

ANDHRA KESARI UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE

MASTER OF COMPUTER SCIENCES (M.Sc.) COURSE

2026-27

AK UNIVERSITY – M.Sc. Course Structure

M.Sc. I Year – I Semester

S. No.	Course Code	Category	Course	Max Marks		Hours Per Week			Credits
				I	E	L	T	P	
1	MS26101	PC	Python Programming	30	70	3	1	0	4
2	MS26102	PC	Database Management Systems	30	70	3	1	0	4
3	MS26103	PC	Computer Networks	30	70	3	1	0	4
4	MS26104	PC	Artificial Intelligence	30	70	3	1	0	4
5	MS26105	PC	Data Mining	30	70	3	1	0	4
6	MS26106	HS-Lab	Communication Skills Lab	50	-	0	0	4	2
7	MS26107	PC-Lab	Python Programming Lab	25	50	0	0	6	3
8	MS26108	PC-Lab	Database Management Systems Lab	25	50	0	0	6	3
			TOTAL	**250**	**450**	**15**	**5**	**16**	**28**

M.Sc. I Year – II Semester

S. No.	Course Code	Category	Course	Max Marks		Hours Per Week			Credits
				I	E	L	T	P	
1	MS26201	PC	Core Java Programming	30	70	3	1	0	4
2	MS26202	PC	Data Structures	30	70	3	1	0	4
3	MS26203	PC	Research Methodology & Intellectual Property Rights (IPR)	30	70	3	1	0	4
4	MS26204A	PE-I	1. Cyber Security Fundamentals	30	70	3	1	0	4
	MS26204B		2. Software Engineering						
	MS26204C		3. Data Science						
5	MS26205A	PE-II	1. Cloud Computing	30	70	3	1	0	4
	MS26205B		2. Computer Forensics						
	MS26205C		3. Distributed Computing						
6	MS26206	HS	Digital Wellbeing	50	-	4	0	0	2
7	MS26207	PC-Lab	Core Java Programming Lab	25	50	0	0	6	3
8	MS26208	PC-Lab	Data Structures Lab	25	50	0	0	6	3
9	MS26209	MC	SWAYAM Courses	-	-	-	-	-	2*
			TOTAL	**250**	**450**	**19**	**5**	**12**	**28**

PC – Program Course

HS – Humanities and Social Sciences

PE – Professional Elective

MC – Mandatory Courses (MOOCs)

*NOTE: The credits assigned for SWAYAM Course (MOOCs Mandatory Course) will not be counted for the GPA.

M.Sc. II Year – III Semester

S. No.	Course Code	Category	Course	Max Marks		Hours Per Week			Credits
				I	E	L	T	P	
1	MS26301	PC	Advance Java Programming	30	70	3	1	0	4
2	MS26302	PC	Machine Learning	30	70	3	1	0	4
3	MS26303	PC	R Programming	30	70	3	1	0	4
4	MS26304A	PE-III	1. Operating System (OS)	30	70	3	1	0	4
	MS26304B		2. Cyber Law						
	MS26304C		3. Cryptography & Network Security						
5	MS26305A	PE-IV	1. WISER – Quantum Foundation and Applied Technologies	30	70	3	1	0	4
	MS26305B		2. Neural Networks & Deep Learning						
	MS26305C		3. Internet of Things (IoT)						
	MS26305D		4. Blockchain Technology						
6	MS26306	PC-Lab	Advance Java Programming Lab	25	50	0	0	6	3
7	MS26307	PC-Lab	Machine Learning Lab	25	50	0	0	6	3
8	MS26308	PC-Lab	R Programming Lab	50	-	0	0	4	2
9	MS26309	MC	SWAYAM Plus Courses	-	-	0	0	0	2*
			Total	**250**	**450**	**15**	**5**	**16**	**28**

M.Sc. II Year – IV Semester

S. No.	Course Code	Category	Course	Max Marks		Hours Per Week			Credits
				I	E	L	T	P	
1	MS26401	PROJ	Major Project	100	200	0	0	36	12
			TOTAL	**100**	**200**	**0**	**0**	**36**	**12**

PC – Program Course

PE – Professional Elective

HS – Humanities and Social Sciences

MC – Mandatory Courses (MOOCs)

*NOTE: The credits assigned for SWAYAM Plus Course (MOOCs Mandatory Course) will not be counted for the GPA.

SEMESTER-I

M.Sc. I Year – I Semester

S. No.	Course Code	Category	Course	Max Marks		Hours Per Week			Credits
				I	E	L	T	P	
1	MS26101	PC	Python Programming	30	70	3	1	0	4
2	MS26102	PC	Database Management Systems	30	70	3	1	0	4
3	MS26103	PC	Computer Networks	30	70	3	1	0	4
4	MS26104	PC	Artificial Intelligence	30	70	3	1	0	4
5	MS26105	PC	Data Mining	30	70	3	1	0	4
6	MS26106	HS-Lab	Communication Skills Lab	50	-	0	0	4	2
7	MS26107	PC-Lab	Python Programming Lab	25	50	0	0	6	3
8	MS26108	PC-Lab	Database Management Systems Lab	25	50	0	0	6	3
			TOTAL	**250**	**450**	**15**	**5**	**16**	**28**

PC – Program Course

PE – Professional Elective

HS – Humanities and Social Sciences

MC – Mandatory Courses (MOOCs)

Python Programming					M.Sc. 1st year 1st semester			
Code	Category	Hours / Week			Credits	MARKS		
		L	T	P	C	Internal	End Exam	Total
MS26101	PC	3	1	0	4	30	70	100

Learning Objectives (LO):

The course is designed to meet the objectives of:

1. LO1: Understand the basics and functions of Python Programming Language.
2. LO2: Understand the string operation and sequences used in Python Programming Languages.
3. LO3: Understand the modules and packages in Python Programming Language.
4. LO4: Understand File operations in Python Programming Language

Course Outcomes (CO):

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

1. CO1: Apply control structures, functions and packages in Problem Solving. (L3)
2. CO2: Analyze various String handling functions and data structures(L4)
3. CO3: Model the object-oriented problems with classes and objects (L4)
4. CO4: Solve the problems by using Inheritance and polymorphism (L3)
5. CO5: Illustrate programs on Exception Handling and various packages(L3)

UNIT I

Problem Solving: Definition and Steps, Problem Analysis Chart, Developing an Algorithm, Flowchart and Pseudo- code. Introduction to python – Interactive and Script Mode – Indentation – Comments – Variables – Reserved Words – Data Types – Operators and their precedence – Expressions – Built-in Functions – Importing from Packages.

UNIT II

Control Structures Decision Making and Branching: if, if-else, nested if, multi-way if-elif statements – Looping: while loop, for loop – else clauses in loops, nested loops – break, continue and pass statements.

Functions and Modules: Declaration and Definition Function Calling, More on Defining Functions, Recursive Functions, Modules, Packages in Python, Doc Strings.

UNIT III

Collection Lists: Create, Access, Slicing, Negative indices, List methods, List comprehensions – Tuples: Create, Indexing and slicing, Operations on tuples – Dictionary: Create, add, and replace values, Operations on dictionaries – Sets: Creation and operations.

Strings and Regular Expressions: String Operations, Built-in String Methods and Functions, Comparing Strings, function in Regular Expression.

UNIT IV

Functions and Files

Functions – Parameters and Arguments: Positional arguments, Keyword arguments, Parameters with default values – Local and Global scope of variables – Functions with Arbitrary arguments – Recursive Functions – Lambda Function. Files: Create, Open, Read, Write, Append and Close – tell and seek methods.

UNIT V

Python NumPy: NumPy ND array, Data Types, Functions of NumPy Array, NumPy Array Indexing, Mathematical Functions on Arrays in NumPy

Python Pandas: Pandas Features, Dataset in Pandas, Data Frames, Manipulating the Datasets, Describing a Dataset, group by Function, Filtering, Missing Values in Pandas, Concatenating Data Frames. Import data from csv file.

Introduction to Matplotlib, Plot, Scatterplot, Introduction to Tkinter, Date and Time Packages.

Prescribed Textbook

1. Ashok Namdev Kamthane, Amit Ashok Kamthane, programming and problem solving with python, 2nd edition, McGrahill, 2020.
2. Reema Thareja, Python Programming using Problem Solving Approach, First Edition, Oxford Higher Eduction,2017
3. James Payne, Beginning Python using Python 2.6 and Python 3,1st Edition

Reference Books

1. Charles Dierach, Introduction to Computer Science using Python,2013
2. https://www.programiz.com/python-programming
3. https://www.javatpoint.com/python-tutorial
4. https://www.geeksforgeeks.org/python-programming-language.

Database Management Systems						M.Sc. 1st year 1st semester		
Code	Category	Hours / Week			Credits	Marks		
		L	T	P	C	Internal	End Exam	Total
MS26102	PC	3	1	0	4	30	70	100

Learning Objectives (LO):

The course is designed to meet the objectives of:

1. LO1: Discuss Database management systems, databases and its applications.
2. LO2: Familiarize the students with a good formal foundation on the relational model.
3. LO3: Outline the various systematic database design approaches.
4. LO4: Describe the concepts of transactions and transaction processing and the issues, techniques related to concurrency and recovery manager.
5. LO5: Explore the File organizations, indexing and hashing mechanisms.

Course Outcomes (CO):

At the end of this Database Management Systems course, students will be able to:

1. CO1: Model Entity-Relationship diagrams for enterprise level databases.
2. CO2: Formulate Queries using SQL and Relational Formal Query Languages.
3. CO3: Apply different normal forms to design the Database.
4. CO4: Summarize concurrency control protocols and recovery algorithms.
5. CO5: Identify suitable Indices and Hashing mechanisms for effective storage and retrieval of Data.

UNIT I

Introduction to Database System Concepts: Database-System Applications, Purpose of Database Systems, View of Data, Database Language, Database Design, Database Architecture, Database Users and Administrators.

Introduction to the Relation Models and Database Design using ER Model: Structure of Relational Databases, Database Schema, Keys, Schema Diagrams, Relational Query Languages, Relational Operations, Overview of the Design Process, The Entity-Relationship Model, Constraints, Entity- Relationship Diagrams- Unary, Binary, ternary, Aggregation.

UNIT II

Introduction to SQL: Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Aggregate Functions, Nested Sub queries.

Formal Relational Query Languages: The Relational Algebra, Tuple Relational Calculus.

UNIT III

Relational Database Design: Features of Good Relational Designs, Atomic Domains and First Normal Form, Functional Dependencies, Closure set of Functional dependencies, Procedure for Computing F+, Boyce Codd Normal form, BCNF Decomposition Algorithm, Third Normal Form, Third Normal Form Decomposition

Algorithm. Transactions: Transaction Concept, A Simple Transaction Model, Storage Structure, Transaction Atomicity and Durability, Serializability.

UNIT IV

Concurrency Control: Lock-Based Protocols, Deadlock Handling, Multiple Granularity, Timestamp-Based Protocols, Validation-Based Protocols.

Recovery System: Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, ARIES, Remote Backup Systems.

UNIT V

File Organization: Fixed and variable length records, Sequential file organization, Data Dictionary, Buffer manager.

Indexing and Hashing: Basic Concepts, Ordered Indices, B+-Tree Index Files, B+-Tree Extensions, Multiple- Key Access, Static Hashing, Extendible Hashing, Comparison of Ordered Indexing and Hashing, Bitmap Indices.

Prescribed Textbook

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Database System Concepts, Sixth Edition, Tata McGraw-Hill 2006.

Reference Books

1. Raghu Rama Kirshna, Johannes Gehrke, Database Management System, Third Edition, TATA MCGraw Hill, 2003.
2. C J Date, A Kannan, S Swamynathan, An Introduction to Database Systems, Eight Edition, Pearson2006
3. P Raja Sekhar Reddy, A Mallikarjuna Reddy, Foundations of Database Management Systems, Lambert Academic Publishing, 2020 (e-Book)
4. https://www.pdfdrive.com/fundamentals-of-database-systems-pdf-e51477130.html

Computer Networks						M.Sc. 1st year 1st semester		
Code	Category	Hours / Week			Credits	Marks		
		L	T	P	C	Internal	End Exam	Total
MS26103	PC	3	1	0	4	30	70	100

Learning Objectives (LO):

The course is designed to meet the objectives of:

1. LO1: Elaborate on the fundamental concepts of computer networks and network models
2. LO2: Interpret the error and flow control mechanisms in the data link layer
3. LO3: Explore the knowledge of various routing algorithms
4. LO4: Describe the transport layer functionalities
5. LO5: Illustrate different application layer functionalities

Course Outcomes (CO):

At the end of this Computer Networks course, students will be able to:

1. CO1: Illustrate the functionalities of various network models and Data Link Layer
2. CO2: Analyze error and flow control mechanisms in the data link layer
3. CO3: Examine various Routing Protocols
4. CO4: Compare various congestion control mechanisms to improve the QoS of networking
5. CO5: Identify the suitable Application layer protocols for specific applications

UNIT I

Introduction: Physical Structures, Network Models-Layered Tasks, OSI model, TCP/IP protocol Suite, Addressing. Data Link Layer: Introduction, Hamming Distance, Cyclic Redundancy Check, Checksum.

UNIT II

Data Link Control: Framing, Flow and Error Control, Noiseless Channels, Noisy Channels, HDLC. Multiple Access: Random Access, Controlled Access, Channelization.

UNIT III

Network Layer: IPV4 and IPV6 address space, Classful and classless Addressing, IPV4 and IPV6 datagram format, Transition from IPv4 to IPv6, Delivery, Forwarding and Routing, Routing protocols: Distance Vector Routing, Link State Routing, Path Vector Routing.

UNIT IV

Transport Layer: Process-to-Process delivery, Transmission control protocol, User datagram protocol, Data traffic, Congestion Control, Quality of Service, Techniques to improve QoS.

UNIT V

Application Layer: Domain Name Space, Distribution of Name Space, DNS in the Internet, Resolution, DNS Messages, Electronic mail, File Transfer Protocol.

Prescribed Textbook

1. Behrouz A Forouzan," Data Communications and Networking", 4th Edition, McGraw-Hill, 2007.

Reference Books

1. Andrew S. Tanenbaum, Computer Networks, Third Edition, Prentice Hall, 2012.
2. William Stallings, Data and Computer Communications, Eight Editions. Pearson Publishers, 2008. http://highered.mheducation.com/sites/0072967757/student_view0/index.html

Artificial Intelligence						M.Sc. 1st year 1st semester		
Code	Category	Hours / Week			Credits	MARKS		
		L	T	P	C	Internal	End Exam	Total
MS26104	PC	3	1	0	4	30	70	100

Learning Objectives (LO):

The course is designed to meet the objectives of:

1. LO1: Summarize overview of artificial concepts
2. LO2: Discuss uniform search and informed search
3. LO3: Demonstrate how to solve the zero sum gain problem
4. LO4: Describe the logic in artificial intelligence and knowledge representation
5. LO5: Elaborate notion of different production and expert systems in AI

Course Outcomes (CO):

At the end of the Artificial Intelligence course, students will be able to:

1. CO1: Describe the concepts and applications of artificial intelligence
2. CO2: Compare uniform search and informed search algorithms
3. CO3: Solve problems using Zero Sum Game algorithms
4. CO4: Represent logic for given problems using facts and rules
5. CO5: Summarize functionalities of production and expert systems

UNIT I

Overview of Artificial Intelligence: Introduction. The Turing Test, Strong AI Versus Weak AI, Identifying Problems Suitable for AI, Applications and Methods, Early History of AI, Recent History of AI to the Present, AI in the New Millennium

UNIT II

Uninformed Search: Introduction: Search in Intelligent Systems, State-Space Graphs, Generate-and-Test Paradigm, Blind Search Algorithms, Implementing and Comparing Blind Search Algorithms

Informed Search: Introduction, Heuristics, Informed Search Algorithms – Finding Any Solution, The Best- First Search, The Beam Search, Additional Metrics for Search Algorithms, Informed Search – Finding an Optimal Solution.

UNIT III

Search Using Games: Introduction, Game Trees and Minimax Evaluation, Minimax with Alpha-Beta Pruning, Variations and Improvements to Minimax, Games of Chance and the Expect minimax Algorithm

Logic in Artificial Intelligence: Introduction, Logic and Representation, Propositional Logic, Predicate Logic – Introduction, Several Other Logics, Uncertainty and Probability

UNIT IV

Knowledge Representation: Introduction, Graphical Sketches and the Human Window, Graphs and the Bridges of Königsberg Problem, Search Trees, Representational Choices, Production Systems, Object Orientation, Frames, Semantic Networks

UNIT V

Production Systems: Introduction, Background, Production Systems and Inference Methods, Production Systems and Cellular Automata, Stochastic Processes and Markov Chains, Basic Features and Examples of Expert Systems

Prescribed Textbook

1. Stephen Lucci, Danny Kopec, Artificial Intelligence in the 21st Century-A Living Introduction, Mercury Learning and Information, Second Edition, 2016

Reference Books

1. Russell, Norvig: Artificial Intelligence, A Modern Approach, Pearson Education, Second Edition, 2004
2. Rich, Knight, Nair: Artificial Intelligence, Tata McGraw Hill, Third Edition, 2009
3. Saroj Kaushik. Artificial Intelligence. Cengage Learning, 2011

Data Mining					M.Sc. 2nd year 2nd semester			
Code	**Category**	**Hours / Week**			**Credits**	**MARKS**		
		L	**T**	**P**	**C**	**Internal**	**End Exam**	**Total**
MS26105	**PC**	3	1	0	4	30	70	100

Learning Objectives (LO):

The course is designed to meet the objectives of:

LO1	understand classical models and algorithms in data warehousing and data mining,
LO2	Enable students to analyze the data, identify the problems, and choose the relevant models and algorithms to apply
LO3	Assess the strengths and weaknesses of various methods and algorithms and to analyse their behavior.
LO4	Conceptualization and summarization of big data, big data computing technologies.
LO5	Demonstrate various challenges in processing Big Data.

Course Outcomes (CO):

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

CO1	Learn implementation of classical algorithms in data mining and data warehousing
CO2	Learn to identify the application area of algorithms, and apply them
CO3	Learning clustering applications and resent works in data mining
CO4	Understand the concepts of map and reduce and functional programming
CO5	Interpret the characteristics of datasets and compare the trivial data and big data for various applications.

UNIT – I

Data Warehouse: An Overview, What is Data Warehouse? Data warehouse Architecture - From Data Warehousing to Data Mining

OLAP Technology: A Multidimensional Data Model-Online Analytical Processing, OLAP Operations, ROLAP, HOLAP, MOLAP.

UNIT – II

Data mining – Introduction, Data mining on what kind of data, Data mining functionalities, classification of Data mining systems, Major issues in Data mining.

Mining Association rules in large databases - Association rule mining, Mining single-Dimensional Boolean association rules from Transactional databases, Mining multi-Dimensional Association rules from relational Databases and Data Warehouses.

UNIT – III

Classification and Prediction - Introduction classification by decision tree induction, Bayesian Classification. Other classification methods, classification by back propagation, Prediction, classifier accuracy

UNIT – IV

Cluster analysis – Introduction types of data in cluster analysis a categorization of major clustering methods portioning methods, hierarchical methods, Density based methods, DBSCAN, Grid-based method STRING, Model based clustering method Statistical Approach, outlier analysis.

UNIT – V

Big Data Introduction – distributed file system – Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications.

Hadoop: Hadoop Architecture, Hadoop Storage HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read., Hadoop MapReduce paradigm. Writing Hadoop MapReduce Programs

Prescribed Textbooks

1. Jiawei Han Micheline Kamber, “Data mining & Techniques”, Morgan Kaufmann publishers
2. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN 9788126551071, 2015.
3. Chris Eaton, Dirk deroos et al., “Understanding Big data”, McGraw Hill, 2012.

Tom White, “HADOOP The definitive Guide”, O Reilly 2012.

Communication Skills Lab						M.Sc. 1st year 1st semester		
Code	Category	Hours / Week			Credits	Marks		
		L	T	P	C	Internal	End Exam	Total
MS26106	HS-Lab	0	0	4	2	50	-	50

Course Description

The course aims at preparing the students with the tools needed for successful communication at the professional front. It is designed to improve students' academic and professional skills which the employers are currently looking for.

Learning Objectives (LO):

LO: The course is designed to meet the objective of preparing the students to use the language effectively in all professional pursuits.

Course Outcomes (CO):

At the end of this Computer Networks course, students will be able to:

1. CO1: Analyze the language use in communicative process
2. CO2: Describe the process and product
3. CO3: Interpret the ideas in group activities
4. CO4: Apply different approaches to comprehend the written text
5. CO5: Write any technical and official correspondence within the framework

UNIT I

Essentials of Communication:

Essentials of Grammar-Rudiments of Communications Skills (Listening, Speaking, Reading, and Writing)-Applied Grammar and Usage- Non-Verbal Communication.

UNIT II

Listening Skills:

Art of Listening- Developing Effective Listening Skills-Process of Listening, Intensive & Extensive Listening Podcasts, Vodcasts (ICT enabled) - Five steps to Active Listening-Effective and Ineffective Listening Skills-Listening & Note- taking

UNIT III

Speaking Skills:

Dynamics of Effective Speaking -Group Discussion-Simulated Presentations, Process & Product Descriptions-Proxemics, Paralinguistic Features

UNIT IV

Reading Skills:

The Art of Effective Reading- Basic steps to Effective Reading-Extensive and Intensive Reading - Approaches to Efficient Reading-Reading Comprehension

UNIT V

Writing Skills:

Art of Condensation-Descriptive Writing Techniques-Writing & Answering Memos, Circulars -Inter & Intra Official Communication -Writing Minutes of Meeting-Netiquette - E-mail & Blog Writing - Note-making

Prescribed Textbook

1. Kumar, Sanjay and Pushpa Lata, Communication Skills, Second edition, Oxford University Press,2015.

Reference Books

1. Adair, John. The Effective Communicator. Jaico Publishing House.1995.
2. Adler, B. Ronald. Communicating at Work (Seventh edition.) McGraw Hill.2004.
3. Aruna, Koneru. Professional Communication. McGraw Hill.2017.
4. Ibbotson, Mark. Cambridge English for Engineering Professionals. Cambridge University.2008.
5. Oxford English for Careers. Oxford University Press.

Python Programming Lab						M.Sc. 1st year 1st semester		
Code	Category	Hours / Week			Credits	MARKS		
		L	T	P	C	Internal	End Exam	Total
MS26107	PC-Lab	0	0	6	3	25	50	75

Course Outcomes (CO):

At the end of this Python Programming Lab course, students will be able to:

1. Develop programs on data types, operators and expressions
2. Apply the data structures in real time scenarios
3. Write programs on strings and functions
4. Implement programs on class and related concepts
5. Solve various exception handling programs and implement the packages

Week 1

Installation and Environment set up of Python & Programs on Data types

Week 2

Programs on Standard I/O, Operators and Expressions

Week 3

Programs on Functions

Week 4

Programs on lists and Tuples

Week 5

Programs on Dictionaries

Week 6

Programs on Strings and string operations

Week 7

Programs on Regular Expressions

Week 8

Programs on class & object, static and instance method implementation

Week 9

Programs on Inheritance and Polymorphism

Week 10

Programs on Stacks and Queues

Week 11

Programs on Exception Handling, Database Connectivity, Executing queries

Week 12

Demonstration of Numpy Package

Week 13

Demonstration of Pandas Package

Week 14

Demonstration of Matplotlib Package and Tkinter Package

Week 15

Demonstration of Date and Time Packages

Note: The above experiments are for indicative purposes only. However, the concerned faculty member can adda few more experiments in addition to the existing. In such cases the concerned faculty member should get the syllabus approved by the BoS.

Database Management Systems Lab						M.Sc. 1st year 1st semester		
Code	Category	Hours / Week			Credits	Marks		
		L	T	P	C	Internal	End Exam	Total
MS26108	PC-Lab	0	0	6	3	25	50	75

Course Outcomes (CO):

At the end of this Lab course, students will be able to:

1. Apply different types of SQL commands to create, manipulate and access data from the database.
2. Construct a database by using various integrity constraints.
3. Develop basic PL/SQL programs.
4. Implement PL/SQL Programs using procedures, functions and cursors.
5. Create a trigger for a given problem.

List of Experiments

Week 1

1. Database user creation, Data definition Language commands, Data Manipulation commands, DataControl Language Commands, Transaction Control Language commands.

Week 2

1. Database Schema for a customer-sale scenario Customer (Cust id: integer, cust_name: string) Item (item_id: integer,item_name: string, price: integer)

Sale (bill_no: integer, bill_data: date, cust_id: integer, item_id: integer, qty_sold: integer) For the above schema, perform the following—

a. Create the tables with the appropriate integrity constraints
b. Insert around 10 records in each of the tables
c. List all the bills for the current date with the customer names and item numbers
d. List the total Bill details with the quantity sold, price of the item and the final amount
e. List the details of the customer who have bought a product which has a price>200
f. Give a count of how many products have been bought by each customer
g. Give a list of products bought by a customer having cust_id as 5
h. List the item details which are sold as of today
i. Create a view which lists out the bill_no, bill_date, cust_id, item_id, price, qty_sold, amount
j. Create a view which lists the daily sales date wise for the last one week

Week 3

2. Database Schema for a Student Library scenario Student (Stud_no : integer,Stud_name: string) Membership (Mem_no: integer,Stud_no: integer)

Book (book_no: integer, book_name:string, author: string) Iss_rec(iss_no:integer, iss_date: date, Mem_no: integer, book_no: integer)

For the above schema, perform the following:

a. Create the tables with the appropriate integrity constraints
b. Insert around 10 records in each of the tables
c. List all the student names with their membership numbers
d. List all the issues for the current date with student and Book names
e. List the details of students who borrowed book whose author is CJDATE
f. Give a count of how many books have been bought by each student
g. Give a list of books taken by student with stud_no as 5
h. List the book details which are issued as of today
i. Create a view which lists out the iss_no, iss _date, stud_name, book name
j. Create a view which lists the daily issues-date wise for the last one week

Week 4

3. Database Schema for a Employee-pay scenario employee (emp_id : integer,emp_name: string) Department (dept_id: integer,dept_name:string)

Paydetails (emp_id : integer,dept_id: integer, basic: integer, deductions: integer, additions: integer, DOJ: date)
Payroll (emp_id : integer, pay_date: date)

For the above schema, perform the following:

Create the tables with the appropriate integrity constraints

a. Insert around 10 records in each of the tables
b. List the employee details department wise
c. List all the employee names who joined after particular date
d. List the details of employees whose basic salary is between 10,000 and 20,000
e. Give a count of how many employees are working in each department
f. Give a name of the employees whose netsalary>10,000
g. List the details for an employee_id=5
h. Create a view which lists out the emp_name, department, basic, deductions, netsalary
i. Create a view which lists the emp_name and his netsalary

Week 5

4. Database Schema for a Video Library scenarioCustomer (cust_no: integer,cust_name: string) Membership (Mem_no: integer, cust_no: integer)

Cassette (cass_no:integer, cass_name:string, Language: String) Iss_rec(iss_no: integer, iss_date: date, mem_no: integer, cass_no: integer)For the above schema, perform the following—

a. Create the tables with the appropriate integrity constraints
b. Insert around 10 records in each of the tables
c. List all the customer names with their membership numbers
d. List all the issues for the current date with the customer names and cassette names

e. List the details of the customer who has borrowed the cassette whose title is " The Legend"

f. Give a count of how many cassettes have been borrowed by each customer

g. Give a list of books which has been taken by the student with mem_no as 5

h. List the cassettes issues for today

i. Create a view which lists outs the iss_no, iss_date, cust_name, cass_name

j. Create a view which lists issues-date wise for the last one week

Week 6

5. Database Schema for a student-Lab scenarioClass (class_no: string,descrip: string)

Student (stud_no: integer, stud_name: string, class_no: string) Lab (mach_no: integer, Lab_no: integer, description: String)

Allotment (Stud_no: Integer, mach_no: integer, dayof week: string)

For the above schema, perform the following:

a. Create the tables with the appropriate integrity constraints

b. Insert around 10 records in each of the tables

c. List all the machine allotments with the student names, lab and machine numbers

d. List the total number of lab allotments day wise

e. Give a count of how many machines have been allocated to the 'CSIT' class

f. Give a machine allotment etails of the stud_no 5 with his personal and class details

g. Count for how many machines have been allocatedinLab_no1 for the day of the week as "Monday"

h. How many students class wise have allocated machines in the labs

i. Create a view which lists out the stud_no, stud_name, mach_no, lab_no, dayofweek

j. Create a view which lists the machine allotment details for "Thursday".

Week 7

6. Write a program to find the largest number from the given three numbers.
7. Simple programs using loop, while and for iterative control statements.
8. Write a program to check whether the given number is Armstrong or not
9. Write a program to generate all prime numbers below 100.

Week 8

10. Write a program to demonstrate the GOTO statement.
11. Write a program to demonstrate %type and %row type attributes

Week 9

12. Write a program to demonstrate predefined exceptions
13. Write a program to demonstrate user defined exceptions
14. Create a cursor, which displays all employee numbers and names from the EMP table.

Week 10

15. Create a cursor, which update the salaries of all employees who works in deptno 10.
16. Create a cursor, which displays names of employees having salary > 50000.

Week 11

17. Create a procedure to find reverse of a given number
18. Create a procedure to update the salaries of all employees whose salary is between 25000 to50000

Week 12

19. Create a procedure to demonstrate IN, OUT and INOUT parameters
20. Create a function to check whether a given string is palindrome or not.

Week 13

21. Create a function to find the sum of salaries of all employees working in depart number 10.
22. Create a trigger before/after update on the employee table for each row/statement.

Week 14

23. Create a trigger before/after delete on the employee table for each row/statement.
24. Create a trigger before/after insert on the employee table for each row/statement.

Week 15 Review

Prescribed Textbooks

1. Ivan Bayross, SQL, PL/SQL, The programming Language of Oracle, 3rd Revised Edition, BPB Publications, 2008.

Note: The above experiments are for indicative purposes only. However, the concerned faculty member can add a few more experiments in addition to the existing. In such cases the concerned faculty member should get the syllabus approved by the BoS.

SEMESTER-II

M.Sc. I Year – II Semester

S. No.	Course Code	Category	Course	Max Marks		Hours Per Week			Credits
				I	E	L	T	P	
1	MS26201	PC	Core Java Programming	30	70	3	1	0	4
2	MS26202	PC	Data Structures	30	70	3	1	0	4
3	MS26203	PC	Research Methodology & Intellectual Property Rights (IPR)	30	70	3	1	0	4
4	MS26204A	PE-I	1. Cyber Security Fundamentals	30	70	3	1	0	4
	MS26204B		2. Software Engineering						
	MS26204C		3. Data Science						
5	MS26205A	PE-II	1. Cloud Computing	30	70	3	1	0	4
	MS26205B		2. Computer Forensics						
	MS26205C		3. Distributed Computing						
6	MS26206	HS	Digital Wellbeing	50	-	4	0	0	2
7	MS26207	PC-Lab	Core Java Programming Lab	25	50	0	0	6	3
8	MS26208	PC-Lab	Data Structures Lab	25	50	0	0	6	3
9	MS26209	MC	SWAYAM Courses	-	-	-	-	-	2*
			TOTAL	**250**	**450**	**19**	**5**	**12**	**28**

PC – Program Course

PE – Professional Elective

HS – Humanities and Social Sciences

MC – Mandatory Courses (MOOCs)

*NOTE: The credits assigned for SWAYAM Course (MOOCs Mandatory Course) will not be counted for the GPA.

Core Java Programming						M.Sc. 1st year 2nd semester		
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
		L	**T**	**P**	**C**	**Internal**	**End Exam**	**Total**
MS26201	**PC**	3	1	0	4	30	70	100

Learning Objectives (LO):

The course is designed to meet the objectives of:

1. LO1: Impart knowledge of core language features of Java
2. LO2: Appraise the concepts of Inheritance and Packages
3. LO3: Elaborate the use of Exceptions and collection frameworks in Java
4. LO4: Familiarize Event Handling and Applets
5. LO5: Emphasize GUI based application development

Course Outcomes (CO):

At the end of this Object-Oriented Programming course, students will be able to:

1. CO1: Appraise the basic concepts of java
2. CO2: Implement inheritance and polymorphism
3. CO3: Identify usage of collection framework and build multi-threaded applications
4. CO4: Design Applets by using Event Handling features
5. CO5: Implement Graphical User Interface applications using Swings

UNIT I

Java Basics: History of Java, Java buzzwords, data types, variables, scope and lifetime of variables, arrays, operators, expressions, control statements, simple java program, concepts of classes, objects, constructors, methods, access control, this keyword, static keyword, Garbage collection, Overloading methods and constructors, parameter passing.

UNIT II

Inheritance: Introduction, forms of inheritance- specialization, specification, construction, extension, limitation, combination, Member access rules, super uses, using final with inheritance.

Polymorphism: Method overriding, Abstract classes, Object class

Packages and Interfaces: Defining, Creating and Accessing a Package, importing packages, differences between classes and interfaces, File, Byte Streams, Character Streams

UNIT III

Exception Handling - Concepts of exception handling, exception hierarchy, usage of try, catch, throw, throws and finally, built in exceptions, creating own exception subclasses.

Package java.util- The Collection Interfaces, The Collection classes: LinkedList Class, HashSet Class. TreeSet Class, String Tokenizer, Date, Random, Scanner.

Multi-Threading: Differences between multithreading and multitasking, thread life cycle, creating threads, thread priorities, synchronizing threads, inter thread communication.

UNIT IV

Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes.

Applets – Concepts of Applets, differences between applets and applications, life cycle of an applet, create applets, passing parameters to applets.

UNIT V

GUI Programming with Swing – Introduction, limitations of AWT, MVC architecture, components, containers. Understanding Layout Managers, Flow Layout, Border Layout, Grid Layout, Card Layout, Gridbaglayout.

Creating a Swing Applet, Painting in Swing, A Paint example, Exploring Swing Controls- JLabel and ImageIcon, JTextField, The Swing Buttons, JButton, JToggleButton, JCheckBox, JRadioButton, JTabbedPane, JScrollPane, JList, JComboBox, Swing Menus, Dialogs.

Prescribed Textbook

1. Herbert Schildt, Java - The Complete Reference, Seventh edition, Tata McGraw Hill, 2006.

Reference Books

1. Bruce Eckel, Thinking in Java, Fourth Edition, Prentice Hall, 2006.
2. Y. Daniel Liang, Introduction to Java programming, Tenth Edition, Pearson education, 2014.

Data Structures						M.Sc.1st year 2nd semester		
Code	Category	Hours / Week			Credits	MARKS		
MS26202	PC	L	T	P	C	Internal	End Exam	Total
		3	1	0	4	30	70	100

Learning Objectives (LO):

The course is designed to meet the objectives of:

1. LO1: Appraise the fundamental concepts of data structures and their representations
2. LO2: Describe the applications of non-linear data structures
3. LO3: Summarize the concepts of Advanced Trees
4. LO4: Discuss the implementation of various Graph representations and traversals
5. LO5: Outline the basic concepts of Hashing and Collision resolution Techniques

Course Outcomes (CO):

At the end of this Data Structures course, students will be able to:

1. CO1: Summarize Static and Dynamic data structures in implementing Stack applications
2. CO2: Implement Tree traversal algorithms in solving real time applications
3. CO3: Analyze the concepts of Advanced Trees to generate search efficiently
4. CO4: Interpret the importance of Graphs in solving real time applications
5. CO5: Apply the concepts of hashing

UNIT I

Introduction: What is data structure, Types of data structures, Static and Dynamic representation of data structure and comparison. Stacks-Definition, Operations, Implementation of stacks using arrays, Applications of stacks – Representation and evaluation of expressions using Infix, Prefix and Postfix, Algorithms for conversions and evaluations of expressions from infix to prefix and postfix using stack, Towers of Hanoi, Parenthesis checker.

Queues- Definition, Operations, Implementation of queues using arrays, Applications of queues

UNIT II

Linked Lists: Introduction to Linked List, Operations on Single Linked List (search, Insertion &Deletion)

Trees: Basic terminology, Types of trees: Binary Tree: terminology, Complete and Full Binary Tree, Extended Binary Trees, Threaded Binary Trees-Inorder Threading. Representation of Trees using Arrays and Linked lists (advantages and disadvantages). Tree Traversal and Representation of Algebraic expressions; Algorithms for Tree Traversals. Heaps: Introduction, Types of Heaps – Min binary heap, Max binary heap.

UNIT III

Advanced concepts on Trees: Representation and Creation of Binary Search Trees (BST), Algorithm for inserting, deleting and searching in BST. Representation and advantages of AVL Trees, Algorithms on AVL Trees-Insertion, Rotation and Deletion. Definition and advantages of B-trees, B Tree of Order M, operations-Insertion and Searching, Introduction to Red-Black Trees and Splay Trees.

UNIT IV

Graphs: Basic terminology, Representation of Graphs: sequential representation (Adjacency, Path Matrix) Linked representation.

Graph Traversals-Breadth First Search, Depth First Search with algorithms. Definition and properties of Spanning Tree, Minimum Spanning Tree, Minimum Spanning Tree Algorithms, Dijkstra Algorithms.

UNIT V

Hashing: General Idea, Hash Functions, Collision Resolution- Separate Chaining, Open Addressing-Linear probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing, Implementation of Dictionaries.

Prescribed Textbook

1. Richard F. Gillberg & Behrouz A. Forouzan, Data Structures, A Pseudo code Approach with C, Second Edition, Cengage Learning, India Edition, 2005

Reference Books

1. Seymour Lipschutz, Schaum's Outlines, Data Structures, Special Second Edition, Tata McGraw-Hill,2014.
2. Aaron M. Tanenbaum, Yedidyah Langsam and Moshe J. Augenstein, Data Structures Using C and C++, PHI Learning Private Limited, Delhi India, 2001.
3. Horowitz and Sahani, Fundamentals of Data Structures, Galgotia Publications Pvt Ltd. Delhi India,2015.
4. A.K. Sharma, Data Structure Using C, Pearson Education India, 2011

Research Methodology & Intellectual Property Rights (IPR)						M.Sc. 1st year 2nd semester		
Code	Category	Hours / Week			Credits	Marks		
		L	T	P	C	Internal	End Exam	Total
MS26203	PC	3	1	0	4	30	70	100

Course Description and Purpose:

The aim of this course is to develop research bent of mind (spirit of inquiry) and impart research skills to all Post graduate students. It also encompasses the series of research methodology contents: from problem formulation, to design, to data collection, analysis, reporting and dissemination. This course also covers intellectual property rights (IPR) and is intended to equip students with conceptual understanding of current scenario of IPR, and the practical issues encountered in filing patents, trademarks and copyrights.

Learning Objectives (LO):

- LO1: To understand some basic concepts of research and its methodologies
- LO2: To develop an understanding of the basic framework of research processes.
- LO3: To develop an understanding of various research designs and techniques.
- LO4: To identify various sources of information for literature review and data collection.
- LO5: Ability to write a research Proposal, report and thesis
- LO6: To demonstrate knowledge and understanding of IPR Filing and Rights

Course Learning Outcomes (CO):

Upon successful completion of the course, the student will be able to:

- CO-1: Understand some basic concepts of research and its methodologies
- CO-2: Identify appropriate research topics
- CO-3: Select and define appropriate research problems and parameters
- CO-4: Demonstrate the ability to choose methods appropriate to research aims and objectives
- CO-5: Have adequate knowledge on measurement & scaling techniques
- CO-6: Have basic awareness of data analysis-and hypothesis testing procedures

UNIT I

Foundations of Research

Meaning of Research – Definitions of Research – Motivation in Research – General Characteristics of Research– Criteria of Good Research – Types of Research – Research Process – Research Methods vs. Methodology – Defining and Formulating the Research Problem – Review of Literature – Approaches to Critical Literature Review – Importance of Literature Review in Identifying Research Gaps and Defining a Problem – Development of Working Hypothesis.

UNIT II

Research Design, Sampling Concepts, and Data Collection Methods

Meaning, Significance and Characteristics of Good Research Design – Types of Research Design: Exploratory,

Conclusive Research and Experimental – Sampling Theory: Types of Sampling and Errors in Sampling – Data Collection: Types of Data – Data Collection Methods and Techniques for Primary and Secondary Data.

UNIT III

Measurement & Scaling Techniques, Hypothesis Formulation and Testing, Overview of Data Analysis and Report Writing

Basic measurement scales – Reliability & Validity – Definition and Types of Hypothesis – Hypothesis Formulation and Testing Procedure – Overview of Data Analysis: Methods, Process and Types – Report Writing: Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports – How to Write a Research Proposal, Research Ethics, Conflict of Interest and Plagiarism.

UNIT IV

Intellectual Property Rights (IPR)

Definition and Nature and Features of Intellectual Property Rights (IPR) – Types of Intellectual Property Rights – Procedure for Grants of Patents – Rights of a Patent – Scope of a Patent Rights

–Licensing and Transfer of Technology – Why protection of intellectual property is important?

–Enforcement of IPR – Infringement of IPR.

UNIT V

Indian and International Scenario and New Developments in IPR

IPR Developments in India for the past Five Years – Development of IPR Laws in India – International Cooperation on IPR – New Developments in IPR – Administration of Patent System –International Patent protection – Case Studies in Indian and Global Contexts.

Prescribed Textbooks:

- Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002, An introduction to Research Methodology, RBSA Publishers.
- Cohen, L. Lawrence, M., & Morrison, K. (2005), Research Methods in Education (5thedition). Oxford: Oxford University Press.
- Kothari, C.R., 1990, Research Methodology: Methods and Techniques, New Age International.
- Dornyei, Z. (2007). Research Methods in Applied Linguistics. Oxford: Oxford University Press.
- Anthony, M., Graziano, A.M. and Raulin, M.L., 2009, Research Methods: A Process of Inquiry, Allyn and Bacon.

Cyber Security Fundamentals						M.Sc. 1st year 2nd semester		
Code	Category	Hours / Week			Credits	Marks		
		L	T	P	C	Internal	End Exam	Total
MS26204A	PE-I	3	1	0	4	30	70	100

Learning Objectives (LO):

The course is designed to meet the objectives of:

1. LO1: Summarize major types of cyber-attacks.
2. LO2: Discuss computer malware programs and their impact on the world.
3. LO3: Elaborate firewall and password management.
4. LO4: Describe major cyber-security prevention mechanisms.
5. LO5: Outline Cyber-Security aspects of wireless networks and routers.

Course Outcomes (CO):

At the end of this Fundamentals of Cyber Security course, students will be able to:

1. CO1: Analyze the cyber security needs of an organization.
2. CO2: Design operational and strategic cyber security strategies and policies.
3. CO3: Demonstrate various network security applications.
4. CO4: Analyze software vulnerabilities and security solutions to reduce the risk of exploitation.
5. CO5: Design and develop a security architecture for an organization.

UNIT I

Introduction to Cyber Security Basics, Importance of Cyber Security, Cyber- attacks, objectives of cyber-attacks, Types of Cyber-attacks, Denial of Service (DoS), Distributed Denial of Service (DDoS), Man-in- the-Middle (MITM) Attacks, Crypto jacking, SQL Injection, Spamming, Cyber-terrorism, Digital Property Misappropriation, zero-day exploitation, phishing, digital vandalism, cyber-stalking, cyber frauds and forgery.

UNIT II

Introduction to Cyber-attacks and their impact, Equifax Data Theft, VPN Filter Cyber- attack, WannaCry Ransom Attack, Peta Cyber-attack, US Election Manipulation, Power Grid Hacking, Shadow Network attack, GitHub DDoS Attack, Under Armor Account Hacking, Types of Computer Malware, Viruses, Trojan Horse, Rootkit, Spyware, Worms, Adware, Scare-ware, Browser Hijacker.

UNIT III

Introduction to Computer Security, Firewall Settings, Antivirus Software, Anti-Spyware Software, Anti- Spam Software, Security Updates, Secure Browsing Settings, Scan Devices before Data Transfer, Social Engineering Attack Precautions. Password Management, Basics of Passwords, Threats to Passwords, Good and Bad about Passwords, Hacking Password, Effective Password Management, Creating and Managing Secure Passwords, Strong Password, Use of Biometrics, Two-Factor Authentication, Multi- Factor Authentication, Password Manager Tools.

UNIT IV

Prevention from Cyber-attacks, Algorithms and Techniques, Cyber-attack Detection, Cyber-attack Prediction, Cyber-attack Prevention , Firewalls, Activating Windows Firewall, Windows 10 firewall, Windows 7 firewall, Enabling Windows 7 firewall, Enabling Windows firewall service, Traffic Issues and rules , firewall settings, Intrusion Detection/Prevention Systems, Intrusion Detection System (IDS) , Intrusion Prevention System (IPS), Authentication Using Hash, Message Digest , Secure Hash Algorithm, Multi-Factor Authentication, Activating Two-Factor Authentication, Creating Application Specific Passwords , What If Your Phone with All Apps Enabled Is Lost?, Mac Computer Firewall Configuration, Virtual Private Network.

UNIT V

Introduction to Wireless Security, LAN Vulnerabilities, Reconnaissance Vulnerability, Resource Stealing and Invasion, Rogue Access Points (APs), STA and AP Plain Text Transaction, Denial of Service (DoS),Default AP Configuration, Rogue Insiders, Protocol Vulnerabilities, Ad Hoc Network Mode Security Problems ,Wireless WAN Vulnerabilities ,IoT Vulnerabilities, Wireless Network Security Measures, Modify Default Configuration, Wireless Router Location, Update Router Software, Stronger Encryption Algorithms, MAC Address Filtering, Useful Tips on Safe Use of Wireless Network.

Prescribed Textbook

1. Dr Kutub Thakur Dr Al-Sakib Khan Pathan, Cyber-security Fundamentals Real-World Perspective, first edition published 2020 by CRC Press, © 2020 Taylor & Francis Group, LLC.

Reference Books

1. Rajkumar Singh Rathore, Aatif Jamshed, Mayank Bhusan, Fundamental of Cyber Security Principles and Theory and Practices, BPB Publications, 01-Jun-2018.
2. J. Pieprzyk, T. Hardjono and J. Seberry, Fundamentals of computer security, Springer, 2003.

Software Engineering						M.Sc. 1st year 2nd semester		
Code	Category	Hours / Week			Credits	MARKS		
MS26204B	PE-I	L	T	P	C	Internal	End Exam	Total
		3	1	0	4	30	70	100

Learning Objectives (LO):

The course is designed to meet the objectives of:

1. LO1: Identify an appropriate Process Model.
2. LO2: Deliberate Software Requirements-functional and nonfunctional.
3. LO3: Design various system models for a given scenario.
4. LO4: Elaborate about different testing techniques.
5. LO5: Describe role of risk management in Software Engineering.

Course Outcomes (CO):

At the end of this course, students will be able to:

1. CO1: Analyze process models.
2. CO2: Emphasize Software Requirements -functional and nonfunctional.
3. CO3: Appreciate the system models.
4. CO4: Compare and contrast various testing techniques.
5. CO5: Identify various risk strategies

UNIT I

Introduction to Software Engineering: The evolving role of software, Changing Nature of Software, Software myths. A Generic view of process: Software engineering- A layered technology, a process framework, The Capability Maturity Model Integration (CMMI).

Process models: The waterfall model, Incremental process models, Evolutionary process model. [TB:1, CH:1,2,3]

UNIT II

Agile process Model: Agile principles, Extreme programming, Dynamic System Development Methods, Feature Driven Development, Scrum framework, Sprint, Scrum master, Roles of Scrum Master, Implementing Scrum

- A case study. [TB:1, CH:4]

Software Requirements: Functional and non-functional requirements, the software requirements document. Requirements engineering process: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management. [TB:2, CH:6,7]

UNIT III

System Models: Context Models, Behavioral models, Data models, Object models, structured methods. [TB:2, CH:8]

Design Engineering: Design process and Design quality, Design concepts, the design model. Modeling component level design: design class-based components, conducting component level design. Performing User interface design: Golden rules. [TB:1, CH:9,11]

UNIT IV

Testing Strategies: A strategic approach to software testing, test strategies for conventional software, Black-Box and White-Box testing, Validation testing, System testing.

Product metrics: Software Quality, Metrics for Analysis Model- function based metrics, Metrics for Design Model-object oriented metrics, class-oriented metrics, component design metrics, Metrics for source code, Metrics for maintenance. [TB:1, CH:13,14,15]

UNIT V

Risk Management: Reactive vs. Proactive Risk strategies, software risks, Risk identification, Risk projection, Risk refinement, RMMM, RMMM Plan.

Quality Management: Quality concepts, Metrics for Software Quality, Software Reviews, Formal Technical Reviews, Software Reliability, The ISO 9000 quality standards. [TB:1, CH:25, 26]

Prescribed Textbooks

1. Roger S. Pressman, Software Engineering - A practitioner‘s Approach, 6th edition. McGraw Hill International Edition, 2005.
2. Somerville, Software Engineering, 7th Edition, Pearson Education, 2009.

Reference Books

1. K.K. Agarwal & Yogesh Singh, Software Engineering, New Age International Publishers,3rd edition,2008
2. Pankaj Jalote, An Integrated Approach to Software Engineering, Narosa Publishing House, 3rd edition,2005.
3. James F. Peters, Witold Pedrycz, Software Engineering - an Engineering approach, JohnWiely, 2007.
4. Waman S Jawadekar, Software Engineering Principles and Practice, The McGraw-Hill Companies,2013.
5. https://nptel.ac.in/courses/106/105/106105182/

Data Science						M.Sc. 1st year 2nd semester		
Code	Category	Hours / Week			Credits	Marks		
MS26204C	PE-I	L	T	P	C	Internal	End Exam	Total
		3	1	0	4	30	70	100

Learning Objectives (LO):

The course is designed to meet the objectives of:

1. LO1: Summarize the concepts of Data science
2. LO2: Outline various steps involved in Data science
3. LO3: Discuss data collection and manipulation methods in Data science
4. LO4: Describe how to handle categorical and time series data
5. LO5: Compare various methodologies in data visualization

Course Outcomes (CO):

At the end of this course, students will be able to:

1. CO1: Discuss data science concepts and Process
2. CO2: Handle large data in Single Computer
3. CO3: Manipulate large data using Python Programming language
4. CO4: Analyze large categorical and time series data
5. CO5: Create dashboards to display the data using visualization

UNIT I

Data science in a Big Data World: Benefits and uses of data science and big Data-Facets of data-The data science process-The big data ecosystem and data science. The data science process-Overview of the data science process-Steps: Defining research goals and creating-- Retrieving data. [TB:1, CH:1]

UNIT II

Handling Large Data on a Single Computer: The problem in handling large data-General techniques for handling large volumes of data-General programming tips for dealing with large data sets-Case Studies. [TB:1, CH:2,4]

UNIT III

Data Manipulation with Pandas: Introducing Pandas Objects- Data Indexing and Selection- Operating on Data in Pandas- Handling Missing Data- Hierarchical Indexing- Combining Datasets: Concat and Append- Combining Datasets: Merge and Join- Aggregation and Grouping. [TB:2, CH:3]

UNIT IV

Data Manipulation with Pandas: Pivot Tables- Vectorized String Operations- Working with Time Series- High-Performance Pandas: eval () and query (). [TB:2, CH:3]

UNIT V

Visualization with Matplotlib: Simple Line Plots- Simple Scatter Plots- Visualizing Errors- Density and Contour Plots- Histograms, Binnings, and Density- Customizing Plot Legends- Customizing Colorbars- Multiple Subplots- Text and Annotation- Customizing Ticks- Customizing Matplotlib: Configurations and Stylesheets- Three- Dimensional Plotting in Matplotlib- Geographic Data with Basemap. [TB:2, CH:4]

Prescribed Textbooks

1. Davy Cielen, Arno d. B. Meysman, Mohamed Ali, Introduction to Data Science, Manning Publications,2016.
2. Jake Vanderplas, Python Data science Hand Book, O'Reilly, 2017.

Reference Books

1. Cathy O'neil, Rachel Schutt, Doing Data Science, straight talk from the frontline, O'Reilly, 2013
2. Jure Leskovek, Anand Rajaraman, Jeffry Ullman, Mining of Massive datasets, V2.1, Cambridge University Press, 2014.
3. Joel Grus, Data Science from Scratch: First Principles with Python, first edition, O'Reilly, 2015.

Web References

1. An introduction to data science

   https://www.edureka.co/blog/what-is-data-science/

   https://intellipaat.com/blog/what-is-data-science/

2. **Data collection:**

   http://bigdata-madesimple.com/3-effective-methods-of-data-collection-for-market-research/

3. Data sources:

   https://www.allerin.com/blog/top-5-sources-of-big-data/

   http://tdan.com/combining-data-from-multiple-sources-join-integrate-blend/19877

   https://www.techrepublic.com/blog/big-data-analytics/use-normalization-and-etl-to-get-the-big-dataresults-you-want/

   https://www.youtube.com/watch?v=f0nMfV1GvOg

Cloud Computing					M.Sc. 1st year 2nd semester			
Code	**Category**	**Hours / Week**			**Credits**	**MARKS**		
		L	**T**	**P**	**C**	**Internal**	**End Exam**	**Total**
MS26205A	**PE – II**	3	1	0	4	30	70	100

Learning Objectives (LO):

The course is designed to meet the objectives of:

LO1	The student will learn about the cloud environment, building software systems and components that scale to millions of users in modern internet
LO2	Cloud concepts capabilities across the various cloud service models including Iaas, Paas, Saas
LO3	Developing cloud-based software applications on top of cloud platforms.
LO4	To provide students with a sound foundation of the Cloud Application Architecture
LO5	To gain knowledge on various security issues in cloud architecture.

Course Outcomes (CO):

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

CO1	Understanding the key dimensions of the challenge of Cloud Computing
CO2	Assessment of the economics, financial, and technological implications for selecting cloud computing for own organization
CO3	Obtain knowledge on cloud components, infrastructure and services
CO4	Analyze various cloud application architectures.
CO5	Apply various security measures on cloud architecture in solving real time security issues

UNIT-I

Introduction: Cloud computing at a glance, Historical Developments, Building Cloud Computing Environments, Computing Platforms and Technologies.

Principles of Parallel and Distributed Computing Eras of Computing, Parallel Vs Distributed computing, Elements of Parallel Computing, Elements of Distributed Computing, Technologies for Distributed Computing.

UNIT-II

Virtualization Introduction, Characteristics of Virtualized Environments, Taxonomy of Virtualization Techniques, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples.

Cloud Computing Architecture Introduction, Cloud reference model, Types of clouds, Economics of the cloud, open challenges.

UNIT-III

Aneka Cloud Application Platform Framework Overview, Anatomy of the Aneka Container, Building Aneka Clouds, Cloud programming and Management.

Concurrent Computing Thread Programming Introducing Parallelism for Single machine Computation, Programming Application with Threads, Multithreading with Aneka, Programming Applications with Aneka Threads.

UNIT-IV

High- Throughput Computing Task Programming Task Computing, Task-based Application Models, Aneka Task-Based Programming.

Data Intensive Computing Map-Reduce Programming What is Data-Intensive Computing, Technologies for Data-Intensive Computing, Aneka MapReduce Programming.

UNIT-V

Cloud Platforms in Industry Amazon Web Services, Google App Engine, Microsoft Azure, Observations.

Cloud Applications Scientific Applications, Business and Consumer Applications.

Advanced Topics in Cloud Computing Energy Efficiency in Clouds, Market Based Management of Clouds, Federated Clouds/ Inter Cloud, Third Party Cloud Services.

Prescribed Book

- Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing", Mc Graw Hill Education.

REFERENCES

1. Michael Miller, “Cloud Computing”, Pearson Education, New
2. Haley Beard, Cloud Computing Best Practices for Managing and Measuring Processes for On- demand Computing, Applications and Data Centers in the Cloud with SLAs, Emereo Pty Limited, July 2008.
3. Cloud Application Architectures, George Reese, ISBN 8184047142,Shroff/O' Reilly, 2009.

Computer Forensics					M.Sc. 1st year 2nd semester			
Code	Category	Hours / Week			Credits	MARKS		
		L	T	P	C	Internal	End Exam	Total
MS26205B	PE – II	3	1	0	4	30	70	100

Learning Objectives (LO):

The course is designed to meet the objectives of:

1. LO1: Explain the responsibilities and liabilities of a computer forensic investigator
2. LO2: Plan and prepare for an incident requiring computer forensic skills
3. LO3: Seize a computer from a crime scene without damaging it or risking it becoming inadmissible in a court of law
4. LO4: Explain where digital evidence resides on computer storage devices
5. LO5: Hire experts to perform detailed forensic analysis and expert testimony

Course Outcomes (CO):

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

1. CO1: Understand the role of computer forensics in the business and private world
2. CO2: Identify some of the current techniques and tools for forensic examinations
3. CO3: Describe and identify basic principles of good professional practice for a forensic computing practitioner
4. CO4: Apply forensic tools in different situations.

Unit I

Introduction to Computer Forensics: Computer forensics definitions, Computers' roles in crimes, Computer forensics tasks, Prepare for an investigation, Collect evidence, Preserve evidence, Recover evidence, Document evidence Challenges associated with making "cybercrime" laws, Jurisdictional issues.

Unit II

Computer Crimes: Crimes, Violent crimes where computers are used include terrorism, assault threat, stalking, child pornography, Nonviolent crimes where computers are used include trespass, theft, fraud, vandalism, Where evidence often resides for different types of crimes, Address books, chat logs, e-mail, images, movies, Internet browser history, etc.

Unit III

Computer Criminals: Using evidence to create a crime timeline, Modify Access Create (MAC) dates associated with files, Problems with using these (they don't change in a logical fashion in some cases), Criminals and crime fighters, Understanding "cyber criminals" and their victims, Understanding "cyber investigators.

Unit IV

Building a Cybercrime Case*:* Bodies of law, Constitutional law, Criminal law, Civil law, Administrative regulations, Levels of law, Local laws, State laws, Federal laws, International laws, Levels of culpability, Intent,

Knowledge, Recklessness, Negligence, Level and burden of proof, Criminal versus civil cases, Vicarious liability, Laws related to computers, CFAA, DMCA, CAN Spam, etc.

Unit V

Preserving and Recovering Digital Evidence*:* Disk imaging, Creating a message digest or hash code for a disk, Where data hides; deleted and erased data, File systems, Files, Modify Access Create (MAC) dates to establish timeline, File headers - info about file type

References books

1. Guide to Computer Forensics and Investigations, By Bill Nelson, Amelia Phillips, Christopher Steuart
2. Scene of the Cybercrime, by Debra Littlejohn Shinder.
3. John R. Vacca, Computer Forensics: Computer Crime Scene Investigation, 2nd Edition, Charles River Media, 2005
4. Christof Paar, Jan Pelzl, Understanding Cryptography: A Textbook for Students and Practitioners, 2nd Edition, Springer's, 2010
5. Ali Jahangiri, Live Hacking: The Ultimate Guide to Hacking Techniques & Countermeasures for Ethical Hackers & IT Security Experts, Ali Jahangiri, 2009
6. Computer Forensics: Investigating Network Intrusions and Cyber Crime (Ec-Council Press Series: Computer Forensics), 2010

Student Activity:

1. Collect calls made from a cell tower and analyze them.
2. Trace the IP address of the machine from which you received an email.

Distributed Computing					M.Sc. 1st year 2nd semester			
Code	Category	Hours / Week			Credits	MARKS		
		L	T	P	C	Internal	End Exam	Total
MS26205C	PE – II	3	1	0	4	30	70	100

Learning Objectives (LO):

The course is designed to meet the objectives of:

- LO1: To introduce computation and communication models of distributed systems
- LO2: To illustrate the issues of synchronization and collection of information in distributed systems
- LO3: To describe distributed mutual exclusion and distributed deadlock detection techniques
- LO4: To elucidate agreement protocols and fault tolerance mechanisms in distributed systems
- LO5: To explain the cloud computing models and the underlying concepts

Course Outcomes (CO):

Upon the completion of this course, the student will be able to

- **CO1**: Explain the foundations of distributed systems (K2)
- **CO2**: Solve synchronization and state consistency problems (K3)
- **CO3** Use resource sharing techniques in distributed systems (K3)
- **CO4**: Apply working model of consensus and reliability of distributed systems (K3)
- **CO5**: Explain the fundamentals of cloud computing (K2)

UNIT I

Introduction: Definition-Relation to Computer System Components – Motivation – Message - Passing Systems versus Shared Memory Systems – Primitives for Distributed Communication – Synchronous versus Asynchronous Executions – Design Issues and Challenges; A Model of Distributed Computations: A Distributed Program – A Model of Distributed Executions – Models of Communication Networks – Global State of a Distributed System.

UNIT II

Logical Time: Physical Clock Synchronization: NTP – A Framework for a System of Logical Clocks – Scalar Time – Vector Time; Message Ordering and Group Communication: Message Ordering Paradigms – Asynchronous Execution with Synchronous Communication – Synchronous Program Order on Asynchronous System – Group Communication – Causal Order

– Total Order; Global State and Snapshot Recording Algorithms: Introduction – System Model and Definitions – Snapshot Algorithms for FIFO Channels.

UNIT III

Distributed Mutual exclusion Algorithms: Introduction – Preliminaries – Lamport's algorithm – Ricart Agrawala's Algorithm –– Token-Based Algorithms – Suzuki-Kasami's Broadcast Algorithm; Deadlock Detection in Distributed Systems: Introduction – System Model – Preliminaries – Models of Deadlocks – Chandy-Misra-Haas Algorithm for the AND model and OR Model.

UNIT IV

Consensus and Agreement Algorithms: Problem Definition – Overview of Results – Agreement in a Failure-Free System (Synchronous and Asynchronous) – Agreement in Synchronous Systems with Failures; Checkpointing and Rollback Recovery: Introduction – Background and Definitions – Issues in Failure Recovery – Checkpoint-based Recovery – Coordinated Checkpointing Algorithm - - Algorithm for Asynchronous Checkpointing and Recovery

UNIT V

Definition of Cloud Computing – Characteristics of Cloud – Cloud Deployment Models – Cloud Service Models – Driving Factors and Challenges of Cloud – Virtualization – Load Balancing – Scalability and Elasticity – Replication – Monitoring – Cloud Services and Platforms: Compute Services – Storage Services – Application Services

Prescribed Textbooks

- Kshemkalyani Ajay D, Mukesh Singhal, "Distributed Computing: Principles, Algorithms and Systems", Cambridge Press, 2011.
- Mukesh Singhal, Niranjan G Shivaratri, "Advanced Concepts in Operating systems", McGraw Hill Publishers, 1994.

Reference Books

- George Coulouris, Jean Dollimore, Time Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2012.
- Pradeep L Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.
- Tanenbaum A S, Van Steen M, "Distributed Systems: Principles and Paradigms", Pearson Education, 2007.
- Liu M L, "Distributed Computing: Principles and Applications", Pearson Education, 2004.
- Nancy A Lynch, "Distributed Algorithms", Morgan Kaufman Publishers, 2003.

  Arshdeep Bagga, Vijay Madisetti, "Cloud Computing: A Hands-On Approach", Universities Press, 2014.

Digital Wellbeing						M.Sc.1st year 2nd semester		
Code	Category	Hours / Week			Credits			
MS26206	HS	L	T	P	C	Internal	End Exam	Total
		4	0	0	2	50	-	50

Digital Wellbeing – Credit Course

(Teaching + Case Studies & Co-Curricular Activities)

(Note: Course can a self-study and we can provide video recordings)

Learning Objectives (LO):

LO: To create awareness of digital wellbeing among students and fellow citizens regarding digital wellbeing by educating them in various kinds of frauds, threats and attacks in digital world along with their basic counter measures.

Course Outcomes (CO):

By the end of the course, students will be

1. CO1: Able to gain knowledge regarding cybercrimes and cyber offenses
2. CO2: Able to know how to uncover fake news and how to protect online data
3. CO3: Able to understand cyber bullying, and its counter measures, social media management along with Digital Parenting
4. CO4: Able to gain knowledge in Digital Legal and Ethical Issues
5. CO5: Able to analyze various case studies

UNIT – I Introduction to Digital Wellbeing

a) Introduction to Digital Wellbeing

UNIT – II Digital Security Tools and Techniques

b) Uncovering fake news, Is Privacy is a Myth?

c) Consent & Data Why is it different online.

d) Uncovering Fake News

UNIT – III Digital Safety – Physical & Psychological Wellbeing

e) Cyber bullying,

f) Digital Parenting,

g) Digital Addiction,

UNIT – IV Digital Spirit – Legal and Ethical Issues

h) Cyber Crime against Women and Children,

i) Managing Negative Comments Online,

j) Social Engineering Crimes

k) Digital Intelligence (Tips on Safety)

UNIT – V Case Studies

Case Studies (Mini Cases Example): State of Tamil Nadu vs. Suhas Katti Case, The Slumdog Millionaire Movie Piracy case, Cyber Pornography involving a Juvenile Criminal, Pune Citibank Mphasis call Center fraud, Swedish case of hacking and theft of trade secrets, Indian case of Cybersquatting and different varieties of Social Engineering Crimes and their modus operandi. (Or Any Case Study of Students Choice, A minimum of two case studies each 2000-word document)

Prescribed Textbooks:

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics ad Legal Perspectives – Nina Godbole – Sunit Belapure. Wiley India -2014. (Unit I, V)
2. Uncovering Fake News : ISBN: 978-81-946731-0-1
3. Is Privacy is a Myth?: ISBN: 978-81-946731-4-9
4. Consent & Data Why is it Different Online? : ISBN: 978-81-946731-6-3
5. Cyberbullying : ISBN: 978-81-946731-1-8
6. Digital Parenting : ISBN: 978-81-946731-7-0
7. Digital Addiction : ISBN: 978-81-946731-8-7
8. Cyber Crime Against Women and Children : ISBN: 978-81-946731-2-5
9. Managing Online Negative Comments : ISBN: 978-81-946731-5-6

Co – Curricular Activities:

Students shall perform co-curricular activities like assignments, conducting seminars in government schools, colleges and in neighborhood, group discussions, etc.

Core Java Programming Lab						M.Sc. 1st year 2nd semester		
Code	Category	Hours / Week			Credits	Marks		
		L	T	P	C	Internal	End Exam	Total
MS26207	PC-Lab	0	0	6	3	25	50	75

Course Outcomes (CO):

At the end of this Java Programming Lab course, students will be able to:

1. Implement simple Java Programs
2. Develop the programs using interfaces and packages
3. Demonstrate the use of threads and Exception handling
4. Design Applet programs
5. Develop GUI applications using Swings

List of Experiments

Week 1

1. Write a Java Program to define a class, define instance methods for setting and retrieving values of instance variables and instantiate its object
2. Demonstrate the use of static keyword and this keyword.

Week 2

1. Write a program to illustrate types of constructors and constructor overloading
2. Write a Java program to demonstrate the use of String class and its methods.

Week 3

1. Write a program to illustrate parameter passing Techniques
2. Write a java program to illustrate Recursion and nested class

Week 4

1. Write a program to demonstrate the use of inheritance.
2. Write a java program to demonstrate the concept of polymorphism.

Week 5

1. Write a program to illustrate Files.
2. Demonstrate the use of I/O Streams.

Week 6

1. Write a program to illustrate the use of packages.
2. Write a program to illustrate Interfaces.

Week 7

1. Write a program to illustrate try, catch, throw, throws and finally keywords

2. Write a program to implement the concept of User defined Exceptions.

Week 8

1. Write a program to illustrate Multithreading.
2. Write a program to illustrate thread priorities.

Week 9

1. Write a program to illustrate Thread Synchronization.
2. Write a program to illustrate Inter Thread Communication.

Week 10

1. Write a program to illustrate collection classes and interfaces.
2. Write a program to illustrate String Tokenizer, Date, Random and Scanner classes.
3. Write a program to illustrate Event Handling (keyboard, Mouse events).

Week 11

1. Develop an applet in Java that displays a simple message.
2. Develop an applet in Java that receives an integer in one text field, and computes its factorial Value and returns it in another text field, when the button named “Compute” is clicked.

Week 12

1. Write a program to develop a calculator application using Swings.

Week 13

Review.

Data Structures Lab						M.Sc. 1st year 2nd semester		
Code	Category	Hours / Week			Credits	MARKS		
		L	T	P	C	Internal	End Exam	Total
MS26208	PC-Lab	0	0	6	3	25	50	75

Course Outcomes (CO):

At the end of this Data Structures Lab course, students will be able to:

1. Develop the programs on stacks and its applications
2. Demonstrate the operations on Trees
3. Code the implementation of various advanced trees
4. Design and implementation of programs on BST and Graph Traversals
5. Develop the programs on Hashing and Dictionaries

Week 1

1. Program to implement Stack Operations using arrays and Linked Lists
2. Program to implement Queue Operations using arrays and Linked Lists

Week 2

1. Program to convert infix to postfix notation
2. Program to evaluate postfix notations

Week 3

1. Program to implement towers of Hanoi
2. Program to implement parenthesis checker

Week 4

1. Program to implement Single linked list

Week 5

1. Program to illustrate tree traversals

a) In order b) Preorder c) Post order

Week 6

1. Program to illustrate insertion, deletion and searching in Binary Search Tree

Week 7

1. Program to implement Heaps

a) Min Heap b) Max Heap

Week 8

1. Program to illustrate Insertion on AVL Trees

2. Program to illustrate deletion and Rotation on AVL Trees

Week 9

1. Program to illustrate Graph traversals

a) Breadth First Search

b) Depth First Search

Week 10

1.Program to implement

a) Prim's algorithm b) Kruskal's algorithm

Week 11

1.Program to Implement Dijkstra algorithm

Week 12

1.Program to implement Hashing and collision resolution techniques

Week 13

1.Program to implement Dictionaries

Week 14 Internal Assessment

Note: The above experiments are for indicative purposes only. However, the concerned faculty member can add a few more experiments in addition to the existing. In such cases the concerned faculty member should get the syllabus approved by the BoS.

SWAYAM Courses						M.Sc. 1st year 2nd semester		
Code	Category	Hours / Week			Credits	MARKS		
		L	T	P	C	Internal	End Exam	Total
MS26209	MC	0	0	0	2*	-	-	-

*__NOTE:__ The credits assigned for SWAYAM Courses (MOOCs Mandatory Course) will not be counted for the GPA.

Course Description

This course component develops practical and employment-oriented skills through approved SWAYAM Plus courses. Preference shall be given to offerings related to Artificial Intelligence, Machine Learning, Data Science, Data Analytics, and associated software tools.

Students shall undertake a course that provides suitable practical learning through exercises, case studies, projects, or tool-based activities. The emphasis is on applying knowledge to clearly defined problems and demonstrating the skills acquired.

Learning Objectives (LO):

1. LO1: Develop practical skills relevant to contemporary computing roles.
2. LO2: Strengthen the application of AI, ML, and Data Science tools.
3. LO3: Introducing students to professional workflows and problem-solving practices.
4. LO4: Encourage the creation of demonstrable work and learning portfolios.
5. LO5: Promote responsible, continuous, and employment-oriented learning.

Course Outcomes (CO):

Upon successful completion of the approved course, students will be able to:

- **CO1:** Use the tools and techniques introduced in the selected course.
- **CO2:** Complete relevant practical exercises or case studies.
- **CO3:** Apply acquired skills to a defined computing or data-analysis problem.
- **CO4:** Evaluate the quality, limitations, and responsible use of the resulting solution.
- **CO5:** Demonstrate learning through a portfolio, report, presentation, or viva voce.

Recommended Areas for Course Selection

1. **Applied AI and ML:** Implementing and evaluating machine learning solutions using appropriate programming tools.
2. **Data Analytics and Visualization:** Preparing datasets, analyzing information, creating visualizations, and communicating findings.
3. **Python for AI and Data Science:** Practical programming, data processing, and use of analytical libraries.
4. **Generative AI Applications:** Effective use and evaluation of generative tools, output verification, and responsible application development.
5. **Applied Deep Learning:** Introductory practical work in image, text, or other suitable data domains.

6. **Deployment and Data Workflows:** Introductory model deployment, cloud-based analytical workflows, or related practices appropriate to the student's level.

The detailed instructional content shall be determined by the approved course. The Department should favor offerings with clear learning outcomes, suitable practical content, and verifiable assessment or completion requirements.

Course Selection and Approval

- Students shall select a course with prior departmental approval.
- The selected course should match the students' prerequisites and the intended learning outcomes of the MCA programme.
- Course workload, provider, assessment arrangements, certificate requirements, software access, and any applicable fees shall be reviewed before approval.
- Where both SWAYAM and SWAYAM Plus components occur in the programme, students should choose complementary courses.
- The same learning activity or certificate shall not be counted twice.

Suggested Practical Work

Depending on the selected course, students may undertake one of the following:

- Prepare and analyze a dataset using Python.
- Create an analytical dashboard and explain its findings.
- Build and evaluate a classification or regression model.
- Compare alternative machine learning approaches.
- Develop a small AI-enabled application.
- Demonstrate a text-analysis or image-analysis workflow.
- Document a practical case study using relevant tools.

Where predictive modelling is involved, students should use an appropriate evaluation method and avoid data leakage. Work involving personal or sensitive information shall follow applicable institutional requirements.

Expected Deliverables

- Evidence of enrolment and successful completion
- A brief description of the skills acquired
- Practical exercises, notebooks, source code, dashboards, or other relevant artefacts
- A short application report explaining the problem, method, results, and limitations
- A demonstration or viva-voce as prescribed by the Department

Where the selected course does not include a practical submission itself, the Department may prescribe a proportionate application exercise aligned with its learning outcomes.

Assessment and Recognition

Evaluation should consider successful completion of the approved course and the student's ability to demonstrate the skills acquired. Any departmental assessment, grade conversion, or credit recognition shall follow the University's approved scheme. A provider certificate shall not automatically establish equivalence

to an MCA credit-bearing course.

Recommended Courses and Learning Resources

Students are encouraged to select courses related to Artificial Intelligence, Machine Learning, Data Science, and their programming or mathematical foundations. The following courses are indicative options, subject to availability and prior departmental approval:

1. **Python for Data Analytics, Machine Learning and Generative AI: A Comprehensive Guide**
   Recommended for developing foundations in Python programming, data analysis, machine learning, and generative AI.
   Course link: https://onlinecourses.swayam2.ac.in/imb26_mg130/preview
2. **Data Science Using Python**
   Recommended for learning data preparation, analysis, visualization, and modelling using Python.
   Course link: https://onlinecourses.swayam2.ac.in/ini24_cs02/preview
3. **SWAYAM Course Catalogue**
   Students may identify other suitable courses in Artificial Intelligence, Machine Learning, Data Science, Deep Learning, Natural Language Processing, Computer Vision, Probability, Statistics, and related areas.
   Course catalogue: https://swayam.gov.in/search_courses

Selection and Completion Guidelines

The listed links refer to course offerings and may remain accessible after enrolment closes. The Department shall verify the current offering, prerequisites, syllabus, workload, assessment arrangements, and certification requirements before approving enrolment. Where a listed course is unavailable, an equivalent course in an approved subject area may be selected.

Learning materials, assignments, readings, and references prescribed by the selected course shall form the primary learning resources. Students shall complete the requirements specified by the course provider and submit the evidence prescribed by the Department. Credit recognition, where applicable, shall follow the University's approved regulations.