D. Y. Patil Education Society

Deemed to Be University

School of Engineering and Management

KASABA BAWADA, KOLHAPUR

Accredited by NAAC with

'A++' Grade

Final Year B. Tech

Structure and Curriculum (as per NEP 2020)

Department of Computer Science and Engineering

w. e. f. A. Y. 2026-27

D. Y. PATIL DEEMED TO BE UNIVERSITY
SCHOOL OF ENGINEERING AND MANAGEMENT
Teaching and Evaluation Scheme from Year 2023-24 (as per NEP-2020)
B. Tech. Computer Science Engineering (SEMESTER- VII)

Sr. No.	Course Code	Course Type	Course Name	Teaching Scheme				Theory			Practical		Total Marks
				Credits	Contact Hrs			ISE	MSE	ESE	INT	OE/ PoE	
					L	P	T						
1	23CSEU7P01	PCC	Advanced Database Systems	**3**	3		-	20	30	50		-	100
2	23CSEU7P02	PCC	Advanced Database Systems Lab	**1**		2					25	25	50
3	23CSEU7P03	PCC	Software Testing and Quality Assurance	**2**	1	2	-	-	-	-	25	25	50
4	23CSEU7M04	MDM-V	API Testing	**2**	2	-	-	-	-	50	-	-	50
5	23CSEU7E05	PEC-IV	Cyber Security	3	3	-	-	20	30	50	-	-	100
6	23CSEU7E06		Artificial Neural Network										
7	23CSEU7E07		Mobile Technology										
8	23CSEU7E08	PEC-V	Business Intelligence and Analysis	3	3	-	-	20	30	50	-	-	100
9	23CSEU7E09		Computer Vision										
	23CSEU7E10		Natural Language Processing										
10	23CSEU7E11		Software Defined Network										
11	23CSEU7R11	RM$	Research Methodology	**4**	4	-	-	20	30	50	-	-	100
12	23CSEU7J12	PR	Project	**4**	-	8	-	-	-	-	75	75	150
13	23CSEU7D13	AC	Liberal Learning	-	2*	-	-	-	-	-	50*	-	0
			Total	**22**	**14**	**12**	**-**						**700**

HONORS

Sr. No.	Course Code	Course Type	Course Name	Teaching Scheme				Theory			Practical		Total Marks
				Credits	L	P	T	ISE	MSE	ESE	INT	OE/	
1	23CSEU7Z01	Honors	Deep Learning	3	3	-	-	20	30	50	-	-	100
2	23CSEU7Z02	Honors	Deep Learning Lab	1	-	2	-	-	-	-	25	-	25
3	23CSEU7Z03	Honors	Cyber-crime and Laws	3	3	-	-	20	30	50	-	-	100
4	23CSEU7Z04	Honors	Cyber-crime and Laws Lab	1	-	2	-	-	-	-	25	-	25

Note:
$ - Open & Distance Learning
* - Values are not included in total marks
Min. Marks for Passing: 40% of total marks of individual course
#- Students opted Cyber Security as Honors are not allowed to opt Foundations of Cyber Security (PEC IV)

D.Y. PATIL EDUCATION SOCIETY (Deemed to be University) Kasba Bawada, Kolhapur School of Engineering & Management KOLHAPUR

Course Code:	23CSEU7P01
Course Name:	Advanced Database Systems

L	T	P	Credit
3	0	0	3

Course Prerequsites:

Database Engineering Concepts

Course Description:

Advanced Database Engineering is an extension to database systems. Advanced database focuses and presents the features, benefits of advanced data models like Object oriented & Object relational models. Explores ahead the extension of SQL to PL/SQL to draw the benefits to the database designer & to the developer's community. This course covers NoSQL Databases like Key-Value Database, Document Database, etc.

Course Outcomes:	After the completion of the course the student will be able to -	**SDGs**
CO1	Understand and Use the knowledge of PL/SQL in writing queries	4
CO2	Demonstrate the use of data mining & data warehousing techniques in business data analytics	9
CO3	Illustrate design, architectures, data storage, distribution &query processing in Parallel & distributed databases.	9
CO4	Construct a database using the SQL security features.	16

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	1	1					1		2	2	1
CO2	2	3	2	1	3		2	2	1	3	3	2	3	3
CO3	2	3	2	1	3		2	1		1	1	1	3	3
CO4	2	2	1	2	2	2	2	3		1	2	1	3	3

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

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Course Contents:			SDGs
Unit 1	**Advanced SQL**	**6 Hours**	9
Introduction to PL/SQL, PL/SQL Functions & Procedures, Oracle Sequences, Embedded SQL			
Unit 2	**Object-Database Systems**	**6 Hours**	9
Motivating Example, Structured Data Types, Operations on Structured Data, Encapsulation and ADTs, Inheritance, Objects aIDs, and Reference Types, Database Design for an ORDBMS,ORDBMS Implementation Challenges, OODBMS, Comparing RDBMS, OODBMS, andORDBMS			
Unit 3	**NoSQL Database Management**	**7 Hours**	9
Introduction, Data management with distributed databases, ACID and BASE NoSQL Types: Key-Value Database, Document Database, Column Family Database, and Graph Database Comparisonof relational databases and NoSQL			
Unit 4	**Data Warehousing and Data Mining**	**8 Hours**	8
DATA WAREHOUSING AND DECISION SUPPORT: Introduction to Decision Support, OLAP: Multidimensional Data Model, Multidimensional Aggregation Queries, Finding AnswersQuickly, Data Warehousing, Views and Decision Support, View Materialization. **DATA MINING:** Introduction to Data Mining, Counting Co-occurrences, Mining for Rules,Tree-Structured Rules, Clustering, Similarity Search over Sequences, Incremental Mining andData Streams, Additional Data Mining Tasks			
Unit 5	**Parallel and Distributed Databases**	**8 Hours**	4
Introduction, Architectures for Parallel Databases, Parallel Query Evaluation, ParallelizingIndividual Operations, Parallel Query Optimization, Introduction to Distributed Databases,Distributed DBMS Architectures, Storing Data in a Distributed DBMS, Distributed Catalog Management, Distributed Query Processing, Updating Distributed Data, Distributed Transactions,Distributed Concurrency Control, Distributed Recovery.			
Unit 6	**Database Security**	**6 Hours**	9
Introduction to Database Security Issues, Discretionary Access Control Based on Granting andRevoking Privileges, Mandatory Access Control and Role-Based Access Control for MultilevelSecurity, SQL Injection, Privacy Issues, and Preservation, Challenges of Database Security, OracleLabel-Based Security			

Text Books:

1. Oracle® PL/SQL™ by Example FOURTH EDITION BENJAMIN ROSENZWEIG ELENA SILVESTROVA RAKHIMOV(Unit : 1)
2. Database Management System - Raghu Ramakrishnan, Johannes Gehrke - MGH, [4e] (Units: 2,4,5)
3. NoSQL for Mere Mortals- Dan Sullivan- 1st Edition, Pearson Education(Unit-3)
4. Fundamentals of Database Systems -R. Elmasri S. B. Navathe - Addison Wesley-SixthEdition(Unit-6)

Reference Books:

1. Database System Concepts - Silberschatz, Korth, Sudarshan - MGH, 6th Edition
2. Data Mining - Margaret H. Dunham - Pearson Education
3. NoSQL Distilled: A brief guide to merging world of Polyglot persistence - Pramod J. Sadalage and Marin Fowler - Addison Wesley
4. Database Systems, Design, Implementation and Management - Coronel-Morris- Rob - Cengage Learning, [9e]

D.Y. PATIL EDUCATION SOCIETY KOLHAPUR Kasba Bawada, Kolhapur

Course Code:	23CSEU7P02
Course Name:	Advanced Database Systems Lab

L	T	P	Credit
0	0	2	1

Course Prerequsites:

Set Theory, Fundamental of Software Engineering (SDLC)

Course Description:

The course develops hands-on skills in PL/SQL programming, database programming, Oracle database features, NoSQL databases, data warehousing, database security, object-relational concepts, and SQL operations through structured laboratory assessments and real-world applications.

Course Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	Understand fundamentals of database management systems	4
CO2	Analyze & construct good database design	9
CO3	Apply SQL queries to design & manage the database	9

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1		3	1	1			1	1	1		
CO2	1	3	2	3	2	3	1	3	1	1	3	2		
CO3	2	3	2	2	3	3	1	3	1	1	3	2		
CO4														

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	Internal	50%	Practical performance, Submission, Internal POE
2	External	50%	POE



Course Contents:		SDGs
Assessment No. 1 : Write a simple PL/SQL Program for the following i. Print the sum of "N" numbers ii. Check whether the input number is prime or not.	4 Hours	4,9
Assessment No. 2 : Implement & Demonstrate Declaring, Defining, and Invoking a Simple PL/SQL Function for the below statement. i. Find the Factorial of the number.	4 Hours	4,9
Assessment No. 3 : Implement a PL/SQL Procedure for the following i. Find a Maximum of three numbers using "IN" & "OUT" Parameters ii. Find the square of the Number using the "IN OUT" Parameter	2 Hours	4,9
Assessment No. 4 : Using Oracle Sequence demonstrate creating and dropping of an auto-number field for Customer Table.	2 Hours	9,4
Assessment No. 5 : Demonstrate NoSQL Key-Value Database.	2 Hours	9,4
Assessment No. 6 : Demonstrate No SQL Document Database.	2 Hours	9,4
Assessment No. 7 : Demonstrate Data Control Language Commands	2 Hours	9
Assessment No. 8 : Construct star schema. Demonstrate Fact and dimension tables	2 Hours	8
Assessment No. 9 : Examine SQL Injections.	4 Hours	9
Assessment No. 10 : Demonstrate Object-oriented& Object Relational databases.	2 Hours	4

Text Book:

1. Oracle® PL/SQL™ by Example FOURTH EDITION BENJAMIN ROSENZWEIG ELENA SILVESTROVA RAKHIMOV(Unit : 1)
2. Database Management System - Raghu Ramakrishnan, Johannes Gehrke - MGH, [4e] (Units: 2,4,5)
3. NoSQL for Mere Mortals- Dan Sullivan- 1st Edition, Pearson Education(Unit-3)
4. Fundamentals of Database Systems -R. Elmasri S. B. Navathe - Addison Wesley-SixthEdition(Unit-6)

D.Y. PATIL EDUCATION SOCIETY KOLHAPUR Kasba Bawada, Kolhapur

Course Code:	23CSEU7P03	L	T	P	Credit
Course Name:	Software Testing and Quality Assurance	1		2	2

Course Prerequsites:

Software Engineering, Object Oriented Modeling and Design

Course Description:

This course covers basic concepts, techniques, and tools used in Software Testing and Quality Assurance with emphasis on theory and hands-on practice. The syllabus is aligned with industry practices, focusing on verification, validation, test design, automation, metrics, and quality models. All laboratory work uses open-source tools only.

Course Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	Understand fundamentals of software testing, quality, and verification models.	4,9
CO2	Design effective test cases, test plans, and test documentation.	4,9
CO3	Apply software metrics and quality models for process and product evaluation.	9,12
CO4	Experience hands-on practice with open-source testing and automation tools.	4,9,17

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		1		2			1		3	2	2	1	
CO2	1	2	2	1	3			1		2	3	1	3	1
CO3	1	1	1	1	3						1	1	3	
CO4	1	1	1	2	3			1		2	1	2	3	1

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	Internal Assessment	50%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	POE	50%	Practical/Oral Examination

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Course Contents:			SDGs
Unit 1	**Introduction to Software Testing and QA**	**3 Hours**	
Software failures and lessons learned, Role of testing in software development, Testing process and terminology, Principles and limitations of testing, Software Quality concepts, Verification vs Validation, V-Model and Agile testing overview.			4,9
Unit 2	**Software Verification and Test Design**	**4 Hours**	
Verification methods and reviews, SRS and design document verification, Code and user documentation reviews, Software project audits, Use case diagrams and scenarios, Test case design from SRS and use cases, Boundary value analysis, equivalence partitioning, Database testing basics			4,9
Unit 3	**Regression and Object-Oriented Testing**	**4 Hours**	
Regression testing concepts, Test case selection and prioritization, Risk-based testing, Code coverage techniques, Object-oriented testing principles, Class testing, state-based testing, interaction and path testing.			9
Unit 4	**Software Metrics and Measurement**	**4 Hours**	
Web application architecture overview, Functional and UI testing, Usability and accessibility testing, Compatibility and configuration testing, Security and performance testing basics, Automated test data generation approaches, Overview of open-source automation frameworks.			9,10,17

List of Experiments:		SDGs
1	**Software Verification** – Review and verification of SRS and design documents using checklists.	4,9
2	**Use Case Modeling** – Creation of use case diagrams and scenarios for a given system.	4,9
3	**Test Case Design** – Designing test cases from SRS and use cases.	4,9
4	**Test Plan Preparation** – Preparing a complete test plan for a given application.	8,9
5	**Manual Testing** – Functional and regression testing of a sample application.	9,12
6	**Object-Oriented Testing** – Class and interaction testing for an OO-based system.	4,9
7	**Unit Testing with Open-Source Frameworks** – JUnit/TestNG based unit testing.	9,17
8	**Automation Testing (UI)** – Web UI automation using Selenium.	8,9
9	**API Testing** – REST API testing using Postman or similar open-source tools.	9,17
10	**Performance Testing** – Load and stress testing using Apache JMeter.	9,12
11	**Test Data Generation and Reporting** – Automated test data generation and test report preparation.	4,9

Text Books:

1. Yogesh Singh, Software Testing, Cambridge University Press, First Edition.
2. Norman Fenton and Shari Lawrence Pfleeger, Software Metrics: A Rigorous and Practical Approach, 2nd Edition, Thomson Press.

Reference Books:

1. Foundations of Software testing: Aditya P. Mathur, Pearson, Second Edition
2. Software Testing: Ron Patton, Pearson (SAMS), Second Edition
3. Software Metrics – A Rigorous & Practical approach: Norman Fenton, Shari Lawrence Pfleeger, 2nd Edition (Thomson Press)

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Course Code:	23CSEU7M04
Course Name:	API Testing

L	T	P	Credit
2			2

Course Prerequsites:

Basic programming knowledge in Java or any object-oriented programming language.
Familiarity with HTTP, JSON, and XML formats.

Course Description:

This course introduces the fundamentals and modern techniques of Natural Language Processing (NLP). It covers text preprocessing, language modeling, text classification, sentiment analysis, vector semantics, embeddings, sequence labeling, and lexical resources. Students will gain hands-on experience with popular NLP tools and explore recent trends such as transformer-based models and real-world applications like question answering and chatbots.

Course Outcomes:	After the completion of the course the student will be able to -	SDG
CO1	Understand API fundamentals, client-server architecture, REST and GraphQL concepts.	4,9
CO2	Design, execute, and automate data driven API test cases using Postman.	4,8,9
CO3	Make use of Apache JMeter for API performance and load testing and analyze performance metrics.	4,8,9
CO4	Develop data-driven REST API testing frameworks using REST Assured.	4,8,9

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2			1					1		1		
CO2	2	3	3	2	3				1	2		2	2	1
CO3	2	3	2	3	3				1	1		2	3	3
CO4	3	3	3	2	3				1	2		2	3	3

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	End Semester Examination (ESE)	100%	100% course contents

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Kasba Bawada, Kolhapur

Course Contents:

Unit 1	**Introduction to API testing**	**7 Hours**	**SDG**
Introduction to api basics, client-server architecture model & 3 tier architecture model, HTTP methods, Evolution of APIs, classification of APIs , Introduction to GraphQL, GraphQL Basics and Comparison with REST			4,9
Unit 2	**API Testing Using Postman**	**7 Hours**	
Introduction to Postman and Its Importance, Creating and Organizing Collections, Environment and Global Variables, GET, POST, PUT, DELETE, HEAD, OPTIONS Requests with Examples, Post script and Pre script, Request Chaining, Assertions and Response Validations, Running Collections with Collection Runner and Newman CLI, Query Parameters, Form Parameters, Path Parameters, Schema Validations, Collection Runner and Data driven automation testing, Newman Reports and Postman CLI Reports, Integrating Postman Collections in CI/CD Pipelines, GraphQL testing using Postman			4,8,9
Unit 3	**Introduction to Jmeter**	**7 Hours**	
Jmeter Introduction & Jmeter core concepts, JMeter's Recording, JMeter's Properties Files, JMeter Plugin Manager & Plugins Installation & Uninstallation, Jmeter Test Execution, Performance testing, Load testing using Jmeter			4,8,9
Unit 4	**REST API Testing with Rest Assured**	**7 Hours**	
REST vs SOAP Overview, Adding REST Assured Dependencies in Maven, Setting up Base URI and Base Path, Request and Response Specification Builders, Passing Headers, Path Params, Query Params, Validating Status Codes and Response Body, Authentication: Basic Auth, Bearer Token, OAuth 2.0, Using POJOs for Payloads (Serialization & Deserialization), Data-Driven API Testing with TestNG and Excel/CSV/JSON			4,8,9

Text Books:

API Testing and Development with Postman — Dave Westerveld
REST API Testing Cookbook — Sudhakar Gummadi
Performance Testing with JMeter — Bayo Erinle
Rest-Assured API Testing — Bas Dijkstra
API Testing with Java — Rajkumar G

Reference Books:

Testing Web APIs — Mark Winteringham
Apache JMeter Practical Guide — Emily Hoder
Master Apache JMeter — Jayant Varma
The Complete Guide to Performance Testing with JMeter — Neeraj Kumar
Automated REST API Testing with Java — Alan Richardson
Java for Testers — Alan Richardson

E Resources :

https://www.guru99.com/postman-tutorial.html
https://www.youtube.com/@AutomationStepbyStep
https://www.youtube.com/@postman
https://www.youtube.com/@RahulShettyAcademy
https://www.youtube.com/@naveenautomationlabs



Course Code:	23CSEU7E05
Course Name:	Cyber Security

L	T	P	Credit
3			3

Course Prerequsites:

1. C, C++, Python or Java
2.Understanding of OS concepts (Linux/Windows)
3. Networking Basics
4. Data Structures and Algorithms concepts

Course Description:

This course introduces core concepts of cyber security and digital forensics, covering network protection, threat analysis, legal frameworks, and evidence handling. Students gain practical skills in forensic tools and security measures to counter modern cyber threats.

Course Outcomes:	After the completion of the course the student will be able to -	SDG
CO1	Identify and describe cyber threats and vulnerabilities	9,16
CO2	Apply network security principles and tools to secure communication systems	9
CO3	Demonstrate knowledge of cyber forensic techniques and tools	16
CO4	Analyze digital evidence in accordance with legal and ethical frameworks	16

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	2	1		3	1	2	3	1	3	1
CO2	2	2	1	1	2	1		3	1	2	3	2	3	1
CO3	2	2	2	2	2	1		3	1	2	3	1	3	1
CO4	2	1	1	2	3	1		3	1	2	3	1	3	1
CO5														

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents



Course Contents:			
Unit 1	**Introduction to Cyber Security**	**8 Hours**	**SDG**
1.1 Fundamentals of Cyber Security 1.2 Security frameworks: NIST, ISO27001 and Types of cyber attacks (Phishing, DoS, Ransomware, MITRE Attack etc.) 1.3 Cyber threats and vulnerabilities 1.4 Information Security goals: CIA triad (Confidentiality, Integrity, Availability) 1.5 Security mechanisms and access control models 1.6 Basics of cryptography (Symmetric vs Asymmetric, Hashing, Digital Signatures)			9,16
Unit 2	**Network Security**	**8 Hours**	
2.1 SIEM basics:QRadar, splunk and Incident Response Life Cycle 2.2 Network Security basics: Protocols(TCP/IP, DNS, HTTP) Ports 2.3 Network threats and attacks (Sniffing, Spoofing, MITM, ARP poisoning) 2.4 Firewalls, Firewall rules and types (packet-filtering, proxy, stateful) 2.5 Intrusion Detection Systems (IDS) and Intrusion Prevention Systems (IPS) 2.6 Virtual Private Networks (VPNs) 2.7 Secure socket layer (SSL), HTTPS, EDR Basics 2.8 Wireless network security protocols (WEP, WPA, WPA2)			9
Unit 3	**Cyber Forensics Fundamentals**	**7 Hours**	
3.1 Introduction to Cyber Forensics 3.2 Need for cyber forensics in investigation 3.3 Forensic investigation process (Acquisition, Analysis, Reporting) 3.4 Chain of custody 3.5 Legal and ethical issues in cyber forensics 3.6 Tools used in cyber forensics (FTK, EnCase, Autopsy)			16
Unit 4	**Digital Evidence and Crime Scene Management**	**6 Hours**	
4.1 Types of digital evidence (emails, logs, images, etc.) 4.2 Digital evidence collection and preservation 4.3 Imaging and cloning of digital media 4.4 Evidence handling procedures and documentation 4.5 Investigating disk, memory, mobile, and network-based evidence 4.6 Challenges in digital evidence handling			16
Unit 5	**Cyber Laws and IT Act**	**6 Hours**	
5.1 Overview of Indian IT Act 2000 and amendments 5.2 Legal aspects of digital signatures, electronic records 5.3 Cybercrime and related sections under IPC and IT Act 5.4 Intellectual Property Rights (IPR) in cyberspace 5.5 Cyber ethics and legal frameworks 5.6 Case studies on cybercrime			4,16
Unit 6	**Emerging Trends and Case Studies**	**6 Hours**	
6.1 Cybersecurity in IoT and cloud computing 6.2 Blockchain and security 6.3 Artificial Intelligence in cybersecurity 6.4 Case studies on recent cyber attacks and forensic investigations 6.5 Role of CERT-IN, NCIIPC, and global agencies 6.6 Best practices for securing digital assets			9,16



Text Books:

1. Behrouz A. Forouzan – Cryptography and Network Security, McGraw-Hill.
2. John Sammons – The Basics of Digital Forensics, Syngress/Elsevier
3. Nina Godbole & Sunit Belpure – Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley India.

Reference Books:

1. Nelson, B., Phillips, A., & Steuart, C. –Guide to Computer Forensics and Investigations, Cengage Learning.
2. William Stallings – Cryptography and Network Security, Pearson Education.
3. Marjie T. Britz – Computer Forensics and Cyber Crime, Pearson Education.
4. Chuck Easttom – Computer Security Fundamentals, Pearson Education.



Course Code:	23CSEU7E06
Course Name:	Artificial Neural Networks

L	T	P	Credit
3	0	0	3

Course Prerequsites:

Linear Algebra, Probability & Statistics, Python Programming

Course Description:

This course introduces students to the theory and design of artificial neural networks, covering key architectures such as feedforward, convolutional, and recurrent networks. It emphasizes learning algorithms, optimization techniques, and real-world applications in areas like image and text processing. Students will also explore advanced models and ethical considerations in AI.

Course Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	Understand and explain the architecture, components, and learning mechanisms of various neural network models including feedforward, convolutional, and recurrent networks.	4, 9
CO2	Apply appropriate learning algorithms and optimization techniques to train and evaluate neural networks for classification and prediction tasks.	4, 9
CO3	Analyze the performance of neural network models using metrics and tuning methods, and address issues like overfitting and vanishing gradients.	4, 9
CO4	Explore advanced neural architectures such as autoencoders and GANs, and assess their applications and ethical implications in real-world scenarios.	4, 10, 16

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1											2	
CO2		1		1	1									2
CO3		1		1	1						1			1
CO4						2							2	

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

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Course Contents:			SDGs
Unit 1	**Introduction to Neural Networks**	**6 Hours**	
Biological vs Artificial Neurons, McCulloch-Pitts Model, Perceptron and Linearly Separable Problems, Activation Functions: Sigmoid, Tanh, ReLU, Softmax, Learning Rules: Hebbian, Delta, Perceptron Learning			4, 9
Unit 2	**Multilayer Perceptrons and Back Propagation**	**7 Hours**	
Architecture of MLP, Forward and Backward Propagation, Gradient Descent and its Variants (SGD, Momentum, Adam), Loss Functions: MSE, Cross-Entropy, Overfitting and Regularization (L1, L2)			4, 9
Unit 3	**Deep Neural Networks**	**8 Hours**	
Deep Learning Concepts and Architectures, Vanishing/Exploding Gradient Problem, Batch Normalization, Dropout, Hyperparameter Tuning and Model Evaluation, Introduction to TensorFlow and PyTorch			4, 9
Unit 4	**Convolutional Neural Networks**	**7 Hours**	
Convolution Operation and Filters, Pooling Techniques (Max, Average), CNN Architectures: LeNet, AlexNet, VGG, ResNet, Applications in Image Classification and Object Detection			9
Unit 5	**Recurrent Neural Networks**	**7 Hours**	
RNN Architecture and Training, Vanishing Gradient Problem in RNNs, LSTM and GRU Networks, Applications in NLP: Text Classification, Sentiment Analysis, Time Series Forecasting			9
Unit 6	**Advanced Topics and Applications**	**7 Hours**	
Autoencoders: Sparse, Denoising, Variational, Generative Adversarial Networks (GANs): Architecture and Training, Transfer Learning and Fine-Tuning, Introduction to Transformers, Ethical AI: Bias, Fairness, and Societal Impact			9, 10, 16

Text Books:

1. Haykin, S., Neural Networks and Learning Machines, Pearson Education.
2. Goodfellow, I., Bengio, Y., Courville, A., Deep Learning, MIT Press.
3. Nielsen, M., Neural Networks and Deep Learning, Determination Press.

Reference Books:

1. Kumar, S., Neural Networks: A Classroom Approach, McGraw Hill Education.
2. Aggarwal, C. C., Neural Networks and Deep Learning: A Textbook, Springer.
3. Chollet, F., Deep Learning with Python, Manning Publications.
4. Rashid, T., Make Your Own Neural Network, CreateSpace Independent Publishing.



Course Code:	23CSEU7E07
Course Name:	Mobile Technology

L	T	P	Credit
3			3

Course Prerequsites:

Data Communication & Networking, TCP/IP Protocol Suite

Course Description:

Mobile Technology subject mainly deals with the science of mobile communication. It covers layered approach of mobile communication covering layers such as – data link, network and transport layer. It also introduces the 5G technology.

Course Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	Explain the basic physical and technical functioning of mobile communications systems.	4,9
CO2	Describe the basic principles of mobile communication system and summarize the working of network and transport layer in the context of mobility.	4,9
CO3	Compare principles of the modern mobile and wireless communication systems such as 5G with 3G/4G.	9,11
CO4	Illustrate the principles and applications of wireless systems and standards.	4,9

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2													
CO2	1	2			1									
CO3	1	3		3	1								2	
CO4	1		2		1								1	2

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents



Course Contents:			SDGs
Unit 1	**Introduction**	**7 Hours**	9
Introduction to Wireless Networks, Applications, History, Simplified Reference Model, Wireless transmission, Frequencies, Signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread spectrum, Cellular Systems: Frequency Management and Channel Assignment, Types of handoff and their characteristics.			
Unit 2	**Medium Access Control (MAC) & GSM Telecommunication System**	**7 Hours**	9
MAC, Motivation, SDMA, FDMA, TDMA, CDMA, Telecommunication Systems, GSM: Architecture, Location tracking and call setup, Mobility management, Handover, Security, GSM SMS, International roaming for GSM, call recording functions, subscriber and service data management.			
Unit 3	**Mobile Network Layer:**	**7 Hours**	9
IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunneling and Encapsulation, Route Optimization, DHCP.			
Unit 4	**Mobile Transport Layer**	**7 Hours**	9
Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit / Fast recovery, Transmission / Timeout freezing, Selective retransmission, Transaction Oriented TCP.			
Unit 5	**Mobile Ad hoc Networks (MANETs)**	**7 Hours**	9,11
Introduction, Applications & Challenges of a MANET, Routing, Classification of Routing Algorithms, Algorithms such as DSR, AODV, DSDV, etc. , Mobile Agents, Service Discovery.			
Unit 6	**5G Mobile Network – Future of Mobile Communication**	**7 Hours**	9,11
10 Pillars of 5G, concept of small cell, Cognitive radio -overview, spectrum optimization literature, key requirements and challenges for 5G cognitive terminal. Wireless spectrum white spaces – Background, TV white space technology, white space spectrum opportunities and challenges.			

Text Books:

1. Jochen Schiller, \Mobile Communication", Pearson Education.
2. Theodore & S. Rappaport, \Wireless Communications, Principles, Practice", PHI.
3. William Stallings, \Wireless Communications and Networks", Pearson Education.
4. Jonathan Rodriguez, Fundamentals of 5G Mobile Networks, First Edition 2015 John Wiley & Sons, Ltd Publication

Reference Books:

1. Wireless telecommunications systems and networks / Gary J. Mullett. Cengage Publication.



Course Code:	23CSEU7E08
Course Name:	Business Intelligence and Analysis

L	T	P	Credit
3			3

Course Prerequsites:

Basic knowledge of programming, database management systems, data structures, and introductory statistics is required. Familiarity with data analysis concepts and SQL will be beneficial.

Course Description:

This course provides an overview of Business Intelligence concepts and analytical techniques used for data-driven decision making. It covers data warehousing, data mining, visualization, performance management, text analytics, web analytics, and social analytics.

Course Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	Define basic concepts ,Architecture and data warehousing related concepts of Business Intelligence	4, 9
CO2	Demonstrate the impact of business reporting, information visualization, and dashboards.	8, 9, 12
CO3	Apply text analytics and web analytics business intelligence methods to various situations.	9, 16

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	3	2				2	3	3	3	3	3
CO2	2	3	2	3	2	3		3	3	3	3	3	3	3
CO3	1	3	2	3	2	3		3	3	3	3	3	3	3

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents



Course Contents:			SDGs
Unit 1	**Introduction to Business Intelligence**	**8 Hours**	
Introduction to Business Intelligence (BI), Need for Business Intelligence in Organizations, Framework for Business Intelligence (BI), Architecture of Business Intelligence Systems (Data sources, Data integration layer, Data warehouse, Analytics and reporting layer) Benefits and Business Value of BI, Role of BI in Decision Making (Strategic, Tactical, Operational), Comparison of Business Intelligence with Competitive Intelligence and Knowledge Management, Applications of BI in different domains (Finance, Marketing, Healthcare, Retail overview)			8,9
Unit 2	**Data warehousing**	**7 Hours**	
Introduction to Data Warehousing, Characteristics of Data Warehousing, Data Marts and their Types, Data Warehousing Process, Data Warehousing Architectures(Single-tier, Two-tier, and Three-tier architectures), Data Integration, Extraction Transformation and Load (ETL) Process, OLAP versus OLTP, Data Warehousing Implementation Issues, Real-Time Data Warehousing			9
Unit 3	**Business Reporting, Visual Analytics and Business Performance Management**	**6 Hours**	
Introduction to Business Reporting, Data and Information Visualization, Types of Charts and Graphs, Emergence of Data Visualization and Visual Analytics, Performance Dashboards, Balanced Scorecard, Dashboards versus Scorecards, Six Sigma as a Performance Measurement System			8, 9, 12
Unit 4	**Data mining – Supervised and unsupervised learning**	**8 Hours**	
Introduction to Data Mining, Data Mining Concepts and Applications, Data Mining Process, Data Mining Methods, Supervised Learning Techniques, Unsupervised Learning Techniques, Association Rule Mining, Data Mining Software Tools, Case Studies, OLAP and ETL Tools: Case Studies			4, 9
Unit 5	**Text Analytics, Text Mining and Sentiment Analysis**	**7 Hours**	
Introduction to Text Analytics and Text Mining, Text Analytics and Text Mining: Concepts and Definitions,Text Mining Process, Text Mining Tools, Sentiment Analysis Overview, Sentiment Analysis Applications, Sentiment Analysis Process			9, 16
Unit 6	**Web Analytics, Web Mining, and Social Analytics**	**6 Hours**	
Introduction to Web Mining, Web Mining Overview, Web Content Mining and Web Structure Mining, Search Engines, Search Engine Optimization (SEO), Web Usage Mining, Web Analytics Maturity Model, Web Analytics Tools, Social Analytics, Social Network Analysis			9, 16

Text Books:

Ramesh Sharda, Dursun Delen, Efraim Turban, Business Intelligence and Analytics, Pearson 10th edition, 2018 .

Reference Books:

1. Ramesh Sharda, Dursun Delen, Efraim Turban, Business Intelligence, Analytics, and Data Science: A Managerial
Perspective, 4th Edition, Pearson, 2017
2. "Business Intelligence For Dummies" by Swain Scheps.



Course Code:	23CSEU7E09
Course Name:	Computer Vision

L	T	P	Credit
3	0	0	3

Course Prerequsites:

Computer graphics, Data structures

Course Description:

This course on Computer Vision introduces students to the fundamental principles, techniques, and applications of computer vision. Through hands-on experience, students will learn how to process, analyze, and interpret visual data from the world around us. The course covers topics such as image preprocessing, feature extraction, object detection, deep learning for computer vision, and advanced topics like generative models and autonomous systems. Students will also work with popular computer vision frameworks and libraries such as OpenCV, TensorFlow, and Keras

Course Outcomes:	After the completion of the course the student will be able to -
CO1	Define computer vision and image processing and explain the basics of image representation
CO2	Apply edge detection techniques and image segmentation methods
CO3	Examine the principles of neural networks and deep learning and apply CNNs for image classification
CO4	Develop image analysis using the Google Cloud Vision API

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	SDGs
CO1	3	2	1	1	2				1	2	2	1	3	3	4,9
CO2	3	3	2	3	3				2	2	2	2	3	3	9,3
CO3	3	3	3	2	3	2	1	1	2	2	2	2	3	3	9,4
CO4	3	2	2	3	2	2	1		2	2	3	2	3	3	9,8

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation1 [10 Marks]	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination [30 Marks]	30%	50% Course Contents
3	In Semester Evaluation2 [10 Marks]	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination [50 Marks]	50%	100% Course Contents

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Course Contents:			SDGs
Unit 1	**Introduction to Computer Vision and Image Processing**	**7 Hours**	4,9
Overview of Computer Vision, Image representation and formats, Basic image transformations (scaling, rotation, flipping),Image enhancement and filtering techniques, Color space conversions and histogram equalization, Introduction to OpenCV			
Unit 2	**Detection and Extraction**	**7 Hours**	9,3
Keypoint detection and matching (SIFT, SURF, ORB),Edge detection techniques (Sobel, Canny, Laplacian),Image segmentation (Thresholding, Region Growing),Histogram of Oriented Gradients (HOG),Feature extraction using deep learning			
Unit 3	**Object Detection and Recognition**	**7 Hours**	9,11
Object detection vs. image classification ,Haar Cascades and Viola-Jones Algorithm for face detection ,Convolutional Neural Networks (CNN) for image classification ,R-CNN, Fast R-CNN, Faster R-CNN for object detection ,YOLO (You Only Look Once) for real-time object detection ,SSD (Single Shot Multibox Detector)			
Unit 4	**Deep Learning for Computer Vision**	**7 Hours**	9,4
Introduction to neural networks and deep learning ,Training CNNs for image classification ,Transfer learning and pre-trained models (VGG, ResNet, Inception),Data augmentation techniques ,Generative Adversarial Networks (GANs) for image generation			
Unit 5	**Visual Intelligence**	**7 Hours**	11,3
Image captioning using CNN and RNN ,Semantic segmentation using models like U-Net and FCN, 3D computer vision: Stereo vision, depth sensors ,Face recognition using deep learning (FaceNet, OpenFace) ,Object tracking techniques: Optical flow, Kalman filters, and Deep SORT ,Computer vision in autonomous systems (Self-driving cars)			
Unit 6	**Cloud-based Computer Vision Solutions**	**7 Hours**	9,17
Google Cloud Vision API for image analysis ,Training custom models using Google Cloud AutoML Vision ,Cloud-based deployment and scaling using Google Cloud AI Platform, Real-time inference and monitoring using Google Cloud			

Text Books:

1.“Programming Computer Vision with Python: Tools and algorithms for analyzing images”- Jan Erik Solem
2.“Learning OpenCV 4: Computer Vision with Python” by Adrian Kaehler and Gary Bradski
3.“Computer Vision: Algorithms and Applications” (2nd Edition)- Richard Szeliski

Reference Books:

1. “Hands-On Computer Vision with TensorFlow 2" by Benjamin Planche and Eliot Andres
2.“Cloud AI Services with Google Cloud: Building Smart Applications with Vision, Language, and Conversation AI”- Gunjan Aggarwal



Course Code:	23CSEU7E10
Course Name:	Natural Language Processing

L	T	P	Credit
3			3

Course Prerequsites:

Basic Python programming skills, Fundamentals of probability and statistics, Introductory machine learning concepts

Course Description:

This course introduces the fundamentals and modern techniques of Natural Language Processing (NLP). It covers text preprocessing, language modeling, text classification, sentiment analysis, vector semantics, embeddings, sequence labeling, and lexical resources. Students will gain hands-on experience with popular NLP tools and explore recent trends such as transformer-based models and real-world applications like question answering and chatbots.

Course Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	Explain the core concepts and challenges in natural language processing.	4
CO2	Apply language modeling, text preprocessing, and classification techniques to text data.	4, 9
CO3	Implement NLP applications using standard tools and resources.	9
CO4	Analyze recent trends and resources in NLP for real-world applications.	9, 10

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1												
CO2	2	1			2								2	1
CO3	1	2	2	2	3								3	3
CO4		3	2	3	3								3	3

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents



Course Contents:

Unit 1	**Introduction**	**6 Hours**	**SDGs**
Origins and challenges of NLP, Levels of NLP (morphology, syntax, semantics, pragmatics), Ambiguity and language complexities, Text normalization, Regular expressions, Corpora, Applications of NLP in real-world systems			4, 9
Unit 2	**Language Modelling & Text Preprocessing**	**9 Hours**	
N-gram models (unigram, bigram, trigram), Evaluating language models (perplexity, entropy), Smoothing techniques (Laplace, Kneser-Ney), Minimum Edit Distance (MED), Spelling correction, Stop-word removal, Stemming, Lemmatization, Introduction to NLP tools (NLTK, spaCy)			9
Unit 3	**Text Classification & Sentiment Analysis**	**7 Hours**	
Naive Bayes classifier for text classification, Sentiment analysis approaches (rule-based VADER, statistical), Feature representation (Bag-of-Words, TF-IDF), Evaluation metrics (Precision, Recall, F1-score), Ethical considerations in classification			9, 11
Unit 4	**Vector Semantics & Embeddings**	**7 Hours**	
Lexical semantics and word similarity, Vector space models (TF-IDF, PMI), Word embeddings (Word2Vec basics), Applications of embeddings in NLP tasks, Bias in embeddings and mitigation strategies			5, 10
Unit 5	**Sequence Labeling & Named Entity Recognition**	**7 Hours**	
English word classes, Part-of-Speech tagging (rule-based, HMM), Named Entity Recognition (NER) basics, Conditional Random Fields (CRFs) for sequence labeling, Evaluation of tagging and NER systems, Hands-on with spaCy for POS and NER			9
Unit 6	**Lexical Resources & Recent Trends**	**7 Hours**	
WordNet (synsets, synonyms, antonyms, word senses), Word Sense Disambiguation (WSD) techniques, Lexical resources (Treebank, PropBank, Indian WordNet), Recent trends in NLP (transformers overview: BERT, GPT), Applications (Question answering, chatbots)			9, 10, 11

Text Books:

1. “Natural language processing and Information Retrieval” Tanveer Siddiqui, U.S. Tiwary, Oxford
2. “Speech and Language Processing” Daniel Jurafsky and James H Martin 2E, Pearson Education

Reference Books:

1. “Natural language Understanding”, James Allen 2e, Pearson Education
2. “Natural language processing”: a Paninian perspective, Bharati A., Sangat R., Chaitanya V.. PHI

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Course Code:	23CSEU7R11
Course Name:	Research Methodology

L	T	P	Credit
4			4

Course Prerequsites:

Fundamental knowledge of statistics and mathematics.
Basic English communication and academic writing skills.
Analytical thinking and problem-solving ability.

Course Description:

This course introduces the fundamentals of research methodology, including research design, data collection, sampling, statistical analysis, hypothesis testing, report writing, and research ethics. It also covers citation methods, reference management tools, and the use of software such as SPSS, R, and Python for research. The course prepares students to conduct and communicate ethical, systematic, and high-quality research in engineering and technology.

Course Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	Understand the meaning, objectives, types of research, research process, and formulate research problems	4, 9
CO2	Apply various sampling techniques, data collection methods, and analyze research data using appropriate statistical techniques and tests of significance.	4, 9
CO3	Prepare research reports, thesis writing, research proposals, and communicate research findings effectively through presentations.	4, 9, 17
CO4	Apply research ethics, understand plagiarism issues, and follow proper citation and referencing methods in academic writing.	4, 16

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	1	1					1	1	1		
CO2	1	2		3	3						2	2	3	
CO3	1				1	3			2	3	3	1		
CO4	1		2		1			3		2		2	1	2

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents



Course Contents:			SDGs
Unit 1	**Introduction to Research and Research Problem**	**8 Hours**	
Meaning of Research, Objectives of Research, Motivation in Research, Types of Research - Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical. Research Methods vs. Methodology. Research Process - Steps involved in research process. Criteria of Good Research. Problems Encountered by Researchers in India. Defining the Research Problem - Selecting the problem, Necessity of defining the problem, Technique involved in defining a problem.			4, 9
Unit 2	**Research Design**	**8 Hours**	
Meaning of Research Design, Need for Research Design, Features of a Good Design. Important Concepts Relating to Research Design - Dependent and Independent Variables, Extraneous Variable, Control, Confounded Relationship, Research Hypothesis, Experimental and Non-Experimental Hypothesis-testing Research. Different Research Designs - Research design in case of exploratory research studies, Descriptive and Diagnostic research studies, Hypothesis-testing research studies. Basic Principles of Experimental Designs - Principle of Replication, Principle of Randomization, Principle of Local Control. Important Experimental Designs - Informal Experimental Designs, Formal Experimental Designs (Completely Randomized Design, Randomized Block Design, Latin Square Design, Factorial Designs)			4, 9
Unit 3	**Sampling and Data Collection**	**6 Hours**	
Census and Sample Survey. Implications of a Sample Design. Steps in Sampling Design. Criteria of Selecting a Sampling Procedure. Characteristics of a Good Sample Design. Different Types of Sample Designs - Probability Sampling (Simple Random Sampling, Systematic Sampling, Stratified Sampling, Cluster Sampling, Area Sampling, Multi-stage Sampling) and Non-probability Sampling (Deliberate Sampling, Convenience Sampling, Quota Sampling). Methods of Data Collection - Primary Data - Observation Method, Interview Method, Collection through Questionnaires, Collection through Schedules. Secondary Data - Sources of secondary data, Precautions in using secondary data. Selection of Appropriate Method for Data Collection.			4, 16
Unit 4	**Processing and Analysis of Data**	**8 Hours**	
Processing Operations - Editing, Coding, Classification, Tabulation. Statistics in Research - Measures of Central Tendency (Mean, Median, Mode), Measures of Dispersion (Range, Quartile Deviation, Mean Deviation, Standard Deviation). Measures of Asymmetry (Skewness). Measures of Relationship (Correlation - Karl Pearson's Coefficient of Correlation, Spearman's Rank Correlation). Regression Analysis - Simple Linear Regression, Multiple Regression. Testing of Hypotheses - Basic Concepts concerning Testing of Hypotheses (Null Hypothesis and Alternative Hypothesis, Level of Significance, Decision Rule, Type I and Type II Errors). Flow Chart for Hypothesis Testing Procedure. Important Parametric Tests - z-test, t-test, F-test (ANOVA). Chi-square Test as a Non-parametric Test. Computer Software Packages for Data Analysis - SPSS, R, Python basics.			4, 9
Unit 5	**Interpretation and Report Writing**	**8 Hours**	
Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation. Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report - Preliminary Pages, Main Text, End Matter. Types of Reports - Technical Report, Popular Report, Thesis/Dissertation format. Writing Research Proposal - Purpose and format of research proposal, Components (Introduction, Review of Literature, Research Methodology, Expected Results, Budget and Time Schedule). Presentation of Research Work - Oral Presentation, Poster Presentation. Mechanics of Writing a Research Report - Layout, Structure and Language of Report, Footnotes, Appendix, Bibliography and References. Precautions for Writing Research Reports.			4, 9, 17



Unit 6	Research Ethics and Citation Methods	6 Hours	
Ethics in Research - Research involving human subjects, Animal rights and research, Ethical issues in data collection and analysis, Informed consent, Privacy and confidentiality. Academic Integrity - Plagiarism (Types, Detection, Prevention), Fabrication and Falsification of data, Authorship issues. Citation and Referencing - Importance of citations, Different Citation Styles (APA Style, IEEE Style, ACM Style, Harvard Style, Chicago Style). In-text Citations and Reference List preparation. Using Reference Management Software - Mendeley, Zotero, EndNote basics. Intellectual Property Rights in Research - Copyright, Patents in Computer Science context. Publication Ethics - Duplicate publication, Predatory journals, Peer review process.			4, 16

Text Books:

1. C.R. Kothari, "Research Methodology: Methods and Techniques", New Age International Publishers, 4th Edition (2004).
2. Ranjit Kumar, "Research Methodology: A Step-by-Step Guide for Beginners", SAGE Publications, 5th Edition (2019).

Reference Books:

1. John W. Creswell, "Research Design: Qualitative, Quantitative, and Mixed Methods Approaches", SAGE Publications, 5th Edition.
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction", Juta and Company Ltd, 2nd Edition.
3. Anol Bhattacherjee, "Social Science Research: Principles, Methods, and Practices", University of South Florida, 2nd Edition.
4. Donald H. McBurney and Theresa L. White, "Research Methods", Cengage Learning, 8th Edition.

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Kasba Bawada, Kolhapur

Course Code:	23CSEU7J12
Course Name:	Project

L	T	P	Credit
		8	4

Course Prerequsites:

Completion of the prescribed courses in the Major Engineering Programme and the Multidisciplinary Minor Programme.
Basic knowledge of engineering design, programming/software tools, research methodology, and project development.

Course Description:

The Capstone Project is the culminating component of the Multidisciplinary Minor Programme. It enables students to integrate knowledge acquired from their major discipline and multidisciplinary minor to solve real-world engineering, industrial, societal, or research problems.

Course Outcomes:	After the completion of the course the student will be able to -	**SDGs**
CO1	Identify and analyze a real-world engineering problem related to society, industry, and individuals.	4, 11, 17
CO2	Design and develop an innovative engineering solution as per the requirements	9, 8, 12
CO3	Implement, test, and evaluate the proposed solution considering technical, ethical, environmental, and societal aspects.	9, 12, 13, 16
CO4	Demonstrate effective teamwork, project management, technical documentation, and professional communication through successful project execution and presentation.	4, 8, 17

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	1	2	1					1	1	2
CO2	2	2	3	2	3	1	1		1		2	2	2	2
CO3	2	2	3	3	3	2	2	2	1	1	1	2	2	3
CO4			1		1			2	3	3	3	2	2	

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	Internal POE	50%	Presentations, Demonstration
2	External POE	50%	Presentations, Demonstration

D Y PATIL EDUCATION SOCIETY KOLHAPUR Kasba Bawada, Kolhapur

Guidelines

Students have to form teams that consist of four to five members. Every group will have to submit their area of interest and the corresponding student details through the provided form. Next, in accordance with the selected area of interest and in consideration of the expertise of the faculty, every group will get a guide.

Topic selection and finalization process will take place at the hands of the project evaluation team. After topic selection and finalization, there will be a need for the group to move forward with the preparation and presentation of the project's synopsis inline with the standard document format provided by the Programme Evaluation Committee. The group will need to prepare an SRS document. Evaluation of SRS will be done considering many aspects such as requirement gathering, requirement analysis, teamwork and presentation.

The project selected will be implemented and tested as per the guidelines provided by the group guide. The Project Documentation/Report would be submitted at the end of the semester. The guidelines for all Documentations will be duly provided by the department at relevant time frames.



D. Y. PATIL DEEMED TO BE UNIVERSITY
SCHOOL OF ENGINEERING AND MANAGEMENT
Teaching and Evaluation Scheme from Year 2023-24 (as per NEP-2020)
B. Tech. Computer Science Engineering (SEMESTER- VIII)

Sr. No.	Course Code	Course Type	Course Name	Teaching Scheme				Theory			Practical		Total Marks
				Credits	Contact Hrs			ISE	MSE	ESE	INT	OE/ PoE	
					L	P	T						
1	23CSEU8P01	PCC $	Agentic AI	**3**	3	-	-	20	30	50	-	-	100
2	23CSEU8P02	PCC $	Agentic AI Lab	**1**	-	2	-	-	-	-	25	-	25
3	23CSEU8M03	MDM-VI $	Capstone Project	**2**	-	4	-	-	-	-	25	25	50
4	23CSEU8E04	PEC-VI $	Real Time Operating Systems	2	2	-	-	-	-	50	-	-	50
5	23CSEU8E05		Deep Learning										
6	23CSEU8E06		Digital Forensics										
7	23CSEU8I07	INT	Internship	**12**	-	24	-	-	-	-	200	200	400
			Total	**20**	**5**	**30**	**-**						**625**

Note:
$ - Open & Distance Learning
* - Values are not included in total marks
Min. Marks for Passing: 40% of total marks of individual course
#- Students opted AIML as Honors are not allowed to opt Deep Learning (PEC VI)

HONORS

Sr. No.	Course Code	Course Type	Course Name	Teaching Scheme				Theory			Practical		Total Marks
				Credits	L	P	T	ISE	MSE	ESE	INT	OE/	
1	23CSEU8Z01	Honors	Capstone Project AI/ML $	2	-	4	-	-	-	-	50	-	50
2	23CSEU8Z02	Honors	Capstone Project Cyber Security $	2	-	4	-	-	-	-	50	-	50



Course Code:	23CSEU8P01
Course Name:	AgenticAI

L	T	P	Credit
3			3

Course Prerequsites:

Data Structures, Intermediate Python Object-Oriented Programming (OOP), and Foundational Natural Language Processing (NLP).

Course Description:

A comprehensive deep-dive into the architecture of Agentic AI. Students will move from theoretical reasoning frameworks to building, fine-tuning, and evaluating autonomous agents that can use tools and interact with external environments.

Course Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	Explain the fundamental architecture of AI agents, specifically the "Think → Act → Observe" loop and the role of LLMs as reasoning engines.	4
CO2	Design and implement custom "Tools" for agents to interact with web APIs, databases, and local code environments.	4, 9
CO3	Develop multi-agent systems and agentic RAG workflows using frameworks like smolagents, LangGraph, or LlamaIndex.	9
CO4	Fine-tune models for function-calling and evaluate agent performance using modern observability and testing protocols.	9, 10

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	1	-	-	-	-	-	-	2	2	2
CO2	2	2	3	2	3	-	-	1	-	-	-	2	3	3
CO3	3	3	3	3	3	-	-	-	2	1	-	3	3	3
CO4	3	3	2	3	3	-	-	2	-	-	-	2	3	2

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.



4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit 1	**Foundations of Agentic Intelligence & The ReAct Framework**	**6 Hours**	**SDGs**
Focus: Transitioning from static LLM prompting to dynamic, loop-based reasoning.Core Concepts:The anatomy of an Agent: Core LLM, System Prompts, Chat Templates, and Special Tokens.The Thought -- Action --Observation loop.Deep dive into the ReAct (Reason + Act) paradigm.Building custom programmatic "Tools" via Python function parsing and docstring extraction.			**4, 9**
Unit 2	**Code-Executing Agents & smolagents**	**8 Hours**	
JSON/Text Tool-calling versus Code Execution modalities. The smolagents architecture (CodeAgent vs. ToolCallingAgent). Secure runtime sandboxing and state management for dynamic code execution. Multi-step autonomous tool creation.			**9**
Unit 3	Agentic RAG & Knowledge Retrieval	**8 Hours**	
Schedulability problem, Classification of real-time tasks, Schedulability tests , Worst Case Execution Time (WCET), Static scheduling, Dynamic scheduling, Dependent and independent tasks			**9, 11**
Unit 4	Data Driven Agents and Agentic RAGs	**8 Hours**	
Static RAG versus Agentic RAG. Semantic routing, document indexing, and vector database integration. Advanced query pipelines: Sub-question decomposition and query rewriting. Data Agents: Direct SQL database querying and structured API interaction.			**5, 10**
Unit 5	Multimodal Agents, Web Automation, & SLM Optimization	**8 Hours**	
Vision-Language Models (VLMs) as agent drivers. Web Browser Automation: DOM tree parsing and element bounding boxes. Fine-tuning Small Language Models (SLMs) for strict syntax and function calling. Local agent deployment using Ollama backends.			**9**
Unit 6	**Benchmarking, Safety, & Observability**	**6 Hours**	
Evaluation frameworks: GAIA and SWE-bench benchmarks.			**9, 10, 11**

Text Books:

https://huggingface.co/agents-course
1. Generative AI Systems: Architecture and Engineering". Tom Taulli (O'Reilly Media)
2. "Building Intelligent Systems: A Guide to Machine Learning Engineering". Geoff Hulten (Apress)

Reference Books:

Supplementary Technical References
1. "Natural Language Processing with Transformers: Building Language Applications with Hugging Face". Lewis Tunstall, Leandro von Werra, and Thomas Wolf (O'Reilly Media)
2. "Designing Data-Intensive Applications" Martin Kleppmann (O'Reilly Media)



Course Code:	23CSEU8P02
Course Name:	Agentic AI Lab

L	T	P	Credit
		2	1

Course Prerequsites:

Proficiency in Python Programming (functions, object-oriented concepts, and basic error handling). Foundational understanding of Generative AI & LLMs (tokenization, prompting, API-based model consumption). Basic acquaintance with data libraries (Pandas) and databases (SQL) is helpful but not strictly required.

Course Description:

This hands-on laboratory course introduces students to the architecture, design patterns, and implementation of Agentic AI and multi-agent systems. Moving beyond static Large Language Model (LLM) prompts, students will learn to build autonomous systems capable of reasoning, planning, tool execution, and collaborative problem-solving. Utilizing industry-standard frameworks such as CrewAI, LangGraph, AG2 (AutoGen), and PydanticAI, students will design, debug, and deploy state-driven AI agents tailored for real-world domains like automated software workflows, data exploration, healthcare, and customer support.

Course Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	CO1 (Analyze & Design): Evaluate business and technical workflows to break them down into state-driven, multi-agent architectures using appropriate design patterns (sequential, routing, parallel).	4
CO2	CO2 (Implement & Orchestrate): Build and configure autonomous AI agents that successfully call external APIs, execute custom Python/SQL tools, and manage structured schema inputs safely.	4, 9
CO3	CO3 (Evaluate & Optimize): Implement self-reflection and multi-agent collaboration mechanisms to debug, critique, and optimize the quality of autonomous AI outputs.	9

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		2	3								2	1
CO2	2	3	2	3	3								3	3
CO3	2	3	2	3	3								3	3

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	Internal Evaluation	100%	Assignment, Test, Quiz, Seminar, Presentation, etc.

List of Experiments:		SDGs
1	Lab 1: Fundamentals of Autonomous Reasoning & ReAct — Implement the foundational thought-action-observation loop from scratch using raw Python.	4
2	Lab 2: Precision Tool-Calling & Input Validation — Bind functional math and logic tools to an LLM with strict error-handling defenses.	4, 9
3	API Integration & Web Content Extraction — Build an agent that securely pulls, parses, and summarizes live data from external web services.	9
4	Conversational SQL & Data Exploration — Create an AI data assistant that translates natural language queries into executable SQL commands.	9
5	State Management & Routing with LangGraph — Design a graph-based agent architecture with structured state transitions and conditional routing logic.	9
6	Multi-Agent Choreography with CrewAI — Orchestrate a team of role-specific agents wrapped in a front-end UI to handle complex, multimodal tasks.	9
7	Schema-Driven Design with PydanticAI — Enforce enterprise-grade data guardrails on agent inputs and outputs using strict Pydantic data schemas.	9
8	Self-Reflective Loops & Collaborative Research — Deploy a multi-agent system featuring automated self-critique nodes to iteratively optimize output quality.	9

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KOLHAPUR

Course Code:	23CSEU8E04
Course Name:	Real Time Operating Systems

L	T	P	Credit
2			2

Course Prerequsites:

Basic knowledge of Computer Organization, Programming in C, and Fundamentals of Operating Systems.

Course Description:

This course covers the fundamentals of Operating Systems with a focus on Real-Time Operating Systems, including RTOS concepts, scheduling techniques, schedulability analysis, and comparison of popular RTOS platforms for real-time system design.

Course Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	Explain the fundamentals of Operating Systems and Real-Time Operating Systems	4,9
CO2	Apply RTOS concepts such as task management, time management, inter-task communication, interrupt handling and scheduling techniques in real-time systems	4,9
CO3	Compare features of FreeRTOS, RT Linux, and commercial RTOS.	9,17

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2			1					2		2	1	
CO2	2	3	2	2	2				2	2		1	1	2
CO3	1	3	2	3	3							2	1	3

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	End Semester Examination (ESE) [50 marks]	100% (50 Marks)	100% course contents

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Course Contents:			SDGs
Unit 1	**Introduction**	**6 Hours**	4,9
Introduction to Operating Systems, Real-Time Systems: definition,Structure and characteristics, Types of Real-Time Systems (Hard and Soft), Real-Time Operating System (RTOS): concept and need, General Purpose OS vs RTOS, Basic components of RTOS, Applications of RTOS			
Unit 2	**RTOS Fundamentals**	**8 Hours**	4,9
Task management, Task creation and deletion, Task states and task control ,Time management in RTOS, Inter-task communication basics, Exceptions and interrupt handling.			
Unit 3	**Introduction to real-time scheduling**	**8 Hours**	9
Schedulability problem, Classification of real-time tasks, Schedulability tests , Worst Case Execution Time (WCET), Static scheduling, Dynamic scheduling, Dependent and independent tasks			
Unit 4	**Features of FreeRTOS and Linux**	**6 Hours**	9,17
Features and application of Commercial real time operating systems: PSOS, VRTX, RT Linux			

Text Books:

1. Real-Time Concepts for Embedded Systems by Qing Li and Caroline Yao
2. Embedded Real-Time Systems: Concepts, Design & Programming by Dr. K.V.K.K. Prasad
3. Operating System Concepts by Abraham Silberschatz, Peter B. Galvin, and Greg Gagne

Reference Books:

1. A Practical Introduction to Real-Time Operating Systems (RTOS) by Douglas Wilhelm Harder, Jeff Zarnett & Vajih Montaghami
2. Real-Time Systems: Theory and Practice by Rajib Mall
3. Real-Time Embedded Systems by Christos Koulamas & Mihai T. Lazarescu
4. Mastering the FreeRTOS Real Time Kernel by Richard Barry
5. Using the FreeRTOS Real Time Kernel: A Practical Guide by Richard Barry

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KOLHAPUR

Course Code:	23CSEU8E05
Course Name:	Deep Learning

L	T	P	Credit
2			2

Course Prerequsites:

Python Programming and Scripting

Course Description:

This course introduces the fundamentals and advanced concepts of Deep Learning, covering machine learning basics, neural network architectures, and optimization techniques. It explores feed-forward networks, backpropagation, CNNs, RNNs, LSTMs, and GRUs for vision and sequence tasks. The course also covers generative models, autoencoders, GANs, and modern deep architectures such as ResNet and GCN, with applications in computer vision, language processing, image captioning, and video analysis.

Course Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	illustrate the basic concepts of linear algebra for Mathematical models and Deep neural network model	4,9
CO2	construct the feed forward network using gradient descent and regularization technique	9
CO3	model the Convolutional neural network and articulate the sequence modelling using Recurrent models for processing high dimensional	9
CO4	design the deep neural network to model computer vision related applications such as object detection, image captioning	9

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2									1	2		
CO2	2	2			2					1	2			
CO3	1	1	2	1	3							1		2
CO4	2	2		1	1								1	2

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

D.Y. PATIL EDUCATION SOCIETY (Deemed to be University) Kasba Bawada, Kolhapur KOLHAPUR

Course Contents:			SDGs
Unit 1	**Introduction**	**7 Hours**	
Introduction to Artificial Intelligence, Machine Learning and Deep Learning. Machine Learning Basics, Learning Algorithms, Supervised Learning and Unsupervised Learning, Linear Algebra for Machine Learning, Historical Trends in Deep Learning, Deep Learning Software Libraries, Introduction to a Simple Deep Neural Network (DNN).			4,9
Unit 2	**Data Preparation and Model Evaluation**	**8 Hours**	
Dimensionality Reduction, Overfitting and Underfitting, Cross-Validation, Hyperparameters, Training Set, Validation Set and Test Set, Estimators, Bias and Variance, Regularization Techniques. Introduction to Deep Feed Forward Networks, Shallow Neural Networks, Deep Neural Networks, Learning XOR Problem, Gradient-Based Learning, Backpropagation Algorithm, Activation Functions, Error/Loss Functions, Architecture Design, Differentiation Algorithms, Hyperparameter Tuning, Batch Normalization.			9
Unit 3	**Sequence Modeling and Autoencoders**	**8 Hours**	
Sequence Modeling, Recurrent Neural Networks (RNNs), Difficulties in Training RNNs, Long Short-Term Memory (LSTM), Gated Recurrent Unit (GRU), Encoder–Decoder Architectures, Applications in Spam Classification and Sentiment Analysis. Autoencoders – Architecture, Undercomplete Autoencoders, Regularized Autoencoders, Stochastic Autoencoders, Denoising Autoencoders, Contractive Autoencoders, Variational Autoencoders (VAE), Applications.			9
Unit 4	**Optimization, GANs and Deep Architectures**	**7 Hours**	
Optimization for Deep Learning, RMSProp for RNNs, SGD for CNNs, Adversarial Generative Networks (GANs), GAN Applications, Deep Architectures in Computer Vision, ImageNet and ImageNet Large Scale Visual Recognition Challenge (ILSVRC), ResNet, Graph Convolutional Networks (GCN), Applications in Image Captioning, Applications in Video Tasks			9

Text Books:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press,
2. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012
3. Michael Nielsen, “Neural Networks and Deep Learning”, Online book, 2016
4. Jason Brownlee, “Deep Learning with Python”, 2016.
5. Aaron Courville, Ian Goodfellow, and Yoshua Bengio, “Deep Learning”, MIT Press, 2015.

Reference Books:

1. Richard S. Sutton and Andrew G. Barto, “Reinforcement Learning: An Introduction”
2. by SethWeidman, “Deep Learning from Scratch: Building with Python from First Principles”O’Reily
3. Francois Duval, “Deep Learning for Beginners, Practical Guide with Python and Tensorflow”

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Course Code:	24CSEU7E06
Course Name:	Digital Forensic and Incident response

L	T	P	Credit
2			2

Course Prerequsites:

Basic knowledge of Computer Networks, Operating Systems, and Cyber Security fundamentals.

Course Description:

This course provides a comprehensive understanding of digital forensic techniques and incident response processes used to investigate cybercrimes. Students will learn evidence acquisition, preservation, analysis, and reporting along with handling real-world security incidents. The course emphasizes logal, ethical and practical aspects of Digital Forensic investigation.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Understand principles and processes of digital forensics.
CO2	Apply forensic tools and techniques for evidence acquisition and analysis.
CO3	Analyze and respond to cybersecurity incidents effectively.
CO4	Prepare forensic reports adhering to legal and ethical standards.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	**SDGs**
CO1	1	2									1	2	1		4, 8, 9,16
CO2	2	2			2					1	2				
CO3	1	1	2	1	3							1		2	
CO4	2	2		1	1								1	2	

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

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Course Contents:			
Unit 1	**Introduction**	**6 Hours**	**SDGs**
Introduction to Digital Forensics, Need and Scope of Digital Forensics, Types of Digital Evidence, Digital Forensics			4,8,9
Unit 2	**Computer and Disk Forensics**	**8 Hours**	
File Systems (FAT, NTFS, EXT), Disk Structure, Data Acquisition Techniques, Disk Imaging and Hashing (MD5, SHA), Deleted File Recovery, Slack Space, Metadata Analysis, Introduction to Forensic Tools.			4,8,9
Unit 3	**Memory and Network Forensics**	**8 Hours**	
Volatile Memory Concepts, RAM Acquisition and Analysis, Malware Indicators in Memory, Network Forensics Overview, Packet Analysis, Network Logs, Intrusion Detection Logs, Traffic Analysis Basics.Mobile Device Forensics Overview, SIM and App Data Analysis, Cloud Forensics Challenges			4,8,16
Unit 4	**Incident Response and Handling**	**8 Hours**	
Incident Response Lifecycle (Preparation, Identification, Containment, Eradication, Recovery, Lessons Learned), Incident Classification, Roles and Responsibilities, Incident Documentation, Evidence Handling during Incidents.Types of Cyber Crimes, Malware Types (Virus, Worm, Trojan, Ransomware),			4,8,9

Text Books:

1. “Guide to Computer Forensics and Investigations” — by Bill Nelson, Amelia Phillips, and Christopher Steuart
2. “Incident Response & Computer Forensics” — by Kevin Mandia, Chris Prosise

“Incident Response & Computer Forensics” — by Kevin Mandia, Chris Prosise

Reference Books:

1. “Computer Forensics: Cybercriminals, Laws, and Evidence” — by Marie-Helen Maras
2. “Practical Forensic Imaging” — by Bruce Nikkel
3. “The Art of Memory Forensics” — by Michael Hale Ligh, Andrew Case, Jamie Levy, AAron Walters

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