sensor, Digital Gloves, Movement Capture, Video based Input, 3D
Menus & 3D Scanner, etc.), Output (Visual/Auditory/Haptic Devices) Generic VR system: Introduction,
Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems, Animating
the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the
animation of objects, linear and non-linear translation, shape & object in between, free from deformation,
particle system Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels,
Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft.

SECTION-B

Unit 4: Augmented Reality (AR) [12Hrs]

Taxonomy, Technology and Features of Augmented Reality, AR Vs VR, Challenges with AR, AR systems and functionality, Augmented Reality Methods, Visualization Techniques for Augmented Reality, Enhancing interactivity in AR Environments, Evaluating AR systems

Unit 5: Development Tools and Frameworks: [10Hrs]

Human factors: Introduction, the eye, the ear, the somatic senses Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems Software: Introduction, Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML

Unit 6: AR / VR Applications: [8 Hrs]

Introduction, Engineering, Entertainment, Science, Training, Game Development

Text Books:

1. Coiffet, P., Burdea, G. C., (2003), "Virtual Reality Technology," Wiley-IEEE Press, ISBN: 9780471360896

2. Schmalstieg, D., Höllerer, T., (2016), "Augmented Reality: Principles & Practice," Pearson, ISBN: 9789332578494

3. Norman, K., Kirakowski, J., (2018), " Wiley Handbook of Human Computer Interaction," Wiley-Blackwell, ISBN: 9781118976135

4. LaViola Jr., J. J., Kruijff, E., McMahan, R. P., Bowman, D. A., Poupyrev, I., (2017), "3D User Interfaces: Theory and Practice," Pearson, ISBN: 9780134034324

References Books:

1. Craig, A. B., (2013), "Understanding Augmented Reality, Concepts and Applications," Morgan Kaufmann, ISBN: 9780240824086

2. Craig, A. B., Sherman, W. R., Will, J. D., (2009), "Developing Virtual Reality Applications, Foundations of Effective Design," Morgan Kaufmann, ISBN: 9780123749437

3. John Vince, J., (2002), "Virtual Reality Systems, " Pearson, ISBN: 9788131708446

Pattern of Question Paper:

Six units in the syllabus shall be divided in two equal parts i.e. 3 units in each part. Question paper shall be set having two sections A and B. Section A questions shall be set on first part and Section B questions on second part. Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Minimum ten questions
2. Five questions in each section
3. Question no.1from section A and Question no.6 from section B, 10 marks each, will be compulsory.
4. From the remaining questions in section A and B students are supposed to solve any two questions from each section, 15 marks each.

Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHH. SAMBHAJI NAGAR
FACULTY OF SCIENCE AND TECHNOLOGY
Final Year Engineering (AI &ML)
Semester – I

Course Code: AIM421
Teaching Scheme
Practical: 02 Hours/Week
Credit:1

Title: LAB-1 Soft Computing
Examination Scheme
Practical /Oral Examination: 50Marks
Practical/Oral Examination(Duration):03Hours

Suggestive List of Practical's/Assignments:

Design, develop and implement the following Assignments by

1. Create a perceptron with appropriate no. of inputs and outputs. Train it using fixed increment learning algorithm until no change in weights is required. Output the final weights.

2. Create a simple ADALINE network with appropriate no. of input and output nodes. Train it using delta-learning rule until no change in weights is required. Output the final weights.

3. Write a program to Train the auto correlator by given patterns: A1=(-1,1,-1,1), A2=(1,1,1,-1), A3=(-1, -1, - 1, 1). Test it using patterns: Ax=(-1,1,-1,1), Ay=(1,1,1,1), Az=(-1,-1,-1,-1).

4. Train the ANN using multilayer network for given patterns: A1=(000111001) B1=(010000111), A2=(111001110) B2=(100000001), A3=(110110101) B3(101001010). Test it using pattern A2.

5. Write a program for classification with back propagation algorithm

6. Write a program to train the network with SOM unsupervised algorithm

7. 7Implement Union, Intersection operations on fuzzy sets.

8. Implement Complement and Difference operations on fuzzy sets.

9. Write a program to plot various membership functions.

10. Create fuzzy relation by Cartesian product of any two fuzzy sets and perform max/min composition on any two fuzzy relations.

Practical Examination:

Internal examiner should conduct practical Examination for three hours under the supervision of external examiner. External examiner should evaluate student by checking practical performance and conducting viva.

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Semester – I

Course Code: AIM422

Teaching Scheme

Practical: 02 Hours/Week

Credit: 1

Title: LAB-2 Principles of Compiler Design

Examination Scheme

Practical /Oral Examination: 50Marks

Practical/Oral Examination (Duration):03Hours

Suggestive List of Practical Assignments:
Design, develop and implement the following Assignments…....

1. Program to convert Non-deterministic finite automaton (NFA) to Deterministic finite automaton (DFA).

2. Program to generate lexical tokens.

3. Study of LEX/FLEX and write LEX program to identify tokens: integer, decimal numbers, identifiers, keywords, arithmetic operators, relational operators.

4. Program to implement LR parser.

5. YACC program for desktop calculator.

6. Program to implement any one code optimization technique.

7. Implementation of any one method of Intermediate Code Generator.

8. Implementation of code generator.

9. Assignment No.:1 Case Study: GCC, G++compiler

10. Assignment No.:2 Case Study :Parallel Compilation (NVCC), LLVM compiler

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FACULTY OF SCIENCE AND TECHNOLOGY
Final Year Engineering (AI &ML)
Semester – I

Course Code: AIM423
Teaching Scheme
Practical: 02 Hours/Week
Credit: 1

Title: LAB-3 Cloud Computing
Examination Scheme
Practical /Oral Examination: 50 Marks
Practical/Oral Examination (Duration):03Hours

Suggestive List of Practical Assignments:
Design, develop and implement the following Assignments…....

1. Study of Basic Concepts in Cloud Computing

2. Creating a Warehouse Application in Sales Force.com.

3. Implementation of SOAP Web services in C#/JAVA Applications.

4. Implementation of Full-Virtualization by the use of a Hypervisor.

5. Implementation of Para-Virtualization by the use of a Hypervisor.

6. Installation and Configuration of Single-Node Setup in Hadoop.

7. To study Cloud security challenges.

8. Case Study: PAAS (Facebook, Google App Engine)

9. Case Study: Amazon Web Services.

10. To study the Basics of Hadoop Eco-system

Practical Examination:

Internal examiner should conduct practical Examination for three hours under the supervision of external examiner. External examiner should evaluate student by checking practical performance and conducting viva.

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Final Year Engineering (AI &ML)
Semester – I

Course Code: AIM424
Teaching Scheme
Practical: 02 Hours/Week
Credit: 1

Title: LAB-4 (Elective-III): Cyber Security
Examination Scheme
Term Work: 50Marks

Suggestive List of Practical's/Assignments:

Design, develop and implement the following Assignments by

1. Packet Sniffing and Traffic Analysis using Wireshark

2. Network Scanning and Vulnerability Assessment with Nmap

3. Password Cracking using John the Ripper or Hydra

4. Simulating SQL Injection (SQLi) Attacks

5. Cross-Site Scripting (XSS) Attack Demonstration

6. Configuring and Managing Firewall Rules

7. Generating and Using Digital Certificates with Open SSL

8. Symmetric Encryption and Decryption with AES

9. Asymmetric Encryption and Decryption with RSA

10. Setting up and Monitoring Intrusion Detection System (IDS) (e.g., Snort)

11. Simulating a Denial of Service (DoS) Attack

12. Web Application Security Testing using Burp Suite

Practical Examination:

Internal examiner should conduct practical Examination for three hours under the supervision of external examiner. External examiner should evaluate student by checking practical performance and conducting viva.

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FACULTY OF SCIENCE AND TECHNOLOGY
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Semester – I

Course Code: AIM425
Teaching Scheme
Practical: 02 Hours/Week
Credit:1

Title: LAB-4 (Elective-III): Computer Vision
Examination Scheme
Term Work: 50Marks

Suggestive List of Practical Assignments: (Min.8 experiments to be conducted)

1. Thresholding & Edge Detection – Use Canny, Sobel, and adaptive thresholding.

2. Morphological Operations – Perform dilation, erosion, opening, and closing.

3. Shape Analysis – Label objects, count shapes, and calculate properties.

4. Contour & Descriptor Extraction – Extract contours, chain codes, and moments.

5. Hough Transform – Detect lines, circles, and ellipses.

6. 3D Vision – Simulate shape from shading or stereo depth maps.

7. Motion Estimation – Use optical flow for motion tracking in video.

8. Face Detection & Recognition – Use Haar cascade and Eigen faces or LBPH.

9. K-Means Clustering: Segment the image into clusters based on color/intensity using `cv2.kmeans ()`.

10. Watershed Algorithm: Segment overlapping objects using markers and `cv2.watershed ()`.

11. Feature Matching: Use SIFT, SURF, ORB features for key point detection.

Practical Examination:

Internal examiner should conduct practical Examination for three hours under the supervision of external examiner. External examiner should evaluate student by checking practical performance and conducting viva.

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FACULTY OF SCIENCE AND TECHNOLOGY
Final Year Engineering (AI &ML)
Semester – I

Course Code: AIM426   **Title: LAB-4 (Elective-III): Augmented and Virtual Reality**

Teaching Scheme   **Examination Scheme**
Practical: 02 Hours/Week   **Term Work: 50Marks**
Credit: 1

Suggested list of Assignments:

1. Introduction to Unity/Unreal Engine for VR development
2. Creating a basic 3D Virtual Environment
3. Implementing object interaction using VR controllers
4. Designing and applying lighting and shading effects
5. Developing simple animations using linear and non-linear interpolation
6. Integrating input devices: tracker, sensor, or digital gloves
7. Implementing a collision detection system in a VR scene
8. Creating an Augmented Reality application using Vuforia/ARCore
9. Simulating real-world physics (e.g., pendulum or projectile) in VR
10. Mini project: Developing a basic AR/VR application (e.g., training, game, or simulation)

Practical Examination:

Internal examiner should conduct practical Examination for three hours under the supervision of external examiner. External examiner should evaluate student by checking practical performance and conducting viva.

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FACULTY OF SCIENCE AND TECHNOLOGY
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Semester – I

Course Code: AIM427
Teaching Scheme
Practical: 02 Hours/Week
Credit: 2

Title: Project Part-I
Examination Scheme
Term Work: 25Marks

1. Project Group size should be of maximum 4 students.

2. The project is to be taken up at the start of the semester I and the project must be completed by the end of semester II.

3. While submitting project proposal care is to be taken that project will be completed within the available time of two terms.

4. Project title should be precise and clear. Selection and approval of topic: Topic should be related to real life or commercial application in the field of Information Technology. OR Investigation of the latest development in a specific field of Information Technology. OR Commercial and Interdisciplinary projects should be encouraged. The examination will be conducted independently in respective departments.

5. The group should maintain a logbook of activities. It should have entries related to the work done, problems faced, solution evolved etc., duly signed by guide. This data should be used for finding the total main-hours and estimating the cost of the project.

6. The group is expected to complete details Literature Survey, system/problem definition, analysis, design, etc. in (B.E. first Term) seventh term, as a part of term work in the form of a joint report. Project report must be submitted in the prescribed format only. No variation in the format will be accepted.

7. The guides should regularly monitor the progress of the project work.

8. The guide and a departmental committee shall do assessment of the project for award of term work marks as per the guidelines given in the following table.

9. The suggestive format of the report is as follows:

   (Only one report should be submitted per group as a part of term work submission.)

   Title of the Project:

   Names & Roll Numbers of the students: Name of the guide:

   Chapter 1: Introduction

   Chapter 2: Literature Survey

   Chapter3: System Design

Course Code: AIM428
Practical: 04 Hours/Week
Credit: 2

Title: Seminar
Examination Scheme:
TermWork: 25Marks

All the final year students are informed to present a seminar on a topic related to current trends and technologies. Seminar should be evaluated on the following basis:

- PPT prepared and Presentation skills
- Understanding of subject
- Report preparation

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Final Year Engineering (AI &ML)
Semester – II

Course Code: AIM451

Teaching Scheme

Theory: 04 Hours/Week

Credits: 4

Title: Data Engineering

Examination Scheme

Class Test: 20 Marks

Theory Examination (Marks):80Marks

Theory Examination (Duration):03 Hours

Prerequisite:
SQL, Programming language

Objectives:
1. Discover the basics of data engineering
2. Create a basic data pipeline and visualize the data

CONTENTS
SECTION-A

Unit 1: [8Hrs]

Definition and Overview of Data Engineering, Raw Data, Data Engineering Roles, Data Engineering Process, The Modern Data Stack, Introduction to Data Pipelines, Data Engineering Vs Data Science, Data Preprocessing, Data engineering tools

Unit 2: [10Hr]

Into to Postgres and psql, SQL Basics, Types of Joins, Advanced SQL Features – sub queries, Advanced SQL Features – sub queries, CTE's, Window functions

Unit3: [12Hrs]

Data Lake, Data Warehouse, Data Lake houses, Source Systems, Replication of source data, Batch Processing, Data Ingestion: Introduction to Data Ingestion, Types of Data Ingestion, Data Ingestion vs. ETL, Data Ingestion tools, Data Ingestion Best Practices and Challenges, Streaming Bulk ingestion using the Copy command.

SECTION-B

Unit 4: [12Hrs]

Data Quality of Source Systems, Statistical validation, Rule-based validation, Normalization, Dimensional Modeling, Creating Tables, Schema Migration.

Unit5: [10Hrs]

Business Intelligence Tools, Introduction to Superset, Creating visualizations.

Unit6: [8Hrs]

Data Quality, Observability, Data Catalogs, Data Lineage, Data Governance, DataOps, Data Observability

Text Books:

1. Data Engineering with Python: Work with massive datasets to design data models and automate data pipelines using Python, Paul Crickard, Packt Publishing Limited, 1st Edition, 2020
2. Fundamentals of Data Engineering: Plan and Build Robust Data Systems, Joe Reis and Matt Housley, O'Reilly Media, 1st Edition, 2022
3. The Data Engineering Cookbook, Andreas Kretz

Reference Books:

1. Data pipelines Pocket reference, James Densmore, O'Reilly Media, 1st Edition, 2021

Pattern of Question Paper:

The six units in the syllabus shall be divided into two equal parts, i.e., three units in each part. The question paper shall consist of two sections: Section A and Section B. Section A will contain questions from the first part, and Section B will contain questions from the second part. The question paper should cover the entire syllabus.

For 80 Marks Paper:

1. A minimum of ten questions.
2. Five questions in each section.
3. Question No. 1 from Section A and Question No. 6 from Section B will be compulsory, carrying 10 marks each.
4. From the remaining questions in Sections A and B, students are required to solve any two questions from each section, carrying 15 marks each.

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FACULTY OF SCIENCE AND TECHNOLOGY
Final Year Engineering (AI &ML)
Semester – II

Course Code: AIM452   Title: Ethics of AI
Teaching Scheme   Examination Scheme
Theory: 04 Hours/Week   Class Test: 20 Marks
Credits: 4   Theory Examination (Marks):80Marks
                                Theory Examination (Duration):03 Hours

Prerequisite:
Basic understanding of Artificial Intelligence

Objectives:
1. Understand the ethical implications of AI technologies in society.
2. Analyze fairness, accountability, transparency, and bias in AI systems.
3. Critically evaluate real-world case studies where AI ethics are involved.
4. Explore legal, professional, and societal responsibilities of AI practitioners.

Contents
Section A

Unit 1: Introduction to AI Ethics   **[10 hrs]**

Overview of AI capabilities and trends, Definition and scope of AI ethics, Importance of ethics in AI development and deployment, Historical perspective and landmark events, Responsible AI and the role of stakeholders (developers, organizations, users)

Unit 2: Ethical Theories and Frameworks   **[10 hrs]**

Utilitarianism, Deontology, Virtue Ethics, Frameworks: IEEE Ethically Aligned Design, AI4People, Asilomar AI Principles, Alignment problem and value loading, Case: Use of ethical frameworks in autonomous vehicles

Unit 3: Fairness, Accountability, and Transparency (FAT)   **[10 hrs]**

Bias in datasets and algorithms, Algorithmic discrimination and social justice, Explainable AI (XAI) and the importance of transparency, Auditing AI systems for fairness, Case studies: COMPAS system, facial recognition bias

Section B

Unit 4: Privacy, Surveillance, and Consent   **[10 hrs]**

Data collection, user consent, and privacy rights, Surveillance capitalism and data ethics, GDPR and legal frameworks around data use, Facial recognition and public surveillance ethics, Case: Cambridge Analytica, Clear view AI

Unit 5: Autonomous Systems and Human Agency [10 hrs]

Ethics of self-driving cars, drones, and military AI, Human-AI interaction and decision-making autonomy, Lethal autonomous weapons (LAWS), Role of human oversight and the "human-in-the-loop" concept, Ethical issues in robotics and care giving AI

Unit 6: AI and Society: Social Impact and Policy [10 hrs]

Job displacement and economic impact of AI,AI and misinformation: Deep fakes, social media manipulation, AI governance, regulation, and policy-making, Global perspectives on AI ethics (India, EU, USA, etc.)The future of AI ethics and societal resilience

Textbooks:

1. "Ethics of Artificial Intelligence and Robotics" – Stanford Encyclopedia of Philosophy (Online Resource)

2. Mark Coeckelbergh, "AI Ethics", MIT Press, 2020

3. Wendell Wallach & Colin Allen, "Moral Machines: Teaching Robots Right from Wrong", Oxford University Press

4. Virginia Dignum, "Responsible Artificial Intelligence", Springer, 2019

Reference Books:

1. Nick Bostrom & Eliezer Yudkowsky, "The Ethics of Artificial Intelligence," Cambridge Handbook of AI

Pattern of Question Paper:

The six units in the syllabus shall be divided into two equal parts, i.e., three units in each part. The question paper shall consist of two sections: Section A and Section B. Section A will contain questions from the first part, and Section B will contain questions from the second part. The question paper should cover the entire syllabus.

For 80 Marks Paper:

1. A minimum of ten questions.

2. Five questions in each section.

3. Question No. 1 from Section A and Question No. 6 from Section B will be compulsory, carrying 10 marks each.

4. From the remaining questions in Sections A and B, students are required to solve any two questions from each section, carrying 15 marks each.

Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHH. SAMBHAJI NAGAR

FACULTY OF SCIENCE AND TECHNOLOGY
Final Year Engineering (AI &ML)
Semester – II

Course Code: AIM453
Teaching Scheme
Theory: 04 Hours/Week
Credits: 4

Title: Generative Artificial Intelligence
Examination Scheme
Class Test: 20 Marks
Theory Examination (Marks):80Marks
Theory Examination (Duration):03 Hours

Prerequisite: Basics of AI, Deep Learning
Objectives:

1. To give introduction to Generative AI and GAN

2. To learn Technology behind Generative AI and GAN

CONTENTS
SECTION A

Unit1: Foundations of Generative AI [10Hr]

Overview of Artificial Intelligence & Machine Learning, Difference between Discriminative vs. Generative Models, Introduction to Generative AI: Definition, history, and milestones, Types of Generative Models Autoregressive, GANs, VAEs, Diffusion, Real-world applications (text, images, music, code generation)

Unit 2: Deep Learning & Language Models [10Hr]
Basics of deep learning (ANNs, CNNs, RNNs, and Transformers), Introduction to NLP and Language Modeling, Tokenization, Embeddings, Attention, and Transformers, Overview of GPT (1-4), BERT, T5, and LLaMA, Fine-tuning vs. prompt engineering

Unit 3: Image and Multimodal Generation [10Hr]
Image generation using GANs (DCGAN, Style GAN), Introduction to Diffusion models (e.g., Stable Diffusion, DALL·E), Multimodal models (CLIP, Flamingo, Gemini, GPT-4o), Generative art, image-to-image, and text-to-image synthesis

SECTION-B

Unit 4: Tools, Frameworks, and APIs [10Hr]

Platforms: Open AI, Hugging Face, Replicate, Runway, Lang Chain, Programming with APIs: GPT, DALL·E, Whisper, Claude, No-code Gen AI tools: Pika Labs, Canva Magic Studio, etc.

Lang Chain and Retrieval-Augmented Generation (RAG)

Unit 5: Ethics, Risks, and Responsible AI [10Hr]

Ethical considerations in Gen AI, Hallucination, bias, copyright, deep fakes, misinformation, AI alignment, safety, and interpretability, Legal frameworks and policy (EU AI Act, copyright, IP) [10Hr]

Unit 6: Capstone Projects and Future of Gen AI [10Hr]

Capstone planning and execution, Industry trends: AGI, autonomous agents, Gen AI in healthcare, education, media, Collaboration with Gen AI: Co-creation, human-AI teams

Reflection: Ethical design, future careers, and innovation.

Text Books:

1. Generative Deep Learning – David Foster, O'Reilly Media, 2nd Edition
2. GANs in Action: Deep Learning with Generative Adversarial Networks – JakubLangr and Vladimir Bok, Packt Publishing, 1st Edition
3. Prompt Design Patterns: Mastering the Art and Science of Prompt Engineering – Yi Zhou, ArgoLong Publishing, 1st Edition

Reference Books:

1. Generative AI with LangChain – Ben Auffarth, Packt Publishing, 1st Edition
2. Artificial Intelligence & Generative AI for Beginners – David M. Patel, GD Publishing, 1st Edition
3. Prompt Engineering: The Art of Asking – YaswanthSaiPalaghat, Notion Press, 1st Edition
4. Prompt Engineering for Generative AI – James Phoenix & Mike Taylor, O'Reilly Media, 1st Edition

Pattern of Question Paper:

The six units in the syllabus shall be divided into two equal parts, i.e., three units in each part. The question paper shall consist of two sections: Section A and Section B. Section A will contain questions from the first part, and Section B will contain questions from the second part. The question paper should cover the entire syllabus.

For 80 Marks Paper:

1. A minimum of ten questions.
2. Five questions in each section.
3. Question No. 1 from Section A and Question No. 6 from Section B will be compulsory, carrying 10 marks each.
4. From the remaining questions in Sections A and B, students are required to solve any two questions from each section, carrying 15 marks each.

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FACULTY OF SCIENCE AND TECHNOLOGY
Final Year Engineering (AI &ML)
Semester – II

Course Code: AIM491
Teaching Scheme
Theory: 04 Hours/Week
Credits: 4

Title :(Elective–IV) Graph Theory
Examination Scheme
Class Test: 20 Marks
Theory Examination (Marks):80Marks
Theory Examination (Duration):03 Hours

Objectives:

1. To understand the basic concepts and terminologies of graph theory.

2. To analyze and apply graph algorithms for shortest paths, spanning trees, and connectivity.

3. To explore properties of special graphs including Eulerian, Hamiltonian, and bipartite graphs.

4. To apply graph theory techniques in practical scenarios like network design, coloring, and scheduling.

CONTENTS
SECTION-A

Unit 1: Fundamentals of Graph Theory   **[10 Hours]**

Introduction and Definitions, Sub-graphs, Isomorphic Graphs, Matrix Representations of Graphs, Degree of a Vertex, Directed Walks, Paths, and Cycles, Special Graphs and Complements, Graph Operations: Union, Sum, Cartesian Product, Composition.

Unit 2: Eulerian & Hamiltonian Graphs; Graphic Sequences   **[10 Hours]**

Eulerian and Hamiltonian Digraphs, Eulerian and Hamiltonian Graphs (continued), Graphic Sequences, Havel-Hakimi Criterion, Realization of a Graphic Sequence, Application: Graph-Theoretic Model of the LAN Problem.

Unit 3: Connectivity and Shortest Paths   **[10 Hours]**

Walks, Trails, Paths, Cycles, Connected Graphs and Connectivity, Distance, Cut-Vertices, Cut-Edges, Blocks in Graphs, Weighted Graphs, Shortest Path Algorithms: Dijkstra's Algorithm, Floyd-Warshall Algorithm.

Unit4: Trees and Spanning Trees   [10 Hours]

Definitions and Characterizations of Trees, Counting the Number of Trees, Minimum Spanning Trees, Kruskal's Algorithm, Prim's Algorithm, Special Classes of Graphs:, Bipartite Graphs, Line Graphs, Chordal Graphs.

Unit 5: Eulerian & Hamiltonian Properties; Postman Problem   [10 Hours]

Eulerian Graphs and Fleury's Algorithm, Chinese Postman Problem, Hamiltonian Graphs, Necessary and Sufficient Conditions for Hamilton city.

Unit 6: Coloring, Matching, and Applications   [10 Hours]

Independent Sets and Coverings, Matching's in Bipartite Graphs, Hall's Theorem, Perfect Matching's, Vertex Coloring, Cliques and Chromatic Number, Greedy Coloring Algorithm, Coloring Chordal Graphs, Brooks' Theorem, Edge Coloring, Gupta-Vizing Theorem, Class-1 and Class-2 Graphs, Edge Coloring of Bipartite Graphs, Equitable Edge Coloring & Scheduling Problem

Textbooks
1. Graph Theory with Applications – J.A. Bondy & U.S.R. Murty, North Holland.
2. Introduction to Graph Theory – Douglas B. West, Pearson Education.
3. Discrete Mathematics and Its Applications – Kenneth H. Rosen, McGraw-Hill.
4. Graph Theory – Reinhard Diestel, Springer.

Reference Books
1. Elements of Discrete Mathematics – C.L. Liu, McGraw-Hill.
2. Applied Graph Theory – W.F. Harary, Wiley Eastern.
3. A First Course in Graph Theory – Gary Chartrand& Ping Zhang, Dover Publications.
4. Modern Graph Theory – Bela Bollobás, Springer.

Pattern of Question Paper:
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For 80 Marks Paper:
1. A minimum of ten questions.
2. Five questions in each section.
3. Question No. 1 from Section A and Question No. 6 from Section B will be compulsory, carrying 10 marks each.
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FACULTY OF SCIENCE AND TECHNOLOGY
Final Year Engineering (AI &ML)
Semester – II

Course Code: AIM492	**Title :(Elective-IV) Internet of Things (IoT)**
Teaching Scheme	**Examination Scheme**
Theory: 04 Hours/Week	Class Test: 20 Marks
Credits: 4	Theory Examination (Marks):80Marks
	Theory Examination (Duration):03 Hours

Prerequisite: Basics of Computer Networks, Microcontrollers, Programming in Python/C

Objectives:

1. To understand the concept and characteristics of IoT.

2. To study the layered architecture, communication models, and enabling technologies of IoT.

3. To explore IoT-specific communication protocols and analytics tools.

4. To learn about Web of Things and Cloud of Things architecture.

CONTENTS
SECTION-A

Unit1: [10 Hrs]

Introduction to IoT: Overview of IoT and its evolution, IoTvs. M2M vs. CPS, Basic architecture of IoT, Challenges and Requirements of IoT, Applications of IoT: Smart home, city, grid, agriculture, health, etc., Enabling technologies: RFID, sensors, actuators, embedded systems, Industry 4.0 and the Emerging Industrial IoT Structure

Unit 2: [10 Hrs]

IoT Architecture and Design Principles: IoT layered architecture, Building Blocks of IoT, Networking and Communication Overview, Wired and Wireless Technologies: Wi-Fi, Bluetooth, LoRa, etc.,IoT Communication Models and APIs, Wireless Sensor Networks (WSN),IoT Communication Technologies: NFC, RFID, ZigBeeetc

Unit 3: [10 Hrs]

IoT Protocols and Analytics, IoT Protocol Stack vs. TCP/IP Stack, IoT Protocol Standardization Bodies, IoT Protocols: MQTT, CoAP, AMQP,HTTP/REST Cloud Computing in IoT: Architecture and Services, Edge and fog computing in IoT, IoT Analytics and its Use Cases, Data Visualization in IoT, IoT Front-end Interfaces ,IoT and Big Data: Integration and Challenges

SECTION B

Unit 4: [10 Hrs]

Web of Things and Cloud of Things : Web of Things (WoT) vs. Internet of Things (IoT), Two Pillars of Web Architecture, Standardization for WoT, Middleware and Platform Services for WoT., Unified Multitier Architecture for WoT, WoT Portals and Business Intelligence, Cloud of Things: Architecture and Integration

Unit 5: [8 Hrs]

IoT Security, Privacy and Trust : Need for IoT Security, Key Issues in IoT Security and Privacy, Trust Models in IoT, Physical and Device-Level Security, Software Security: On-device Protection and Privacy, Legal and Ethical Considerations

Unit 6: [12 Hrs]

IoT Applications and , Case Studies: Smart Home, Smart City, Smart Environment , Application Domains: Healthcare, Agriculture, Transportation, Industry, Smart Grid , Role of AI and ML in IoT, Real-time System Design and Integration Challenges,   Mini Projects and Prototyping (e.g., using NodeMCU, Raspberry Pi, Arduino) , Evaluation of IoTEcosystems (Platform, Protocol, Application) , Future Trends in IoT: Digital Twin, Edge AI, Blockchain for IoT

Text Books:

1.ArshdeepBahga and Vijay Madisetti, Internet of Things – A Hands-on Approach, Universities Press

2.Raj Kamal, Internet of Things: Architecture and Design Principles, McGraw-Hill

Reference Books:

1.Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014, ISBN: 978-0-12-407684-6

2.Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013, ISBN-13: 978-1430257400

3.Adrian McEwen & Hakim Cassimally, Designing the Internet of Things, Wiley

Web Resources:

1.   https://onlinecourses.nptel.ac.in/noc22_cs53/preview

2.   https://www.iiitmk.ac.in/iot-lab/

Pattern of Question Paper:

The six units in the syllabus shall be divided into two equal parts, i.e., three units in each part. The question paper shall consist of two sections: Section A and Section B. Section A will contain questions from the first part, and Section B will contain questions from the second part. The question paper should cover the entire syllabus.

For 80 Marks Paper:

1. A minimum of ten questions.

2. Five questions in each section.

3. Question No. 1 from Section A and Question No. 6 from Section B will be compulsory, carrying 10 marks each.

4. From the remaining questions in Sections A and B, students are required to solve any two questions from each section, carrying 15 marks each.

Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHH. SAMBHAJI NAGAR
FACULTY OF SCIENCE AND TECHNOLOGY
Final Year Engineering (AI &ML)
Semester – II

Course Code: AIM493
Teaching Scheme
Theory: 04 Hours/Week
Credits: 4

Title: Elective-IV: Robotics Process Automation
Examination Scheme
Class Test: 20 Marks
Theory Examination (Marks):80Marks
Theory Examination (Duration):03 Hours

Objective:

1. To introduce the fundamental concepts and evolution of Robotic Process Automation (RPA), including its architecture, benefits, and applications across industries.

2. To develop the ability to design, build, and manage automation workflows using leading RPA tools and platforms.

3. To equip students with the skills to handle data manipulation, user interface interactions, and exception handling in automated processes.

4. To provide knowledge on deploying, orchestrating, and maintaining RPA solutions effectively, along with insights into industry trends and open-source tools.

CONTENTS
SECTION-A

Unit 1: Introduction to Robotic Process Automation   **[10 Hrs]**

Emergence and Evolution of Robotic Process Automation (RPA), Difference between RPA and Traditional Automation, Key Benefits of RPA, Application Areas of RPA, Components of an RPA System, Overview of RPA Platforms and Tools.

Unit 2: RPA Tools and Interface   **[10Hrs]**

Introduction to RPA Tools (Ui Path, Automation Anywhere, Blue Prism, etc.), User Interface of RPA Tools, Working with Templates, Domains in RPA Activities, Workflow Files: Types and Organization

Unit 3: Process Activities and Workflow Design   **[10Hrs]**

Sequence and Flowchart Workflows, Control Flow Mechanisms: Decisions, Loops, Switches, Activities and Their Configuration, Designing Efficient Workflow Logic, Best Practices for Sequencing and Logic Handling

SECTION-B

Unit 4: Data Manipulation and Controls [10Hrs]

Working with Variables and Data Types, Arguments, Collections, and Data Tables, Clipboard Management and File Operations, UI Controls: Identifying, Waiting for, and Acting on Controls, Using Ui Explorer and Handling UI Events

Unit 5: Exception Handling and Code Management [10Hrs]

Handling Exceptions: Try-Catch Blocks, Common Exceptions, Logging and Debugging Techniques, Collecting Crash Dumps and Error Reporting, Code Management: Project Structuring and Maintenance, Nesting Workflows and Reusability, Templates and Commenting Best Practices, Introduction to State Machines

Unit 6: Deployment, Maintenance, and Future of RPA [10Hrs]

Deployment Using Publish Utility, Role of Orchestration Server, Controlling and Scheduling Bots, License Management and Update Publishing, Overview of Major RPA Vendors, Open-Source RPA Tools, Trends and the Future of RPA

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

Reference Books:
1. Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation, Amazon Asia-Pacific Holdings Private Limited, 2018
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant, Amazon Asia-Pacific Holdings Private Limited, 2018
3. A Gerardus Blokdyk, "Robotic Process Automation Rpa A Complete Guide ", 2020
4.

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Dr. BABASAHEBAMBEDKARMARATHWADAUNIVERSITY, CHH. SAMBHAJI NAGAR
FACULTY OF ENGINEERING AND TECHNOLOGY
Final Year Engineering (AI &ML)
Part-II

Course Code: AIM471	**Title: LAB-5 Data Engineering**
Teaching Scheme	Examination Scheme
Practical: 02 Hours/Week	Practical /Oral Examination: 50Marks
Credit: 1	Practical/Oral Examination (Duration):03Hours

Objectives:

1. To understand core concepts and roles in data engineering.

2. To develop skills in SQL and PostgreSQL for data manipulation.

3. To explore data storage systems and ingestion methods.

4. To implement data modelling, validation, and quality checks.

Suggestive List of Practical Assignments:

Design, develop and implement the following Assignments-

1. Data Pre-processing using Python (Pandas)

2. Install and Configure Postgre SQL; Execute Basic SQL Queries

3. Perform SQL Joins and Subqueries on Relational Data

4. Use CTEs and Window Functions in Advanced SQL Queries

5. Ingest Data into Postures SQL using the COPY Command

6. Simulate Batch and Streaming Data Ingestion

7. Apply Data Validation Techniques (Statistical & Rule-Based)

8. Design and Implement Dimensional Data Models (Star/Snowflake Schema)

9. Create Data Visualizations using Apache Superset

10. Demonstrate Data Lineage, Data Catalog, and Observability Concepts

Practical Examination:

Internal examiner should conduct practical Examination for three hours under the supervision of external examiner. External examiner should evaluate student by checking practical performance and conducting viva.

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Final Year Engineering (AI &ML)
Part-II

Course Code: AIM472

Teaching Scheme
Practical: 02 Hours/Week
Credit: 1

Title: LAB-6 Ethics of AI

Examination Scheme
Practical /Oral Examination: 50Marks
Practical/Oral Examination (Duration):03Hours

Suggestive List of Practical Assignments:

Any AI tool or programming Language can be used to conduct practicals

1. Recent case study of ethical initiatives in healthcare

2. Recent case study of ethical initiatives in Autonomous Vehicles

3. Exploratory data analysis on a 2 variable linear regression model

4. Experiment the regression model without a bias and with bias.

5. Classification of a dataset from UCI repository using a perceptron with and without bias.

6. Case study on ontology where ethics is at stake.

7. Identification on optimization in AI affecting ethics.

8. Case study on how Ethics of AI is used in Defence.

9. Study of Shape tool.

10. Comparative Study of AI tools.

Practical Examination:

Internal examiner should conduct practical Examination for three hours under the supervision of external examiner. External examiner should evaluate student by checking practical performance and conducting viva.

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FACULTY OF ENGINEERING AND TECHNOLOGY
Final Year Engineering (AI &ML)
Part-II

Course Code: AIM473   **Title: LAB-7 Generative Artificial Intelligence**

Teaching Scheme   **Examination Scheme**

Practical: 02 Hours/Week   **Practical /Oral Examination: 50Marks**

Credit: 1   **Practical/Oral Examination (Duration):03Hours**

Design, develop and implement the following Assignments (Minimum8)

Suggestive List of Practical Assignments:

1. Getting Started with Generative AI

   Run a simple text generation model (e.g., GPT-2) to generate sentences.

2. Text Generation using GPT-2

   Train on a small dataset (e.g., poems, news) and generate similar content.

3. Prompt Engineering with LLMs

   Craft prompts for summarization, translation, and question-answering tasks.

4. Image Generation using Stable Diffusion

   Diffusers library or replicate Stable Diffusion locally.

5. Image-to-Image Translation using GANs (Pix2Pix/Cycle GAN)

   Facades, edges2shoes, or custom.

6. Music Generation using Magenta (Google)

   Use RNN/LSTM-based Magenta models for MIDI creation.

7. Text-to-Speech using Tacotron or TTS libraries

8. Image Captioning using CNN-RNN or BLIP model

9. CLIP-based Zero-Shot Image Classification

10. Deep fake Generation using Face Swap or Deep Face Lab

11. Bias and Hallucination in Generative Models

    Analyze and document hallucinated outputs from an LLM.

Practical Examination:

Internal examiner should conduct practical Examination for three hours under the supervision of external examiner. External examiner should evaluate student by checking practical performance and conducting viva.

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Final Year Engineering (AI &ML)
Part-II

Course Code: AIM474

Teaching Scheme
Practical: 02 Hours/Week
Credit: 1

Title: LAB-VIII (Elective–IV) Graph Theory

Examination Scheme
Term Work: 50Marks

Suggestive List of Practical Assignments:

Minimum 8 Assignments should be conducted

Design, develop and implement the following Assignments

1. Represent a graph using adjacency matrix and adjacency list.
2. Check if two graphs are isomorphic.
3. Implement Depth-First Search (DFS) and Breadth-First Search (BFS).
4. Find the shortest path using Dijkstra's algorithm.
5. Compute all-pairs shortest paths using Floyd-Warshall algorithm.
6. Implement Prim's algorithm to find the Minimum Spanning Tree.
7. Implement Kruskal's algorithm to find the Minimum Spanning Tree.
8. Check if a graph is Eulerian and find Eulerian path using Fleury's algorithm.
9. Check whether a graph is bipartite and find maximum matching using Hall's theorem.
10. Apply Greedy coloring algorithm to color a graph and find chromatic number.

Term Work:

The Term Work shall consist of at least 8 experiments/assignments based on the suggestive list of practical assignments. Assessment of term work should be done as follows:

- Continuous lab assessment

- Actual practical performance in laboratory

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Final Year Engineering (AI &ML)
Part-II

Course Code: AIM475 **Teaching Scheme** Practical:2 Hours/Week Credit: 1	**Title: LAB-8 (Elective–IV) Internet of Things** **Examination Scheme:** **Term Work:50Marks**

Prerequisites:

Basics of Computer Networks, Microcontrollers, Programming in Python/C

Objectives:

1. To introduce the setup and programming of IoT development boards like Node MCU, ESP32, or Raspberry Pi.

2. To develop the ability to interface sensors and actuators with IoT devices.

3. To enable communication between devices using IoT protocols (e.g., MQTT, CoAP).

4. To understand data visualization and cloud integration in IoT systems.

5. To design mini-projects reflecting real-world IoT applications.

Suggestive List of Practical Assignments:

Design, develop and implement the following Assignments-

Level: Basic (all)

1. Implement a program using Arduino IDE for Blink LED.

2. Implement a program for RGB LED using Arduino.

3. Implement interfacing of ultra-sonic sensor with Arduino.

4. Implement a Program for foe monitor temperature using Arduino.

5. Implement Wi-Fi shield using Arduino.

Level: Moderate (any three)

6. Implement RFID, NFC using Arduino/Raspberry Pi

7. Implement MQTT protocol using Arduino.

8. Implement Web controlled LED using REST protocol and Arduino.

9. Build Google Assistant with Raspberry Pi.

10. Create a simple web interface for Raspberry Pi board to control the connected LEDs remotely through the interface.

Level: Complex (any two)

11. Implement Arduino based fire alarm system using temperature and smoke sensors.

12. Implement a weather monitoring system using humidity, temperature and raindrop sensor and Raspberry Pi/Arduino board.

13. Write an application using Raspberry Pi/Arduino for traffic signal monitoring and control system.

Practical Examination:

Internal examiner should conduct practical Examination for three hours under the supervision of external examiner. External examiner should evaluate student by checking practical performance and conducting viva.

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Final Year Engineering (AI &ML)
Part-II

Course Code: AIM476
Teaching Scheme:
Practical: 02 Hours/Week
Credit: 1

Title: LAB-8 (Elective–IV) Robotics Process Automation
Examination Scheme:
Term Work: 50Marks

Suggestive List of Practical's/Assignments:

Design, develop and implement the following Assignments by

1. Setup and Configure a RPA tool and understand the user interface of the tool:
2. Create a Sequence to obtain user inputs display them using a message box;
3. Create a Flowchart to navigate to a desired page based on a condition;
4. Create a State Machine workflow to compare user input with a random number.
5. Build a process in the RPA platform using UI Automation Activities.
6. Create an automation process using key System Activities, Variables and Arguments
   Also implement Automation using System Trigger
7. Automate login to (web)Email account
8. Recording mouse and keyboard actions.
9. Scraping data from website and writing to CSV
10. Implement Error Handling in RPA platform
11. Web Scraping
12. Email Query Processing

Practical Examination:

Practical Examination should be conducted by internal examiner for three hours under the supervision of external examiner. External examiner should evaluate student by checking practical performance and conducting viva.

Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,CHH. SAMBHAJI NAGAR

FACULTY OF ENGINEERING AND TECHNOLOGY

Final Year Engineering (AI&ML)

Part-II

Course Code: AIM477
Teaching Scheme:
    Credit:4

Title: Project Part II
Examination Scheme:
TermWork:50Marks
Practical/Oral Examination:100Marks
Practical/Oral Examination(Duration):03Hours

1. The guide should be internal examiner or oral examination.

2. The external examiner should be from the related area of the concerned project. He should have minimum of five years of experience at degree level / industry.

3. The internal and external examiner should do the evaluations at final oral examination jointly.

4. The same project group of Part I should continue the work in Part – II as well. The project group should complete the project work taken in Part I. It should complete the rest of the work from stage III onwards till the conclusion. The performance Analysis chapter should consist of various testing methods used along with sample test cases. It should also include how better the system is performing as compared to other similar systems. The final examination will consist of the demonstration of work, which will be judged by two examiners (one internal and one external), and the marks will be given accordingly. The suggestive format of the report is as follows:

(Only one report should be submitted per group as a part of term work submission)

Title of the Project:

Names & Roll Numbers of the students:

Name of the guide:

Chapter 1: Introduction

Chapter2: Literature Survey

Chapter3: System Development

(This chapter will include the entire design process with necessary DFDs, other diagrams, design methodologies and other design and implementation details.)

Chapter4: Performance Analysis

Chapter5: Conclusions

(Detailed format of the project report is to be made available by the Dept.)

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DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHHATRAPATI SAMBHAJINAGAR.

Curriculum under Choice Based Credit & Grading System

Revised Syllabus of Bachelor of Engineering

3rd Year

Artificial Intelligence and Machine learning Under the Faculty of Science &Technology

[Effective from the Academic Year 2025-26 & onwards/-]

PROF. (DR). R.R.DESHMUKH
DIRECTOR
INTERNATIONAL CENTRE OF EXCELLENCE
IN ENGG. & MGMT. CHH.SAMBHAJINAGAR.

HEAD OF DEPARTMENT
Computer Science & Engineering
MIT, Aurangabad
Incharge-Chairperson

Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHH. SAMBHAJI NAGAR
FACULTY OF SCIENCE AND TECHNOLOGY
Board of Studies in Artificial Intelligence and Machine Learning
The curriculum structure of TE Artificial Intelligence and Machine learning
PART-I

Sub Code	Semester-I Subject	Contact Hrs/Week				Examination Scheme						Duration of The Theory Examination
		L	T	P	Total	CT	TH	TW	PR	Total	credits	
AIM301	Systems Programming	4	--	--	4	20	80	--	--	100	4	3 Hrs
AIM302	Theory of Automata	4	--	--	4	20	80	--	--	100	4	3 Hrs
AIM303	Computer Network	4	--	--	4	20	80	--	--	100	4	3 Hrs
AIM304	Programming in JAVA	4	--	--	4	20	80	--	--	100	4	3 Hrs
AIM341 AIM342 AIM343	Elective–I	4	--	--	4	20	80	--	--	100	4	3 Hrs
AIM321	Lab1:Computer Network	--	--	2	2	--	--	--	50	50	1	
AIM322	Lab2:Programming in JAVA	--	--	2	2	--	--	--	50	50	1	
AIM323 AIM324 AIM325	Lab3:Elective–I	--	--	2	2	--	--	50	--	50	1	
AIM326	Lab4:Python Programming-II		--	2	2	--	--	--	50	50	1	
BSH305	Communication Skills-II	2	--	--	2	--	--	50	--	50	2	
	Total	22	--	8	30	100	400	100	150	750	26	

Elective I :

Code	Elective-I
AIM341	Information Theory
AIM342	Image Processing
AIM343	High-Performance Computing

Sub Code	Semester-II Subject	Contact Hrs/Week				Examination Scheme					Credits	Duration of The Theory Examination
		L	T	P	Total	CT	TH	TW	PR	Total		
AIM351	Natural Language Processing	4	--	--	4	20	80	--	--	100	4	3 Hrs
AIM352	Software Engineering	4	--	--	4	20	80	--	--	100	4	3 Hrs
AIM353	Data Warehousing and Data Mining	4	--	--	4	20	80	--	--	100	4	3 Hrs
AIM354	Advance ML	4	--	--	4	20	80	--	--	100	4	3 Hrs
AIM391 AIM392 AIM393	Elective-II	4	--	--	4	20	80	--	--	100	4	3Hrs
AIM371	Lab5:NLP	--	--	2	2	--	--	--	50	50	1	
AIM372	Lab6: Software Engineering	--	--	2	2	--	--	50	--	50	1	
AIM373	Lab7:Data Warehousing and Data Mining	--	--	2	2	--	--	--	50	50	1	
AIM374 AIM375 AIM376	Lab8 Elective-II	--	--	2	2	--	--	50	--	50	1	
AIM377	Lab9 SDL-II (Android)	--	--	4	4	--	--	--	50	50	2	
	Total of Semester II	20	--	12	32	100	400	100	150	750	26	
	Total of Semester I & II	42		20	62	200	800	200	300	1500	52	

Elective II:

Code	Elective-II
AIM391	Cryptography and network security
AIM392	Pattern Recognition
AIM393	Game Architecture & Design

L: Lecture hours per week, T: Tutorial hours per Week, P: Practical hours per week, CT: Class Test, TH: University Theory Examination, TW: Term Work, PR: Practical/Oral Examination

Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHH. SAMBHAJI NAGAR
FACULTY OF SCIENCE AND TECHNOLOGY
Third Year Engineering (AI &ML)
Semester – I

Course Code: AIM301
Teaching Scheme
Theory: 04 Hours/Week
Credits: 4

Title: Systems Programming
Examination Scheme
Class Test: 20 Marks
Theory Examination (Marks):80Marks
Theory Examination (Duration):03 Hours

Prerequisite

Data structures and Operating System

Objectives

Students will be able to

1. Understand concepts of system programming, machine language and assembly language

2. Understand concepts of lexical, syntax and semantic analysis

3. Understand assemblers, macros and macro call

4. Understand compilers, loaders, linkers, interpreters and debuggers

CONTENTS

SECTIONA

Unit-1. Introduction to System Programming (10 hrs)

Concept, historical development, components of system software, life cycle of source program,

Programming languages and language processors, fundamentals of language processing, symbol table, foundation of system software.

Unit-2. Assembler (08 hrs)

General design procedure, design the assembler, types of assemblers, one pass assembler, advanced assembly process, design of two pass assembler

Unit-3. Macro language and Macro processors (12 hrs)

Macro instructions, features of macro facility, macro instruction arguments, conditional macro expansion, macro call within macros, macro instruction defining macros Implementation-Implementation of restricted faculty: two pass algorithm, single pass algorithm, implementation of macro calls within macros, implementation within assembler.

SECTION B

Unit-4. Loaders and Linkers
(10hrs)

Loaders scheme : "compile and go loaders", general loader schemes, absolute loaders, subroutine linkages, relocating loaders, direct linking loaders, other loader schemes, binders, linking loaders overlays, dynamic binders. Design of absolute loaders, design of direct linking loaders, linkers vs loaders.

Unit-5. Scanning and Parsing
(10hrs)

Programming language grammar, classification of grammar, ambiguity in grammatic specification, scanning, parsing, top down and bottom up parsing, language processor development tools

Unit- 6. Compilers, Interpreters and Debuggers
(10hrs)

Causes of large semantic gap, binding and binding times, data structure used in compiling scope rules, memory allocation, compilation of expression, compilation of control structure, code optimization. Benefits of interpretation, overview of interpretation, classification of debuggers, dynamic/interactive debugger.

Text Books
1. John J. Donovan, 'System Programming',Tata Mc- Graw Hill.
2. D. M. Dhamdhere, 'System Programming and operating system',Tata Mc- Graw Hill.
3. G. Sudha Sadashiv, 'Compiler design', SciTech.
4. Rajesh K. Maurya,'System Programming',Dreamtech.

PATTERN OF QUESTION PAPER:
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4

Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHH. SAMBHAJI NAGAR
FACULTY OF SCIENCE AND TECHNOLOGY
Third Year Engineering (AI &ML)
Semester – I

Course Code: AIM302
Teaching Scheme
Theory: 04 Hours/Week
Credits: 4

Title: Theory of Automata
Examination Scheme
Class Test: 20 Marks
Theory Examination (Marks):80Marks
Theory Examination (Duration):03 Hours

Prerequisite:
1. Discrete mathematics

Objectives:
1. To introduce the fundamental concepts of formal languages, grammar, and automata theory.
2. To study and develop fundamentals for computational theory.
3. To apply abstract models for solving problems in computing.
4. To understand the differences between decidability and undecidability

CONTENTS
SECTIONA

Unit1: Finite Automata   [10hrs]

Introduction to Finite Automata, Structural representation, Automata and complexity. Chomsky Classification of languages, Central Concepts of Automata Theory, Deterministic Finite Automata, Nondeterministic Finite automata, FA with epsilon transitions, Applications of FA, FA with output: Moore and Mealy machine

Unit 2: Regular Expressions and Languages   [12hrs]

Regular Expressions, Finite automata, and Regular Expression, Algebraic laws for RE, Arden theorem, Pumping lemma for Regular languages, Applications of pumping lemma, Closure and Design properties of regular languages, Equivalence and minimization of Automata, Applications of Regular Expressions.

Unit 3: Context-Free Grammars and Languages   [8 hrs]

Context Grammars, Parse trees, Applications of CFG, Ambiguity in grammars and languages, Normal Forms for CFG: Chomsky Normal Form

Unit 4: Pushdown Automata and LBA [10hrs]

Pushdown Automata – Definition, Languages of PDA, Acceptance by Empty Stack and Final State, Equivalence of PDA and CFG, Deterministic Pushdown Automata, Pumping lemma for CFL, The model of linear bounded Automata.

Unit 5:Turing Machine [10hrs]

The Turing machine–Notation for TM, Instantaneous description for TM, Transition diagram for TM, The language of a TM, Design of Turing Machines, Church Turing Thesis, TM and halting, Extensions to the basic TM: Multi tape TM, Nondeterministic TM, Universal TM.

Unit 6: Decidability and Undecidability [10hrs]

Decidable problems, Decidable problems concerning Regular Language, Undecidable Problems, and Simple Un-decidable Problems: Post Correspondence Problem, Intractable Problems: Classes P and NP.

Text Books:

1. JohnE.Hopcroft, Rajeev Motwani, Jeffrey.Ullman, "Introduction to Automata Theory Languages, and Computation" 3rd ed. , Pearson Education, ISBN: 81-317-1429-2
2. K.L.P. Mishra, N. Chandrasekaran, "Theory of Computer Science: Automata, Languages and Computation" 3rd ed. , PHI , ISBN : 978-81-203-2968-3
3. John C Martin, "Introduction to Languages and the Theory of Computation",3rded.,Tata McGraw Hill, ISBN: 0-07-066048-4)

Reference Books:

1. Michael Sipser , Introduction to the Theory of Computation, CENGAGE Learning, 3rd Edition ISBBN-13:978-81-315-2529-6.
2. Basavaraj S. Anami, KaribasappaK.G., "Formal Languages and Automata Theory" Wiley Publication, ISBN: 978-81-265-2010-7

PATTERN OF QUESTION PAPER:
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Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHH. SAMBHAJI NAGAR
FACULTY OF SCIENCE AND TECHNOLOGY
Third Year Engineering (AI &ML)
Semester – I

Course Code: AIM303
Teaching Scheme
Theory: 04 Hours/Week
Credits: 4

Title: Computer Networks
Examination Scheme
Class Test: 20 Marks
Theory Examination (Marks):80Marks
Theory Examination (Duration):03 Hours

Prerequisite:

1. Computer Fundamentals

2. Data Communication

Objectives:

1. To learn and understand various Networking Protocols & Layers.

2. To understand functioning of a complete network.

3. To study most widely used computer network technologies in detail: Ethernet, TCP/IP.

CONTENTS
SECTION-A

Unit 1: Introduction [10 Hours]

Uses of Computer Networks, Networks, network types, Internet History, Network Hardware , Transmission Media: Twisted pair, coaxial cable, fiber optics cable, Devices: Repeater, hub, switch ,bridge, router and gateway, Networks Software, Protocol layering, TCP/IP protocol suite, OSI model.

Unit 2: Physical Layer [10 Hours]

Data and signals, digital signals, transmission impairment, data rate limits, performance, Digitalto-Digital conversion (line coding, line coding schemes), Digital-to-Analog Conversion: ASK, FSK, PSK, Multiplexing, switching (Three Methods of Switching, Switching and TCP/IP Layers), Circuit-switched networks, Packet switching.

Unit 3:Data-Link Layer [10 Hours]

Nodes and links, services, two categories of links, two sub layers, link-layer addressing, DLC services Framing, Flow control, Error detection and correction: types of errors, redundancy, detection versus correction, block coding ,cyclic codes: Cyclic Redundancy Check(CRC), Media Access Control (MAC): Random access (ALOHA, CSMA, CSMA/CD, CSMA/CA),Ethernet Protocol, Standard Ethernet, Fast Ethernet (100 Mbps), Gigabit Ethernet

Unit 4: Network Layer
[10 Hours]

Network-layer services, packet switching, network-layer performance,IPv4 addresses, forwarding of IP packets, Internet Protocol (IP), ICMPv4, routing algorithms: Distance-Vector Routing, Link-State Routing, Path-Vector Routing, Congestion Control: General principles of congestion control, congestion control in Virtual Circuit, congestion control in Datagram, Internetworking: concatenated virtual circuit, connectionless internetworking

Unit 5: Transport Layer
[10 Hours]

Transport-Layer Services, Transport-Layer Protocols: Services, Port Numbers, User Datagram Protocol UDP): User Datagram, UDP Services, UDP Applications, Transmission Control Protocol(TCP) : TCP Services, TCP Features, Segment, A TCP Connection, State Transition Diagram, Windows in TCP, Flow Control, Error Control, TCP Congestion Control, TCP Timers

Unit 6: Application Layer
[10Hours]

World Wide Web and HTTP, File Transfer Protocol (FTP), Electronic Mail, Domain Name System (DNS).

Text Books:
1. Forouzan B, "Data communication and Computer Networks", 5th Edition, Tata McGraw Hill.
2. Andrew S. Tanenbaum, "Computer Networks", 5th Edition, Pearson Education
Reference Books:
1. William Stallings, "Data and Computer Communication", 8th Edition, Pearson Education,2007.
2. Larry L. Peterson & Bruce S. Davie, "Computer Networks: A Systems Approach", 4th Edition,Morgan Kaufmann Publishers
3. Forouzan B, "TCP/IP Protocol Suite", 4th Edition, Tata McGraw Hill.

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FACULTY OF SCIENCE AND TECHNOLOGY
Third Year Engineering (AI &ML)
Semester – I

Course Code: AIM304	**Title: Programming in JAVA**
Teaching Scheme	**Examination Scheme**
Theory: 04 Hours/Week	**Class Test: 20 Marks**
Credits: 4	**Theory Examination (Marks):80Marks**
	Theory Examination (Duration):03 Hours

Prerequisite:

1. Basics of programming languages.
2. Concepts of Object Oriented Programming languages.

Objectives:

The students will be able to:

1. Apply object-oriented features to store real-time entities.
2. Handle exceptions &implement multithreaded programs.
3. Implement database programming.
4. Design & implement GUI with event handling
5. Develop I/O & networking programs.

CONTENTS

SECTIONA

Unit 1: Introduction   [10Hrs]

Features of Java, Java Virtual Machine, Byte Code, JIT Compiler, Class fundamentals, Declaring objects, Nested and Inner Classes, Introducing Methods, Constructors, Garbage Collection, Overloading Methods, Using Objects as Parameters, Returning Objects, Access Control, Understanding static & final keyword, Inheritance Basics, Using Super, Method Overriding, Abstract Classes, Using final keyword with inheritance, Arrays, Vectors, Strings, Wrapper classes, Using Command-Line Arguments

Unit 2: Packages & interfaces   [10Hrs]

Packages: Defining a Package, Finding Packages and CLASSPATH, A Short Package Example, Access Protection, Importing Packages Study of Java.Lang & Java.util packages, **Interfaces:** Defining an Interface, Implementing Interfaces, Variables in Interfaces, Extending Interfaces, Multiple Inheritance

Unit 2: Exception Handling & Multi threaded Programming   [10Hrs]
Exception handling fundamentals, Exception Types, Usingtry-catch, Multipletry-catch clauses, Nested try statements, throw, throws, finally, Built-in Exceptions, creating your own exception subclasses, The Java Thread Model, The Main Thread, Creating a Thread, Creating Multiple Threads, Using is Alive( ) and join( ), Thread Priorities, synchronization, Suspending, Resuming, and Stopping Threads.

SECTION-B

Unit 4: Java Database Connectivity [8Hrs]

Introduction, Types of JDBC Drivers, Driver interface & Driver Manager Class, Connection Interface, Statement Interface, Prepared Statement, Result Set, JDBC Program for executing Statements &processing Result Set, Using Prepared Statement

Unit 5: Applet, Event Handling and AWT [12Hrs]

Applet: Applet Basics, An Applet Skeleton, Simple Applet Display Methods, Using the Status Window, The HTMLAPPLET Tag, Passing Parameters to Applets, **Event Handling:** The Delegation Event Model, Event Classes, Sources of Events, Event Listener Interfaces, Handling Mouse and Keyboard Events, Adapter Classes, Introduction to AWT, AWT classes, Window, Creating a Frame Window in an Applet, Working with Graphics

Unit 6: Input / Output &Networking [10Hrs]

Input/ Output: I/O Basics, Reading Console Input, Writing Console Output, The Print Writer Class, Reading and Writing Files, The Stream Classes, The Byte Streams, The Character Streams, Object Serialization & deserialization, networking: Networking Basics, The Networking Classes and Interfaces, TCP/IP Client Sockets, TCP/IP Server Sockets, Datagram's

Text/Reference Books:

1. Herbert Schildt, The Complete Reference-Java2,(SeventhEdition),TataMcGrawHill

2. Steven Holzner, Java2Black Book, DreamTechPress

3. Deitel & Deitel, Java: Howto Program, PHI

4. Bert Bates, Kathy Sierra, Head First Java, O'Reilly Media, Inc.

5. E Balagurusamy, Programming with Java, TataMcGraw Hill

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FACULTY OF SCIENCE AND TECHNOLOGY
Third Year Engineering (AI &ML)
Semester – I

Course Code: AIM341
Teaching Scheme
Theory: 04 Hours/Week
Credits: 4

Title: Information Theory (Elective-I)
Examination Scheme
Class Test: 20 Marks
Theory Examination (Marks):80Marks
Theory Examination (Duration):03 Hours

Objectives:
1. Understand the fundamental concepts of information and its quantification.
2. Learn about data compression techniques and their theoretical limits.
3. Analyze different communication channels and their capacities.
4. Study error detection and correction codes to improve communication reliability.

CONTENTS
SECTION-A

Unit 1: Introduction to Information Theory   [10 Hrs]

History and Applications of Information Theory, Information Sources and Source Models, Concept of Information: Information Content, Self-Information, Entropy, Properties of Entropy, Joint Entropy, Conditional Entropy, Mutual Information

Unit 2: Source Coding and Data Compression   [10 Hrs]

Source Coding Theorem, Prefix Codes, Kraft Inequality, Huffman Coding, Shannon-Fano Coding, Arithmetic Coding, Lempel-Ziv Coding

Unit 3: Channel Capacity and Communication Channels   [10 Hrs]

Communication Channel Models: Noiseless and Noisy Channels, Channel Capacity Definition, Binary Symmetric Channel (BSC), Binary Erasure Channel (BEC), Channel Capacity Theorem, Channel Coding Theorem

SECTION-B

Unit 4: Error Control Codes   [10Hrs]

Need for Error Control, Types of Errors, Linear Block Codes: Hamming Codes, Cyclic Codes, Convolution Codes and Decoding (Brief Overview)

Unit 5: Information Measures and Applications   [10 Hrs]

Relative Entropy (Kullback-Leibler Divergence), Entropy Rate of a Stochastic Process, Differential Entropy, Rate-Distortion Theory (Introduction)

Unit 6: Advanced Topics in Information Theory [10Hrs]

Capacity of Gaussian Channels, Multiple Access Channels, Network Information Theory (Basic Concepts), Applications in Data Compression, Cryptography, and Machine Learning

Textbooks:

1. "Elements of Information Theory" by Thomas M. Cover and Joy A. Thomas
2. "Information Theory, Inference, and Learning Algorithms" by David J.C. MacKay
3. "Introduction to Information Theory and Data Compression" by Peter D. Johnson Jr.
4. "Information Theory and Reliable Communication" by Robert G. Gallager

Reference Books:

1. "Fundamentals of Information Theory and Coding Design" by Roberto Togneri and Christos Christopoulos
2. "Coding and Information Theory" by Steven Roman
3. "Principles of Digital Communication and Coding" by Andrew J. Viterbi and Jim K. Omura
4. "Network Information Theory" by Abbas El Gamal and Young-Han Kim (for advanced topics)

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FACULTY OF SCIENCE AND TECHNOLOGY
Third Year Engineering (AI &ML)
Semester – I

Course Code: AIM342
Teaching Scheme
Theory: 04 Hours/Week
Credits: 4

Title: Image Processing (Elective-I)
Examination Scheme
Class Test: 20 Marks
Theory Examination (Marks):80Marks
Theory Examination (Duration):03 Hours

Prerequisite:

1. Engineering Mathematics, Algorithms

Objectives:

1. Understand image formation and the role the human visual system plays in the perception of grey and colour image data.
2. Describe various applications of image processing in various sectors like medical, defense, etc.
3. Learn the signal processing algorithms and techniques in image enhancement and image restoration.
4. Apply various image processing techniques to solve real-world problems.

CONTENTS
SECTION-A

Unit 1: Introduction and Digital Image Fundamentals [10Hrs]

Digital Image Fundamentals, Human visual system, Image as a 2D data, Image representation – Gray scale and Colour images, image sampling and quantization

Unit2: Image enhancement in Spatial domain [10Hrs]

Basic gray level Transformations, Histogram Processing Techniques, Histogram equalization, Histogram Matching, Spatial Filtering, Low pass filtering, High pass filtering, Mexican Hat Transformation,

Unit3: Filtering in the Frequency Domain [10Hrs]

Introduction to the Fourier transform and frequency domain concepts, Extension to functions of two variables, low pass filter, high pass filter, Laplace transformation, Image Smoothing, Image Sharpening, Homo-morphic filtering.

SECTION-B

Unit 4: Image Restoration and Reconstruction [10Hrs]

Various noise models, image restoration using spatial domain filtering, image restoration using frequency domain filtering, Estimating the degradation function, and Inverse filtering.

Colour Image Processing: Colour Fundamentals, Colour Models, Pseudo colour image processing

Unit 5: Image Compression
[10Hrs]

Fundamentals of redundancies, Basic Compression Methods: Huffman coding, Arithmetic coding, Error-free compression, Lossy compression. LZW coding, JPEG Compression standard

Unit 6: Morphological Image Processing:
[10Hrs]

Erosion, dilation, opening, closing, Basic Morphological Algorithms: hole filling, connected components, thinning, skeletons

Text books:

1. Digital Image Processing, 3rd Edition, by Rafael C Gonzalez and Richard E Woods. Publisher: Pearson Education

Reference books:

1. Milan Sonka, Vaclav Hlavav, Roger Boyle, —Image Processing, Analysis and Machine Visionl, 2nd ed., Thomson Learning, 2001

2. Pratt W.K, —Digital Image Processingl, 3rd ed., John Wiley & Sons, 2007

3. Digital Image Processing Using Matlab, Rafel C. Gonzalez and Richard E. Woods, Pearson

4. Education

5. Fundamentals of Digital Image Processing by Anil K Jain, PHI

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FACULTY OF SCIENCE AND TECHNOLOGY

Third Year Engineering (AI &ML)

Semester – I

Course Code: AIM 343	**Title: High Performance Computing (Elective-I)**
Teaching Scheme	**Examination Scheme**
Theory: 04 Hours/Week	**Class Test: 20 Marks**
Credits: 4	**Theory Examination (Marks):80Marks**
	Theory Examination (Duration):03 Hours

Prerequisite:

Students should have knowledge of the following concepts to learn this subject. Operating System, Computer Organization and Architecture, Microprocessor and Architecture, Data structure and algorithms, C & C++ programming.

Objectives:

1. Understand High-Performance Computing (HPC) system architectures and various computational models.
2. Learn the basics of CUDA programming.
3. Apply parallel execution models and methodologies for parallel programming and parallel application development.
4. Design and implement compute-intensive applications on the HPC platform.

CONTENTS
SECTION-A

Unit 1: Introduction Parallel Programming & Computing [10Hrs]

Era of Computing, Parallel Computing, Multiprocessors, and Multicomputer Architectures, Scalar VS Vector Processing, Multi vector and Superscalar Machines, Pipelined Processors, SIMD Computers, Conditions of parallelism, Program flow mechanisms, Types of Parallelism – ILP, PLP, LLP, Program Partitioning and scheduling.

Unit 2: Introduction to High-Performance Computing [10Hrs]

Era of Computing, Scalable Parallel Computer Architectures, towards low-cost computing, Network of Workstations project by Berkeley, Cluster Computing Architecture, Components, Cluster Middleware and SSI, Need for Resource Management and Scheduling, Programming Environments

Unit 3: Cluster Computing [10Hrs]

Clustering Models, Clustering Architectures, Clustering Architectures key factors, types of clusters, Mission critical vs. business Critical Applications, Fault Detection and Masking Algorithms, Check pointing, Heartbeats, Watchdog Timers, Fault recovery through Failover and Failback Concepts

Unit 4: High-Speed Networks & Message Passing [10Hrs]

Introduction to High-Speed Networks, Lightweight Messaging Systems, Xpress Transport Protocol, Software RAID and Parallel File systems, Load Balancing Over Networks – Algorithms and Applications, Job Scheduling approaches, and Resource Management in Cluster

Unit 5: CUDA Programming [10Hrs]

Introduction to CUDA architecture for parallel processing, CUDA Parallelism Model, Foundations of Shared Memory, Introduction to CUDA-C, Parallel programming in CUDA-C, Thread Cooperation and Execution Efficiency, Constants memory and events, memory management, CUDA C on multiple GPUs, Hashing and Natural Parallelism, Scheduling and Work Distribution, Atomics, Barriers and Progress, Transactional Memory, Introduction to CUDA Programming, Thread Execution in CUDA Programming, Matrix Computing in CUDA Programming

Unit 6: Open CL Programming [10Hrs]

Introduction to Open-CL, Open-CL Setup, Basic Open-CL, Advanced Open-CL, Open-CL Matrix Programming, Open-CL Multi Threads programming, Shared-memory programming, Introduction to Open-MP Programming, parallel programming using Open-MP, Open-MP Programming for Matrix Computing.

Textbooks/Reference Books:

1. "High-Performance Cluster Computing: Architectures and Systems"by Rajkumar Buyya, Pearson Education India
2. "Introduction to High-Performance Computing for Scientists and Engineers" by Georg Hager and Gerhard Wellein, Chapman & Hall/CRC computational science series CRC Press
3. "Advanced Computer Architecture: Parallelism, Scalability, Programmability" by Kai Hwang, McGraw Hill International Editions
4. "Scientific Computing: An Introductory Survey (2nd ed.).," by Michael T. Heath, McGraw Hill Education (India) Private Limited, 2011

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FACULTY OF SCIENCE AND TECHNOLOGY
Third Year Engineering (AI &ML)
Semester – I

Course Code: AIM321
Teaching Scheme
Credits: 1

Title: LAB–1 Computer Networks
Examination Scheme
Practical/Oral Examination (Marks):50Marks
Practical/Oral Examination (Duration):03Hours

Suggestive List of Practical's:

1. Fundamental components of data communication

2. Networking device: repeater, hub, switch, router and gateway

3. Transmission media: Guided and Unguided media

4. Creating Networking cable using crimping tool and study of RS232 standard

5. Case Study 1: Working of Physical Layer for a) Standard Ethernet, b) Fast Ethernet, c) Gigabit Ethernet, Understanding Encoding- Bit rate, modulation, topology, mode of communication (Simplex, Half Duplex, Full Duplex) for each of Ethernet generations.

6. Case Study 2: Working of Data Link Layer for a) Standard Ethernet, b) Fast Ethernet, c) Gigabit Ethernet, Understanding Data Link Layer: Framing, Physical Addressing, Flow and Erro Control,MAC for each of Ethernet generations.

7. Creating workgroup of computers and resource sharing (file & printer) (Windows OS preferred)

8. Networking Commands: ifconfig, ping, tracert, netstat (Windows commands:pconfig, traceroute).

9. C Program for Routing Algorithm.

10. Any one of the following

a. Wireshark tool for capturing and analyzing network traffic

b. tcpdump command (Linux command) along with various options for capturing and analyzing network traffic.

11. FileZilla program for File Transfer Protocol

Note: It is compulsory for the Students to perform one additional application based on an assignment which should cover the maximum possible queries.

Practical Examination:
The internal examiner should conduct a practical Examination for three hours under the supervision of external examiner. External examiners should evaluate students by checking practical performance and conducting viva.

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Third Year Engineering (AI &ML)
Semester – I

Course Code: AIM322

Teaching Scheme
Practical: 02 Hours/week
Credits: 1

Title: LAB-2 Programming in Java

Examination Scheme
Practical/Oral Examination (Marks):50Marks
Practical/Oral Examination (Duration):03Hours

Suggestive List of Practical Assignments:

Design, develop, and implement the following Assignments.

1. 1.Write a program to demonstrate basic syntactical constructs of java.

    a. a>Operators & Expressions

    b. b>Looping Statement

    c. c>Decision Making Statement

2. Write a program to define a class, describe its constructor & overload its constructor.

3. Write a program to implement inheritance & demonstrate use of method overriding &various access controls.

4. Write a program to implement Multiple Inheritance with interfaces.

5. Write a program to create a package &use another program.

6. Write a program to implement exception handling using built-in & user-defined exceptions.

7. Write a program to implement concept of multithreading.

8. Write a program for database connectivity using JDBC.

9. Write a program using Applet to demonstrate parameter passing.

10. Write a program to implement event handling

11. Write a program to implement object Serialization & deserialization.

12. Write a program to implement socket programming.

Practical Examination:

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FACULTY OF SCIENCE AND TECHNOLOGY
Third Year Engineering (AI &ML)
Semester – I

Course Code: AIM 323
Teaching Scheme
Practical: 02 Hours/Week
Credits: 1

Title: LAB-3: Information Theory :(Elective-I)
Examination Scheme
Term work: 50 Marks

Suggestive List of Practical Assignments:
Information Theory:

1. Calculate entropy for different discrete probability distributions.
2. Compute joint entropy, conditional entropy, and mutual information from data.
3. Design and implement Huffman coding for given source data.
4. Simulate Shannon-Fano coding and compare it with Huffman coding results.
5. Implement Arithmetic coding on sample data sets.
6. Analyze the performance of the Binary Symmetric Channel (BSC) and calculate channel capacity.
7. Encode and decode messages using Hamming (7,4) code for error correction.
8. Simulate cyclic codes and demonstrate error detection and correction capabilities.
9. Explore compression ratios for different algorithms using sample files.
10. Estimate Kullback- Leibler divergence between two discrete distributions.

TERMWORK

The term work shall consist of at least 8 experiments/assignments based on the syllabus above. Assessment of term work should be done as follows:

- Continuous lab assessment.
- Actual practical performance in the Laboratory.
- An oral examination conducted (internally)at the time of submission.

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Semester – I

Course Code: AIM 324
Teaching Scheme
Practical: 02 Hours/Week
Credits: 1

Title: LAB-3: Image Processing (Elective-I)
Examination Scheme
Term work: 50 Marks

Suggestive List of Practical Assignments:
Implement the following Assignments using MATLAB/SCILAB/OCTAVE/JAVA

1. Image Enhancement using point processing methods

2. Image Enhancement using spatial domain methods: Smoothing Filters, Sharpening Filters

3. Image Enhancement using low pass filter in frequency domain methods: Low Pass Filters, High Pass Filters

4. Demonstration of image compression Methods: Lossless Compression methods, Lossy Compression methods

5. Demonstration of Image Segmentation Methods: Threshholding methods, Region Based Methods

6. Morphological image operations- erosion, dilation, opening and closing.

7. Programs for illustrating colour image processing

8. Programs for region description and boundary representation.

9. Program for object recognition

10. Case studies Guidelines for case studies:
1.Group of 2-3 Students should elect real life IP problem Domain And implement any of its DIP module., Problem Domains, Biometric Imaging , Medical imaging, Satellite imaging etc, IP Modules ,Image enhancement, Image Segmentation etc

TERMWORK
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FACULTY OF SCIENCE AND TECHNOLOGY
Third Year Engineering (AI &ML)
Semester – I

Course Code: AIM325

Teaching Scheme

Practical: 02 Hours/Week

Credits: 1

Title: LAB-3 High Performance Computing (Elective-I)

Examination Scheme

Term work: 50 Marks

Suggestive List of Practical Assignments:

1. Matrix Multiplication using CPU Multithreading-Compare sequential and parallel matrix multiplication using threads.
2. Parallel Merge Sort using Multithreading- Implement merge sort with thread-based parallelism.
3. Cluster Job Scheduling Simulation-Simulate job scheduling using Round Robin or Priority scheduling.
4. Heartbeat Mechanism for Fault Detection in Cluster- Simulate failure detection between nodes using heartbeat exchange.
5. CUDA Program: Vector Addition-Write a basic CUDA C program to add two vectors in parallel.
6. Matrix Multiplication using CUDA C- Implement matrix multiplication using CUDA and compare speedup.
7. CUDA Image Processing: Invert Image Colours- Load the image and use CUDA threads to invert pixel values.
8. Open-CL Program: Matrix Multiplication-Use Open-CL kernels to perform matrix multiplication on GPU.
9. Open-MP Program: Matrix Multiplication-Use #pragmaomp parallel to parallelize matrix operations.
10. Open-MP Program: Find the Maximum Value in Array-Parallel reduction to find the max element using Open-MP

TERMWORK
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FACULTY OF SCIENCE AND TECHNOLOGY
Third Year Engineering (AI &ML)
Semester – I

Course Code: AIM326
Teaching Scheme
Credits: 1

Title: Lab 4 Python Programming-II
Examination Scheme
Practical/Oral Examination (Marks):50Marks
Practical /Oral Examination (Duration):03Hours

List of Suggestive Experiments

Design, develop, and implement the following assignments using Android Studio/Visual Studio xamarin.

Practical No. 1:
a) Running Instructions In Interactive Interpreter
b) Write A Program To Purposefully Raise Indentation Error And Correct It
c) Write A Program To Compute Distance Between Two 15

Practical No. 2:
a) Points Taking Input From The User (Pythagorean 2 Theorem)
b) Write A Program Add. Py That Takes 2 Numbers As Command Line Arguments And Prints Its Sum.
c) Write A Program For Checking Whether The Given Number Is A Even Number Or Not.

Practical No. 3:
a) Using A For Loop, Write A Program That Prints Out The Decimal Equivalents Of 1/2, 1/3, 1/4, . . . , 1/10
b) Write A Program Using A For Loop That Loops Over A Sequence. What Is Sequence?
c) Write A Program Using A While Loop That Asks The 21 User For A Number, And Prints A Countdown From That Number To Zero.

Practical No. 4:
a) Find The Sum Of All The Primes Below Two Million. Each New Term In The Fibonacci Sequence Is 23 Generated By Adding The Previous Two Terms. By Starting With 1 And 2, The First 10 Terms Will Be: 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, ... By Considering The Terms In The Fibonacci Sequence Whose Values Do Not Exceed Four 24 Million, Find The Sum Of The Even-Valued Terms.
b) Write A Program To Print Each Line Of A File In Reverse Order

Practical No. 5:
a) Write A Program To Compute The Number Of Characters, Words, And Lines In A File.
b) Write A Function Ball_ Collide That Takes Two Balls As Parameters And Computes If They Are Colliding. Your Function Should Return A Boolean Representing Whether Or Not The Balls Are 9 Hint: Represent A Ball On A Plane As A Tuple Of (X, Y, R), R Being The Radius If (Distance Between Two Balls Centers) <= (Sum Of Their Radii) Then (They Are Colliding)

Practical No. 6:
a) Find the Mean, Median, and Mode For The Given Set Of Numbers In A-List.
b) Write A Function Nearly_ Equal To Test 32 Whether Two Strings Are Nearly Equal.
c) Two Strings A And B Are Nearly Equal When A Can Be Generated By A Single Mutation On B.

Practical No. 7:
a) Write A Function Dups To Find All Duplicates In The List
b) Write A Function Unique To Find All The Unique Elements Of A List. Functions –
c) Write A Function Cumulative_ Product To Compute the Cumulative Product Of A List Of Numbers.

Practical No. 8:
a) Write A Function Reverse To Reverse A List. Without Using The Reverse Function.

b) Write Function To Compute Gcd, Lcm Of Two Numbers. Each Function Shouldn't Exceed One Line

c) Write A Program That Defines A Matrix And Prints

Practical No. 9:

a) Write A Program To Perform the Addition Of Two Square Matrices

b) Write A Program To Perform Multiplication Of Two Square Matrices Gui, Graphics

Practical No. 10:

a) Write A Gui For An Expression Calculator Using Tk 18

b) Write A Program To Implement The Following Figures Using Turtle

MINI PROJECT (Compulsory): Students have to submit a mini-project at end of the semester with a report in a group of maximum of 3 students

Practical Examination:

Internal examiner should conduct practical Examination for three hours under the supervision of external examiner. External examiner should evaluate student by checking practical performance and conducting viva.

Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHH. SAMBHAJI NAGAR
FACULTY OF SCIENCE AND TECHNOLOGY
Third Year Engineering (AI &ML)
Semester – I

Course Code: BSH305
Teaching Scheme
Theory: 02Hours/Week
Credits: 2

Title: Communication Skill-II
Examination Scheme
Term Work: 50Marks

Prerequisite:
1. Basic Knowledge of Soft Skills
2. Good understanding of English

Objectives:
1. To imbibe leadership skills
2. To develop interpersonal Skills
3. To introduce corporate etiquettes
4. To imbibe team skills

CONTENTS

Unit 1: Understanding self and Goal setting (8Hours)
Self-Assessment: Understanding Self Core Competency (SWOT/SWOC), Long and short-term Goal-setting Execution Skills

Unit 2: Interpersonal Skills (7Hours)
Interpersonal communication, Conflict Management, Problem-Solving, Decision Making Persuasion and Influence

Unit 3: Group Dynamics and Team Building (8Hours)
Group vs. Team, Team Building, Team Work, Developing Leadership Skills

Unit 4: Corporate Etiquette (7Hours)
Clothing Etiquette, Personal hygiene and grooming, time management, Influencing Skills (Impression) Balancing personal and professional Life, Ethics, Values and Laws

Textbook:
1. The Ace of Soft Skills (Gopal aswamy Ramesh) Pearson Publication

Reference Books:
1. Execution;:Ram Charan
   (Publisher: Crown Business;1 edition(June15, 2002)
   Language: English ISBN-10:0609610570ISBN-13: 978-0609610572

2. Laws of Teamwork: John C Maxwell

3. Master of Business Etiquette: Cyrus Gonda
   (Author: Cyrus Gonda, Publisher EMBASSYBOOKS,2017, ISBN 9385492721,9789385492723)

4. Goals :

(Author: Brain Tracy ISBN:1-57675-235-6 Published by Berrett-Koehler Publishers,Inc)

5. Interpersonal Skills at work   :
   (Author: John Hayes Second Edition: Rout ledge)

6. People Smart   :
   (Author: Freda Hans burg by Berrett- Koehler Publishers, Inc)

Term Work Assessment (50marks):
The term work shall consist of internal online examination of 50 Marks, conducted at institute level. The marks of the examination shall be forwarded to the University.

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Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHH. SAMBHAJI NAGAR
FACULTY OF SCIENCE AND TECHNOLOGY
Third Year Engineering (AI &ML)
Semester – II

Course Code: AIM351
Teaching Scheme
Theory: 04 Hours/Week
Credits: 4

Title: Natural Language Processing
Examination Scheme
Class Test: 20 Marks
Theory Examination (Marks):80Marks
Theory Examination (Duration):03 Hours

Objectives:
1. To Learn the fundamentals of NLP, and also to make them for understanding CFG, PCFG in NLP.
2. To know the role of semantics of sentences and pragmatics.
3. To teach the basic concepts of speech processing along with analysis and modeling.

CONTENTS
SECTION-A

Unit 1: Introduction [10Hours]

Origins and challenges of NLP – language modelling : grammar-based lm, statistical lm –regular expressions, finite-state automata – English morphology, transducers for lexicon and rules, tokenization, detecting and correcting spelling errors, minimum edit distance

Unit 2: Word Level Analysis [10Hours]

Unsmoothed n-grams, evaluating n-grams, smoothing, interpolation and back-off – word classes, part-of-speech tagging, rule-based, stochastic and transformation-based tagging, issues in pos tagging – hidden Markov and maximum entropy models.

Unit 3: Syntactic Analysis [10Hours]

A context-free grammar, grammar rules for English tree banks, normal forms for grammar – dependency grammar – syntactic parsing, ambiguity, dynamic programming parsing – shallow parsing – probabilistic cfg, probabilistic cyk, probabilistic lexicalized cfgs – feature structures, unification of feature structures.

SECTION-B

Unit 4: Semantics and Pragmatics [10Hours]

Requirements for representation, first-order logic, description logics – syntax-driven semantic analysis, semantic attachments – word senses, relations between senses, thematic roles, selectional restrictions – word sense disambiguation, wsd using supervised, dictionary & thesaurus, bootstrapping methods – word similarity using a thesaurus and distributional methods.

Unit 5: Basic Concepts of Speech Processing   [10Hours]

Speech fundamentals: articulatory phonetics – production and classification of speech sounds; acoustic phonetics – acoustics of speech production; review of digital signal

processing concepts; short-time Fourier transform, filter- bank and LPC methods.

Unit 6: Speech-Analysis, Speech Modeling   [10Hours]

Features, feature extraction, and pattern comparison techniques: speech distortion measures– mathematical and perceptual – log–spectral distance, cepstral distances,

weighted cepstral distances and filtering, likelihood distortions, spectral distortion using a warped frequency scale, lpc, plp and mfcc coefficients, time alignment and

normalization – dynamic time warping, multiple time – alignment paths. Hidden Markov models: Markov processes, hmms – evaluation, optimal state sequence – Viterbi search, baum-welch parameter re-estimation, implementation issues.

.

Text Books:

1. Daniel Juraf sky, James H. Martin—Speech and Language Processing: "An Introduction to Natural Language Processing, Computational Linguistics and Speech", Pearson Publication, 2014.

2. Steven Bird, Ewan Klein and Edward Loper , —"Natural Language Processing with Python", First Edition, O Reilly Media, 2009.

3. Lawrence Rabiner And Biing-Hwang Juang, "Fundamentals Of Speech Recognition", Pearson Education, 2003.

4. Daniel Jurafsky And James H Martin, "Speech And Language Processing – An Introduction To Natural Language Processing, Computational Linguistics, And Speech Recognition", Pearson Education, 2002

Reference Books:

1. Frederick Jelinek, "Statistical Methods Of Speech Recognition", MIT Press, 1997.

2. Breck Baldwin, —Language Processing with Java and Ling Pipe Cookbook, Atlantic Publisher, 2015

3. Richard M Reese, —Natural Language Processing with Java, O Reilly Media, 2015.

PATTERN OF QUESTION PAPER:
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For 80 marks Paper:
1. Minimum ten questions.
2. Five questions in each section.
3. Question no. 1 from section A and Question no. 6 from section B, 10 marks each, will be compulsory.
4. From the remaining questions in section A and B students are supposed to solve any two questions, 15 marks each.

Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHH. SAMBHAJI NAGAR
FACULTY OF SCIENCE AND TECHNOLOGY
Third Year Engineering (AI &ML)
Semester – II

Course Code: AIM352   Title: Software Engineering
Teaching Scheme   Examination Scheme
Theory: 04 Hours/Week   Class Test: 20 Marks
Credits: 4   Theory Examination (Marks):80Marks
                                                            Theory Examination (Duration):03 Hours

Prerequisite:
1. StudentsshouldhavepriorbasicknowledgeonSoftwareattributes,Processmodels.
2. Students should have some basic knowledge on Testing, Maintenance.

Objectives:
1. This course is intended to provide the students with an overall view over Software Engineering discipline and with insight into the processes of software development.
2. To learn about generic models of software development process.
3. To understand the different design techniques and their implementation.
4. To learn various testing and maintenance measures.

CONTENTS
SECTION-A

Unit 1: Software Engineering–Overview   [10Hrs]

Introduction–Characteristics of Software Engineering, FAQs about software engineering – Professional and ethical responsibility – Socio-Technical systems – emergent system properties – System Engineering – Organizations – people and computer systems–Legacy systems.

Unit 2: Software Process Models   [12Hrs]

The Evolving role of Software – Software – The Changing Nature of Software – Legacy software — A generic view of process– A layered Technology – A Process Framework – The Capability Maturity Model Integration (CMMI) – Process Assessment – Personal and Team Process Models–Product and Process–Process Models– The Waterfall Model– Incremental Process Models – Incremental Model – The RAD Model – Evolutionary Process Models–Prototyping–The Spiral Model–The Concurrent Development Model– Specialized Process Models – the Unified Process.

Unit 3: Requirement Engineering   [8Hrs]

Software Engineering Practice – communication Practice – Planning Practice modelling practice– Construction Practice   Deployment.   Requirements   Engineering   Requirements   Engineeringtasks– InitiatingtherequirementsEngineeringProcess-ElicitingRequirement Developing Use cases –Building the Analysis Models–Elements of the Analysis Model– Analysis pattern – Negotiating Requirements – Validating Requirements.

SECTION-B

Unit 4: Analysis Modeling
[10Hrs]

Requirements Analysis – Analysis Modeling approaches – data modeling concepts – Object-oriented Analysis – Scenario-based modeling – Flow-oriented Modeling – Class-based modeling – creating a behaviour model.

Unit 5: Design & Testing
[10Hrs]

Design Engineering – Design process -Design Quality-Design model-User interface Design – Testing strategies- Testing Tactics - strategies Issues for conventional and object-oriented software-validation testing – system testing –Art of debugging – Project management

Unit 6: Quality Assurance
[10Hrs]

Software evolution - Verification and Validation - Critical Systems Validation – Metrics for Process,ProjectandProduct-QualityManagement-ProcessImprovement–Risk Management Configuration Management – Software Cost Estimation

Textbooks:

1. Roger S. Pressman, Software Engineering: A Practitioner's Approach, Mc Graw Hill International edition, Seventh edition, 2009.
2. Ian Sommerville, Software Engineering, 8thEdition,Pearson Education,2008.

Reference Books:

1. Stephan Schach, Software Engineering, Tata Mc Graw Hill, 2007
2. Pfleeger and Lawrence Software Engineering: Theory and Practice ,Pearson Education, second edition, 2001
3. Software Engineering Principles and Practice by Waman. S. Jawadekar, Tata McGraw Hill,2004.

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For 80 marks Paper:

1. Minimum ten questions.
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DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY CHH. SAMBHAJI NAGAR

FACULTY OF ENGINEERING AND TECHNOLOGY

Third Year Engineering (AI &ML)

Semester – II

Course Code: AIM353
Teaching Scheme
Theory: 04 Hours/Week
Credits: 4

Title: Data Warehousing and Data Mining
Examination Scheme
Class Test: 20 Marks
Theory Examination (Marks):80Marks
Theory Examination (Duration):03 Hours

Prerequisite:
1. Database Management Systems

Objectives:
1. To introduce basic principles, concepts and applications of data warehousing.
2. To introduce students to the basic concept of Data Mining & pre-processing.
3. To introduce a wide range of Association, classification, clustering, classification algorithms.
4. To introduce basic concept of BI.

CONTENTS
SECTION-A

Unit 1: Data Warehousing: [8Hrs]
Data Warehouse: Basic Concepts, A Multi-tiered Architecture, Enterprise Warehouse, Data Mart, Extraction, Transformation, and Loading, Metadata Repository.

Unit 2: Data Warehouse Modeling and Implementation: [12Hrs]
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, A Starnet Query Model for Querying Multidimensional Databases, Indexing OLAP Data: Bitmap Index and Join Index, OLAP Server Architectures: ROLAP versus MOLAP versus HOLAP.

Unit 3: Data Mining: [10Hrs]
Introduction: Data, Types of Data, Data Mining Functionalities, Interestingness of Patterns, Classification of Data Mining Systems, Data Mining Task Primitives, Integration of a Data Mining System with a Data Warehouse, Issues, Data pre-processing.

SECTION-B

Unit 4: Association Rule Mining and Classification: [12hrs]
Mining Frequent Patterns, Associations and Correlations, Mining Methods, Mining various Kinds of Association Rules, Correlation Analysis, Constraint Based Association Mining, Classification and Prediction, Basic Concepts, Decision Tree Induction, Bayesian Classification, Rule Based Classification, Support Vector Machines, Regression Models.

Unit 5: Clustering: [10Hrs]

Introduction, Clustering, Cluster Analysis, Clustering Methods- K means, Hierarchical clustering, Agglomerative clustering, Divisive clustering Introduction to Web Mining: Web Content Mining, Web Structure Mining, Web Usage Mining.

Unit 6: Business Intelligence: [8Hrs]

Introduction, Business Intelligence, Business Intelligence tools, Business Intelligence Infrastructure, Business Intelligence Applications, BI versus Data Warehouse, BI versus Data Mining, Future of BI.

Text Books:

1. Jiawei Han and Micheline Kamber, Data Mining: Concepts and Techniques, Third Edition, Elsevier Publication.
2. Paulraj Ponniah, Data Warehousing: Fundamentals for IT Professionals, Wiley Publication.

Reference Books

1. Business Intelligence: A Managerial Approach (2nd Ed.) Turban, Sharda, Delen, King, Wiley Publication
2. C. S. R. Prabhu: Data Warehousing Concepts, Techniques, Products and Applications, Prentice Hall of India.
3. Alex Berson, Stephan J. Smith: Data Warehousing, Data Mining and OLAP, Tata McGraw Hill Edition.

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For 80 marks Paper:

1. Minimum ten questions.

2. Five questions in each section.

3. Question no. 1 from section A and Question no. 6 from section B, 10 marks each, will be compulsory.

4. From the remaining questions in section A and B students are supposed to solve any two questions, 15 marks each.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY CHH. SAMBHAJI NAGAR

FACULTY OF ENGINEERING AND TECHNOLOGY

Third Year Engineering (AI & ML)

Semester – II

Course Code: AIM354	**Title: Advance Machine Learning**
Teaching Scheme	**Examination Scheme**
Theory: 04 Hours/Week	**Class Test: 20 Marks**
Credits: 4	**Theory Examination (Marks):80Marks**
	Theory Examination (Duration):03 Hours

Prerequisite:

1. Machine Learning, Probability Theory

Objectives:

1. Understand key machine learning paradigms, including supervised and unsupervised learning.

2. Apply advanced methods such as kernel techniques, Bayesian inference, and ensemble learning.

3. Analyze and implement dimensionality reduction and feature selection techniques.

4. Explore recent trends and real-world applications of machine learning in diverse domains.

<u>CONTENTS</u>

<u>SECTIONA</u>

Unit 1: Machine Leaning Concepts   **[10Hrs]**

Key concepts, Supervised/Unsupervised Learning, Loss functions and generalization, Probability Theory, Parametric vs. Non-parametric methods, Elements of Computational Learning Theory Ensemble Learning, Bagging, Boosting, Random Forest

Unit 2: Kernel Methods   **[10Hrs]**

Kernel Methods for non-linear data, Support Vector Machines, Kernel Ridge Regression, Structure Kernels, Kernel PCA, Latent Semantic Analysis

Unit 3: Bayesian methods   **[10Hrs]**

Bayesian methods for using prior knowledge and data, Bayesian inference, Bayesian Belief Networks and Graphical models, Probabilistic Latent Semantic Analysis, The Expectation-Maximisation(EM)algorithm, GaussiProcesses.

Unit 4: Dimensionality Reduction [10Hrs]

Dimensionality Reduction - CCA, LDA, ICA, NMF - Canonical Variates - Feature Selection vs. Feature Extraction

Unit 5: Filter Methods [10Hrs]

Filter Methods - Sub-space approaches - Embedded methods Low-Rank approaches - Recommender Systems .Application areas - Security - Business - Scientific

Unit 6: Recent trends [10Hrs]

Recent trends in supervised and unsupervised learning algorithm, dimensional reducibility, feature selection and extraction

Reference Books:

1.Pattern Recognition and Machine Learning, Christopher M. Bishop

2. John Shawe-Taylor and Nello Cristianini, Kernel Methods for Pattern Analysis.

3. The Elements of Statistical Learning, Springer 2009

4. Machine Learning Algorithms, 2nd Edition, Giuseppe Bona ccorso, Packt Publication

5. Tensor Flow Machine Learning, Nick McClure, Packt Publication

PATTERN OF QUESTION PAPER:

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Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHH. SAMBHAJI NAGAR
FACULTY OF SCIENCE AND TECHNOLOGY
Third Year Engineering (AI &ML)
Semester – II

Course Code: AIM391
Teaching Scheme
Theory: 04 Hours/Week
Credits: 4

Title: Cryptography and Network Security (Elective-II)
Examination Scheme
Class Test: 20 Marks
Theory Examination (Marks):80Marks
Theory Examination (Duration):03 Hours

Prerequisite:

1. Computer fundamentals

2. Computer Networks

Objectives:

1. To understand fundamental concepts of computer networking and functionality of layered network architecture.

2. To understand wireless and mobile networking concepts

3. To apply networking concepts to various situations, classifying networks, and analyzes the performance of computer network infrastructure.

CONTENTS

SECTION-A

Unit 1 : Introduction to Security and Cryptography   [10Hrs]

Security trends, Legal, ethical, and professional aspects of security, Need for security at multiple levels, Security policies and models of network security, Security attacks, services, and mechanisms, OSI security architecture

Unit 2: Classical Cryptography and Foundations   [10Hrs]

Classical encryption techniques: ,Substitution techniques, Transposition techniques, Steganography, Foundations of modern cryptography: Perfect security ,Information theory, Product cryptosystem, Cryptanalysis

Unit 3: Symmetric Key Cryptography   [10Hrs]

Mathematics of symmetric key cryptography:, Algebraic structures, Modular arithmetic, Euclid's algorithm, Congruence and matrices, Groups, rings, and fields, Finite fields, Symmetric key ciphers: SDES, DES – structure and strength, AES – design principles and evaluation criteria, RC4 – stream cipher, Block cipher modes of operation, Differential and linear cryptanalysis, Key distribution

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SECTION-B

Unit IV : Public Key Cryptography [10Hrs]

Mathematics of asymmetric key cryptography: Primes, primality testing, factorization, Euler's totient function, Fermat's and Euler's theorems, Chinese remainder theorem, Exponentiation and logarithm, Asymmetric key ciphers: RSA, Diffie–Hellman key exchange, ElGamal cryptosystem, Elliptic curve arithmetic, Elliptic curve cryptography, Key distribution and management

Unit V: Message Authentication and Digital Signatures [10Hrs]

Authentication requirements and functions, MAC and Hash functions, Security of hash functions and MACs, SHA algorithms Digital signatures and authentication protocols, Digital Signature Standard (DSS), Entity authentication: Biometrics, Passwords, Challenge-response protocols, Authentication applications: Kerberos, X.509

Unit VI: System and Network Security Applications [10Hrs]

E-mail security: PGP, S/MIME, IP security, Web security, System security concepts: Intruders, Malicious software (viruses, worms, trojans), Firewalls – types and configuration

Text Books:

1. William Stallings – Cryptography and Network Security: Principles and Practice, Pearson Education, 7th Edition
2. Behrouz A. Forouzan – Cryptography and Network Security, McGraw Hill, 3rd Edition
3. AtulKahate – Cryptography and Network Security, Tata McGraw Hill, 3rd Edition

Reference Books:

1. Bruce Schneier – Applied Cryptography: Protocols, Algorithms, and Source Code in C, Wiley
2. Douglas R. Stinson – Cryptography: Theory and Practice, CRC Press
3. Charles P. Pfleeger& Shari Lawrence Pfleeger – Security in Computing, Pearson Education
4. Kaufman, Perlman, and Speciner – Network Security: Private Communication in a Public World, Pearson
5. Menezes, van Oorschot& Vanstone – Handbook of Applied Cryptography, CRC Press

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Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHH. SAMBHAJI NAGAR
FACULTY OF SCIENCE AND TECHNOLOGY
Third Year Engineering (AI &ML)
Semester – II

Course Code: AIM392
Teaching Scheme
Theory: 04 Hours/Week
Credits: 4

Title: Pattern Recognition (Elective-II)
Examination Scheme
Class Test: 20 Marks
Theory Examination (Marks):80Marks
Theory Examination (Duration):03 Hours

Objectives:
This course covers the techniques and gain proficiency of pattern recognition that are fundamental to a wide variety of application areas such as medical research, biometrics, computer vision, etc.

CONTENT
SECTION-A

Unit 1: Basics of Probability, Random Processes and Linear Algebra(recap)   [10Hrs]

Probability: independence of events, conditional and joint probability, Bayes-theorem Random Processes: Stationary and non-stationary processes, Expectation, Autocorrelation, Cross-Correlation, spectra. (6) 2) Bayes Decision Theory: Minimum-error-rate classification. Classifiers, Discriminant functions, Decision surfaces. Normal density and discriminant functions. Discrete features.

Unit 2: Parameter Estimation Methods   [12Hrs]

Maximum-Likelihood estimation: Gaussian case. Maximum Posteriori estimation. Bayesian estimation: Gaussian case. Unsupervised learning and clustering - Criterion functions for clustering. Algorithms for clustering: K-Means, Hierarchical and other methods. Cluster validation. Gaussian mixture models, Expectation-Maximization method for parameter estimation. Maximum entropy estimation. Sequential Pattern Recognition. Hidden Markov Models (HMMs). Discrete HMMs. Continuous HMMs. Nonparametric techniques for density estimation. Parzen-window method. K-Nearest Neighbour method.

Unit 3: Dimensionality reduction   [8Hrs]

Principal component analysis - it relationship to Eigen analysis. Fisher discriminant analysis - Generalized Eigen analysis. Eigen vectors/Singular vectors as dictionaries. Factor Analysis, Total variability space - a dictionary learning methods. Nonnegative matrix factorization - a dictionary learning method.

SECTION-B

Unit 4: Linear discriminant functions & Artificial neural networks   [10Hrs]

Gradient descent procedures, perceptron, Support vector machines - a brief introduction. Artificial neural networks: Multilayer perceptron – feed-forward neural network. A brief introduction to deep neural networks, convolutional neural networks, and recurrent neural networks.

Unit 5 : Non-metric methods for pattern classification [10Hrs]

Non-metric methods for pattern classification: Non-numeric data or nominal data. Decision trees: Classification and Regression Trees (CART).

Unit 6: Application(s) [10Hrs]

Application(s): Face recognition – pre-processing, face detection algorithms, selection of representative patterns, classification algorithms, results, and discussion. (4)

Textbooks:

1. O. Duda, P.E.Hart and D.G. Stork, Pattern Classification, John Wiley, 2001

2. S.Theodoridis and K. Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009

Reference Books:

1. C.M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006

2. P.A Devijver and J. Kittler, Pattern Recognition: A Statistical Approach, Prentice-Hall International, Englewood Cliffs, NJ, 1980.

3. K. Fukunaga, Introduction to Statistical Pattern Recognition, 2nd Ed. Academic Press, New York, 1990.

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Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHH. SAMBHAJI NAGAR
FACULTY OF SCIENCE AND TECHNOLOGY
Third Year Engineering (AI &ML)
Semester – II

Code: AIM393
Teaching Scheme
Theory: 04 Hours/Week
Credits: 4

Title: Elective-II Game Architecture & Design
Examination Scheme
Class Test: 20 Marks
Theory Examination (Marks):80Marks
Theory Examination (Duration):03 Hours

Prerequisite:

1. Basic visual design and basic scripting or programming skills
2. Moderatefluencyin2Dand3Danimationandgraphics packages
3. Awareness of game platforms and the technology

Objectives:

1. To familiarize with the process of game design and development
2. To learn the processes, mechanics, and issues design
3. To understand the architecture of game programming

CONTENTS
SECTION-A

Unit 1: Games and Video Games [10Hrs]

Introduction, Conventional Games Versus Video Games, Games for Entertainment, Serious Games, Designing and Developing Games: Key Components of Video Games, The Structure of a Video Game, Stages of the Design Process, Game Design Team Roles, Game Design Documents, The Anatomy of a Game Designer, The Major Genres, Understanding Your Player, Understanding Your Machine, Game Balance.

Unit 2: Game Concepts [10Hrs]

Getting an Idea, From Idea to Game Concept, Game Worlds, Creative and Expressive Play,

Character Development, The Goals of Character Design: The Relationship Between Player and Avatar, Visual Appearances, Character Depth, Audio Design

Unit 3: Storytelling and Creating the User Experience [10Hrs]

Key Concepts, The Storytelling Engine, Linear and Nonlinear Stories, Granularity,

Mechanisms for Advancing the Plot, Emotional Limits of Interactive Stories, Scripted Conversations and Dialogue Trees, When to Write the Story Player-Centric Interface Design, The Design Process, Managing Complexity, Interaction Models, Camera Models, Visual and Audio Elements, Input Devices, Navigation Mechanisms, Accessibility Issues, Allowing for Customization.

Unit 4: Current Methods of Team Management [10Hrs]

The Current Development Model - The Origins of the Industry, The Trouble with Game Developers, The Problem Developer, Excessive Long Hours Mean an Unsuccessful Project, Exceptions to the Rule Roles and Divisions - Assigning Personnel, Improving Morale and the Working Environment, The Software Factory - What Is a Software Factory? Why Use a Software Factory? Solving Game Development Issues, organizing a Software Factory, Applying the Software Factory Structure and Methodology, The Suitability of a Software Factory, Milestones, and Deadlines: Procedures and "Process", Procedures: Where to use them? What Should Source Control Be Used For? The Importance of Information Transmission, Troubleshooting, The Future of the Industry

Unit 5: Architecture Design [10Hrs]

Initial Design, The Beginning, Hardware Abstraction, Sound Hardware Abstraction, Other Hardware, The Problem Domain, Thinking in Tokens, Use of Technology: the State of the Art, Blue-Sky Research, Reinventing the Wheel, Use of Object Technology, Building Blocks Initial Architecture Design: The Birth of an Architecture, Architectural Concepts, The Tier System, Architecture Design Development: The Development Process-Code Quality, Debugging and Module Completion, Types of Bugs, reusable Architecture, Documentation, Design First, Schedule, Catch Mistakes as You Go Along.

Unit 6: Game Analysis [10Hrs]

Game Analysis: Abdicating Authorship, Familiar Subject Matter, Safe Experimentation, Depth and Focus, Interface, Controlled Versus Autonomous Behavior, A Lesson to Be Learned.

Designing Design Tools., Desired Functionality, Scripting Languages, and Object Behaviors, Us Versus Them, The Best of Intentions, A Game Editor for All Seasons, and Play Testing.

Textbooks:

1. Fundamentals of Game Design Third Edition by Ernest Adams,(New Riders Games)
2. Game Architecture and Design by Andrew Rollings Dave Morris

Reference Books:

1. Game Design: Theory & Practice by Richard RouseIIII Illustrations by Steve Ogden, Foreword by Noah Falstein
2. The Art of Game Design by Jesse Schell, Morgan Kaufmann Publication
3. Game Programming Patterns by Robert Nystorm

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2. Five questions in each section.
3. Question no. 1 from section A and Question no. 6 from section B, 10 marks each, will be compulsory.
4. From the remaining questions in section A and B students are supposed to solve any two questions, 15 marks each.

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Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHH. SAMBHAJI NAGAR

FACULTY OF SCIENCE AND TECHNOLOGY

Third Year Engineering (AI &ML)

Semester – II

Course Code: AIM371 **Title: Lab 5 -Natural Language Processing**

Teaching Scheme **Examination Scheme**

Credit: 1 **Practical/Oral Examination: 50Marks**

Practical/Oral Examination (Duration):03 Hours

Suggestive List of Practical Assignments:

1. Write a Python NLTK program to remove stop words from a given text.
2. Write a Python NLTK program to split the text sentence/paragraph into a list of words.
3. Write a Python NLTK program to tokenize sentences in languages other than English.
4. Write a Python NLTK program to create a list of words from a given string.
5. Write a Python NLTK program to list down all the corpus names.
6. Write a Python NLTK program to get a list of common stop words in various languages in Python.
7. Write a Python NLTK program to find the definition and examples of a given word using.
8. Word Net. Write a Python NLTK program to find the sets of synonyms and antonyms of a given word.
9. Write a Python NLTK program to get the overview of the tag set, details of a specific tag in the tag set, and details on several related tag sets, using regular expression.
10. Write a Python NLTK program to find the number of male and female names in the names corpus. Print the first 10 male and female names.
11. Write a Python program to demonstrate Lemmatization with NLTK.
12. Write a Python program to demonstrate Stemming with NLTK.
13. Write a Python Program for NLP analysis of Restaurant reviews.
14. Write a program for Twitter Sentiment Analysis using Python.
15. Write a program for Sentiment Analysis using VADER TEXT.

Practical Examination:

The supervision of an external examiner. External examiners should evaluate students by checking practical performance and conducting viva.

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FACULTY OF SCIENCE AND TECHNOLOGY

Third Year Engineering (AI &ML)

Semester – II

Course Code: AIM372   **Title: LAB 6- Software Engineering**

Teaching Scheme   **Examination Scheme**

Practical: 2 Hours/Week   **Term Work: 50 Marks**

Credit: 1

Suggestive List of Practical Assignments:

Design, develop and implement the following Assignments.

1. Prepare a Software Requirements Specification (SRS) document for a basic system (e.g., Library Management System).

2. Design Use Case Diagrams using UML for a proposed software system.

3. Create Class Diagrams using any modeling tool (e.g., Star-UML, Lucid chart).

4. Draw Sequence Diagrams for major functionalities of the system.

5. Design a Data Flow Diagram (DFD) (Level 0, 1, 2) for any existing or proposed application.

6. Write a Functional Requirement Document (FRD) for a small software product.

7. Implement a simple prototype using a GUI tool (Java-X, Tkinter , or VB.NET).

8. Develop a test plan and test cases (black-box and white box) for a sample application.

9. Perform Requirement Validation through stakeholder review/checklists.

10. Conduct risk analysis using a risk matrix for a given case study.

11. Calculate basic software metrics (defect density, code complexity, productivity).

13. Estimate cost and effort using the COCOMO model or Function Point Analysis.

Term Work:

The term Work shall consist of at least 8 experiments / assignments based on the suggestive list of practical assignments. Assessment of term work should be done as follows:

- Continuous lab assessment

- Actual practical performance in laboratory

- Oral examination conducted(internally) at the time of submission

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Semester – II

Course Code: AIM373   Title: Lab 7- Data Ware Housing and Data Mining
Teaching Scheme: Examination Scheme:
Practical: 02 Hours/Week   Practical /Oral Examination: 50 Marks
Credit: 1   Practical/Oral Exam (Duration):3 hrs.

Suggestive List of Practical's /Assignments:

Design, develop, and implement the following Assignments by

1. To Study Different Types of data warehousing

2. Experiments on Summarization/generalization Techniques

3. Implementation of Star Data Warehouse Schema

4. Implementation of Snowflake Data Warehouse Schema

5. Implementation of Fact Constellation Warehouse Schema

6. Experiments on Associations Techniques

7. Classification Using Decision Trees

8. Classification Using *Bayesian*

9. Experiments on Clustering Techniques using k means

10. Case study

Practical Examination:

The internal examiner should conduct a practical Examination for three hours under the supervision of external examiner. External examiners should evaluate student by checking practical performance and conducting viva.

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Semester – II

Course Code: AIM374   Title: LAB-8: Cryptography and Network Security (Elective –II)
Teaching Scheme: Examination Scheme:
Practical: 02 Hours/Week   Term Work: 50 Marks
Credit: 1

Suggestive List of Practical Assignments:

1. Implement Caesar Cipher / Shift Cipher

2. Write a program to encrypt and decrypt messages using Caesar cipher.

3. Implement Mono-alphabetic and Poly-alphabetic Cipher (e.g., Vigenère Cipher)

4. Develop encryption/decryption logic for substitution ciphers.

5. Implement Playfair Cipher

6. Encrypt and decrypt messages using the Playfair technique.

7. Implement Hill Cipher

8. Use linear algebra (matrices) for encryption and decryption.

9. Implement RSA Algorithm

10. Generate keys and demonstrate encryption and decryption using RSA.

11. Implement Diffie-Hellman Key Exchange Algorithm

12. Simulate secure key exchange between two parties.

13. Implement MD5 and SHA Hash Algorithms

14. Compute the hash of a given message using Python or Java.

15. Implement Digital Signature using RSA

16. Sign a message and verify its authenticity using RSA-based digital signatures.

17. Simulate DES and AES Encryption Algorithms

18. Use built-in libraries or write custom code for block ciphers.

19. Packet Sniffing and Analysis using Wire-shark

20. Capture network packets and analyze protocols (HTTP, TCP, SSL).

Term Work:

The term Work shall consist of at least 8 experiments/assignments based on the suggestive list of practical assignments. Assessment of term work should be done as follows:

- Continuous lab assessment

- Actual practical performance in laboratory

- Oral examination was conducted(internally) at the time of submission

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Semester – II

Course Code: AIM375
Teaching Scheme
Practical: 02 Hours/Week
Credit: 1

Title: LAB-8 Pattern Recognition (ELECTIVE-II)
Examination Scheme
Term Work: 50 Marks

Suggestive List of Practical Assignments:

1. Bayes Classifier Implementation
2. Maximum Likelihood Estimation (MLE) for Gaussian Distribution
3. K-Means Clustering Algorithm
4. Gaussian Mixture Model using Expectation-Maximization (EM)
5. Principal Component Analysis (PCA) for Dimensionality Reduction
6. Fisher's Linear Discriminant Analysis (LDA)
7. Support Vector Machine (SVM) for Classification
8. Multilayer Perceptron (MLP) using Deep Learning Framework
9. Hidden Markov Model (HMM) for Sequence Data
10. Face Recognition using Eigen faces (PCA-based approach)

Term Work:

The term work shall consist of at least 8 experiments/assignments based on the syllabus above. Assessment of term work should be done as follows:

- Continuous lab assessment.
- Actual practical performance in the Laboratory.
- An oral examination conducted (internally)at the time of submission.

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Course Code: AIM376
Teaching Scheme
Practical: 2 Hours/Week
Credit: 1

Title: LAB-8: Game Architecture & Design (Elective-II)
Examination Scheme
Term Work: 50 Marks

Suggestive List of Practical Assignments:

1. Design a Game Concept Document
2. Develop a 2D Game Prototype Using a Game Engine (e.g., Unity, Godot)
3. Character Design and Animation
4. Create a Game Storyboard with Linear and Nonlinear Narrative
5. Design and Implement a Game User Interface (UI)
6. Audio Design – Add Sound Effects and Music to Game Scenes
7. Prototype a Game Level with Balanced Game play
8. Create a Playable Game World Map
9. Use Version Control (Git) for Collaborative Game Development
10. Conduct Play testing and Analyze User Feedback

NOTE: At least 08 experiments along with a mini application must be done in the semester.

Term Work:

The term work shall consist of at least 8 experiments/assignments based on the syllabus above. Assessment of term work should be done as follows:

- Continuous lab assessment.
- Actual practical performance in the Laboratory.
- An oral examination conducted (internally)at the time of submission.

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Course Code: AIM377

Teaching Scheme

Credit: 2

Title: Lab 9 Software Development Lab
(Mobile Application Development for Android)

Examination Scheme

Practical Exam (Marks):50

Practical/Oral Exam (Duration):3 hrs.

Prerequisite
1. Concepts in Object-Oriented Programming Language
2. Knowledge of XML

Objectives:
1. To know the difference between Android and another mobile development platform.
2. To understand how Android apps work through the life cycle, intents, manifests, etc.
3. Todevelopdifferentandroidappwithcompellinguserinterfacesusingmenus, layouts and Views.
4. To use Android API for data storage, retrieval, content providers, SMS, and Telephony.
5. Tap into location-based services and different sensors.

List of Suggestive Experiments
Design, develop, and implement the following assignments using Android Studio/Visual Studio xamarin.
1. Design and develop an Android Application to display "Hello World" using basic Widgets
2. Design and develop an Android Application to demonstrate the Activity Life Cycle
3. Design and develop Android Applications to demonstrate GUI by using different Layouts/widgets
4. Design and develop Android Application to demonstrate views in Android
5. Design and develop Android Applications to demonstrate Intents(Implicit/ Explicit)
6. Design and develop Android Application to demonstrate Broadcast Receivers/Services
7. Design and develop an Android Application to demonstrate Saving Files in External/Internal Storage
8. Design and develop Android Applications to demonstrate Content Providers
9. Design and develop Android applications to demonstrate SQ-Lite database (Dictionary, Quiz, etc.)
10. Design and develop Android applications to demonstrate Firebase operations(data push, retrieval, delete, update, etc.)
11. Design and develop Android Application to demonstrate My-SQL database
12. DesignanddevelopAndroidApplicationtodemonstrateuseofTelephony(Call/SMS)
13. DesignanddevelopAndroidApplicationtodemonstrateuseofBluetooth/wi-fi
14. Design and develop Android Application to demonstrate use of Google map API
15. Design and develop Android Application to play audio/video files
16. DesignanddevelopAndroidApplicationtodemonstratesensors(Accelerometer/Compass)

List of Suggestive Assignments
1. Develop an application for the Hospital(Patient/Doctor portal)
2. Develop an application for an online Quiz
3. Develop chat application

MINI PROJECT (Compulsory): Students have to submit a mini-project at the end of the semester with a report in a group of a maximum of 3 students

Practical Examination:
The internal examiner should conduct practical Examination for three hours under the supervision of an external examiner. External examiners should evaluate students by checking practical performance and conducting viva.