Mahatma Education Society's

Pillai College of Arts, Commerce & Science (Autonomous)

Affiliated to University of Mumbai

'NAAC Accredited 'A' grade (3 cycles)'
'Best College Award' by University of Mumbai
ISO 9001:2015 Certified

SYLLABUS

Program: Bachelors of Science (B. Sc.) in Computer Science

T.Y.B.Sc.Computer Science

PCACS/BSCCS/SYL/2024-25/TY

As per National Education Policy
Choice Based Credit & Grading System

Academic Year 2024-25

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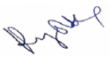
Board of Studies in the Department of Computer Science

Sr. No.	Name of the	Details	Sign
1	Prof. Deepika Sharma	Chairperson (Head of Department of Information Technology & Computer Science), Vice Principal	
2	Dr. Gajanan Wader	Principal	
3.	Mrs.Munawira Kotyad Pillai, Director Pillai Center for Innovation & Research	Management Representative	Absent
4	Dr. Amiya Kumar Tripathy Director Center for GeoAI & ML, Professor, Computer Engineering, Don Bosco Institute of Technology, Mumbai	Subject Expert From Outside Parent University	
5	Dr.Mrs. Anjali Kulkarni CKT College, New Panvel	Vice Chancellor Nominee, University of Mumbai	
6	Mr. Tito Idicula, Director, Programming Hub	Alumni representative	
7	Mr. Anant Baddi, Security Solution Architect, cloud Google Google	Industry Representative (Industry/Corporate/Allied Sector)	Absent
8	Mr. Bhupendra Kesariya Professor,N. M. .College, Vile Parle	Subject Expert in Mathematics From Outside Parent University	
9	Mrs. Anju Somani	Faculty Specialization	

10	Mrs. Shubhangi Pawar	Faculty Specialization	
11	Mrs. Soly Zachariah	Faculty Specialization	
12	Mrs. Ramya S. Kumar	Faculty Specialization	
13	Mrs. Sujata Shahabade	Faculty Specialization	
14	Mrs. Sreevidya T.V.	Faculty Specialization	
15	Mr. Omkar Sherkhane	Faculty Specialization	
16	Mr. Abhijeet Salvi	Faculty Specialization	

1. INTRODUCTION TO BACHELORS IN COMPUTER SCIENCE (C.S.) PROGRAM

B.Sc. in Computer Science is a three years undergraduate programme that concentrates on creating links between theory and practice. Computer science is about understanding computer systems and networks at a deep level. It covers a wide variety of software and hardware technologies and their applications. Students will also gain practical problem solving and program design skills; Students learn how to think more carefully and how to solve problems more effectively. They will not only develop a diverse set of skills to prepare for their curriculum and for employment, but will also be encouraged to launch their own startups or venture into new types of careers using their interdisciplinary training. Our curriculum exposes students to modern advancements and new sub- fields of computer science. As we all know degrees in Computer Science lead to rewarding and lucrative careers, excellent placement and incubation assistance is provided.

Program outcomes

Sr No	PSO Title	POs in brief
PO1	Industry knowledge	Graduates would be fully equipped with the industry relevant domain knowledge.
PO2	Modeling to complex activities.	Apply appropriate techniques, resources, and modern tools including prediction and modeling to complex activities.
PO3	Career opportunities	Graduates would be proficient to take up a career of their choice whether it is corporate leadership, entrepreneurship or higher studies.
PO4	Develop Innovative Ideas	Graduates would be capable of using technology for developing innovative ideas to solve problems.
PO5	Design of conceptual system	Apply mathematical foundations, algorithmic principles, and analysis techniques in the modeling and designing of computational systems
PO6	life- long learning	Engage themselves in lifelong learning to keep up with the pace of changing technology.
PO7	Soft skill Excellence	Graduates would be able to exhibit excellent soft skills and would be competent enough to work in teams to accomplish the desired goal.
PO8	Ethical responsibilities	Take ethical responsibilities, human and professional values and make their contribution to the society.

Program Specific Outcomes

Sr No	PSOs in brief
PSO1	Professionally trained in the areas of programming, multimedia, animation, web designing, Internet of things, networking and mobile app development.
PSO2	Ability to comprehend and write effective project reports in a multidisciplinary environment in the context of changing technologies.
PSO3	Develop an ability to use appropriate techniques, skills and tools required for computing problems.
PSO4	Ability to provide socially acceptable technical solutions to complex computer science problems with the application of modern and appropriate techniques.

Course Structure

	SEMESTER V					
Course Code	**Course Type**	**Course Title**	**Theory/ Practical**	**Marks**	**Credits**	**Lectures /Week**
PUSCS501	Core	Java Framework	Theory	100	2	4
PUSCS502	Core	Advanced Database Management Systems	Theory	100	2	4
PUSCS503	Skill Enhancement	Game Programming / Next Generation Technologies	Theory	100	2	4
PUSCS504 (F)	Discipline Specific Elective	Hybrid Application Development	Theory	100	2	4
PUSCS504 (D)	Discipline Specific Elective	Artificial Intelligence	Theory	100	2	4
PUSCS505	Skill Enhancement	Web Services	Theory	100	2	4
PUSCS506	Skill enhancement	Emotional Intelligence	Theory	50	2	3
PUSCS507	Skill enhancement	Internship	Theory	50	2	2
PUSCS508 P	Practical of Core	Java Framework + Advanced Database Management Systems Practical	Practical	100	2	4

PUSCS509P	Practical of Skill Enhancement	Game Programming +Web Services Practical	Practical	100	2	4
PUSCS510P	Practical of Discipline Specific Elective	Hybrid Application Development / Artificial Intelligence Practical	Practical	50	2	2
	Total			**850**	**20**	
All Subjects having Field Project as part of Continuous Assessment-2						

Course Structure

	SEMESTER VI					
Course Code	**Course Type**	**Course Title**	**Theory/ Practical**	**Marks**	**Credits**	**Lectures/ Week**
PUSCS601	Core	Software Testing & Quality Assurance	Theory	100	2	4
PUSCS602	Core	Cloud Computing	Theory	100	2	4
PUSCS603	Skill enhancement	Android Programming / Hybrid App Development	Theory	100	2	4
PUSCS604 (F)	Discipline Specific Elective	Application Deployment	Theory	100	2	4
PUSCS604 (D)	Discipline Specific Elective	Machine Learning	Theory	100	2	4
PUSCS605	Skill enhancement	Ethical Hacking	Theory	100	2	4
PUSCS606	Skill enhancement	Project	Theory	100	2	4
PUSCS607P	Practical of Core	Cloud Computing + Software Testing & Quality Assurance Practical	Practical	100	2	4
PUSCS608P	Practical of Skill enhancement	Android Programming Practical	Practical	50	2	2
PUSCS609P	Practical of Skill enhancement	Ethical Hacking Practical	Practical	50	2	2

PUSCS610P	Practical of Discipline Specific Elective	Application Deployment /. Machine Learning Practical	Practical	50	2	2
	Total			**850**	**20**	
All Subjects having Field Project as part of Continuous Assessment-2						

Evaluation Pattern

Marking Code	Marking Scheme
A	60 Marks Final Exam, 20 Marks Internal Exam, 20 Marks Project.
B	50 Marks Continuous Exam, 50 Marks Practical Exam.
C	100 marks distributed within report /case study/ project/ presentation etc.
D	50 Marks Practical Examination.

Semester V

Course Code	Course Type	Course Title	Evaluation Pattern
PUSCS501	Core	Java Framework	A
PUSCS502	Core	Advanced Database Management Systems	A
PUSCS503	Skill Enhancement	Game Programming / Next Generation Technologies	A
PUSCS504 (F)	Discipline Specific Elective	Hybrid Application Development	A
PUSCS504 (D)	Discipline Specific Elective	Artificial Intelligence	A
PUSCS505	Skill Enhancement	Web Services	A
PUSCS506	Skill enhancement	Emotional Intelligence	C
PUSCS507	Skill enhancement	Internship	D
PUSCS508P	Practical of Core	Java Framework + Advanced Database Management Systems Practical	D

PUSCS509P	Practical of Skill Enhancement	Game Programming +Web Services Practical	D
PUSCS510P	Practical of Discipline Specific Elective	Hybrid Application Development / Artificial Intelligence Practical	D

SEMESTER VI

Course Code	Course Type	Course Title	Evaluation Pattern
PUSCS601	Core	Software Testing & Quality Assurance	A
PUSCS602	Core	Cloud Computing	A
PUSCS603	Skill enhancement	Android Programming / Hybrid App Development	A
PUSCS604 (F)	Discipline Specific Elective	Application Deployment	A
PUSCS604 (D)	Discipline Specific Elective	Machine Learning	A
PUSCS605	Skill enhancement	Ethical Hacking	A
PUSCS606	Skill enhancement	Project	C
PUSCS607P	Practical of Core	Cloud Computing + Software Testing & Quality Assurance Practical	D
PUSCS608P	Practical of Skill enhancement	Android Programming Practical	D
PUSCS609P	Practical of Skill enhancement	Ethical Hacking Practical	D

PUSCS610P	Practical of Discipline Specific Elective	Application Deployment /. Machine Learning Practical	D

Semester V

BOS	Computer Science
Class	T.Y.B.Sc. C.S.
Semester	V
Course Name	Java Frameworks
Course Code	PUSCS501
Type of course	Advanced
Level of the Subject	Advanced

Course Objectives:

1. Understanding basics of ORM with hibernate framework. And Understanding basic and advanced spring framework.
2. Understanding the nature of problems solved by integrating hibernate and spring.

Unit No.	Name of Unit	Topic No.	Content	Hours
1	Introduction. Transaction Management & Inheritance Mapping	1.1	Introduction: Hibernate Introduction, Hibernate Architecture, Hibernate Environment setup, Hibernate Session, Hibernate SessionFactory, Hibernate .	15
		1.2	Configuration, Hibernate with Hibernate Mapping (XML), Hibernate with Annotation, Hibernate caching. Diff. between save(), saveOrUpdate(), update(), persist() and merge(), Diff. between get() and load()	
		1.3	Transaction Management: Transaction Interface, Example of Transaction Management	

		1.4	Inheritance Mapping : Inheritance Mapping ,Table Per Hierarchy, TPH using Annotation , Table Per Concrete, TPC using Annotation, Table Per Subclass, TPS using Annotation	
2	Mapping, HQL, HCQL & Named Query	2.1	Hibernate Mapping : Collection Mapping, Mapping List, Mapping Set, Mapping Map, One To Many XML ,One To Many Annotation, Many To Many XML, Many To Many Annotation, One To One XML, One To One Annotation, Many To One XML, Many To One Annotation	15
		2.2	HQL: Hibernate Query Language, Query Interface, HQL select, update, and delete queries, HQL with Aggregate functions.	
		2.3	HCQL: Hibernate Criteria Query Language, Criteria Interface, Restrictions class, Order class, HCQL with Projection	
		2.4	Hibernate Named Query: Hibernate Named Query by annotation, Hibernate Named Query by mapping file	

3	Introduction Dependency Injection, Spring AOP	3.1	Introduction: Spring Introduction, spring Architecture, spring environment setup, simple example.	
		3.2	Dependency Injection: IoC container	15
			Dependency Injection, Constructor Injection, CI Dependent Object, CI with collection, CI with Map, , CI Inheriting Bean, Setter Injection, S Dependent Object, SI with Collection, SI with Map, CI vs SI, Autowiring, Factory Method.	
		3.3	Spring AOP: AOP Concepts, Spring1.2 AOP DTD, SP AspectJ Annotation, SP AspectJ XML	
4	Spring JdbcTemplate , Spring ORM & SPEL	4.1	Spring JDBCTemplate: JDBCTemplate Example, PreparedStatement, ResultSetExtractor, RowMapper, NamedParameter, SimpleJdbcTemplate.	15
		4.2	Spring ORM: Spring with ORM, spring with Hibernate.	
		4.3	SPEL : Spring Expression Language, SpEL AP interfaces and classes (Expression interface SpelExpression class, ExpressionParse Interface, SpelExpressionParser class EvaluationContext interface, StandardEvaluationContext class), Operators in SPEL, Variable in SPEL.	
			Total No. of Lectures	**60**

Course Outcomes:

1. Understand the basics of hibernate and hibernate transaction support.

2. Acquire the knowledge about inheritance mapping and collection mapping to establish relationships between tables in the database.
3. Illustrate spring framework over dependency injection, spring AOP.
4. Understand and implement the program for manipulating the data by using hibernate framework (HQL, HCQL , Named Query).
5. Evaluate the role of Spring JdbcTemplate, ORM & SPEL.
6. Develop an application by integrating Hibernate and Spring to solve real world problems.

Referencess:

1. Spring And Hibernate ,Author Spring And Hibernate ,2nd Edition, 2017.
2. Java persistence with Hibernate by Christian Bauer (Author), Gavin King (Author),2nd Edition, 2012.
3. Getting Started With Spring Framework: A Hands-on Guide to Begin Developing Applications Using Spring Framework by J. Sharma (Author), Ashish Sarin (Author),2nd Edition,2014.
4. "Head First Java" by Kathy Sierra and Bert Bates,
5. "Effective Java" by Joshua Bloch
6. "Java: The Complete Reference" by Herbert Schildt.

CASE Studies:

1.AB company has been following a paper based register system for leave management of employees and are now trying to digitize their management system. The new system will let the employee update their leave status digitally . employees can see the leave availability , also number of leaves taken , available and approved..

2. ABC Food Mall has been following the waiter system to take orders from customers and now they are trying to digitize their food ordering system where customers can view the menu using the system , select the required food item with quantity and can order food . by using tablets(iPads) provided on each table. The administration team can view the food items ordered by the customer with quantity and table number..

BOS	**Computer Science**
Class	**T.Y.B.Sc. C.S.**
Semester	**V**
Course Name	**Java Frameworks Practical**
Course Code	**PUSCS508P**
Type of course	**Advanced**
Level of the Subject	**Advanced**

Practical No	Details
1	Design a simple application using hibernate to store records of students into the admission table in the college database.
2	Design an application using hibernates to achieve inheritance mapping by using annotation and xml.
3	Design an application using hibernates to achieve collection mapping by using annotation and xml.
4	Retrieve data by using HQL.
5	Example on HCQL & Named Query.
6	Example on dependency injection in spring.
7	Design a spring application to incept request by using AOP
8	Design a spring application to store records by using JdbcTemplate.
9	Design a spring application to calculate factorial of input number using SPEL .
10	Designs an application by integrating hibernate with spring to store and retrieve employee records from emp table.

BOS	Computer Science
Class	T.Y.B.Sc.C.S
Semester	V
Subject Name	Advanced Database Management System
Subject code	PUSCS502
Level of The Subject	Medium

Course Objectives:

1. To Introduce basic concepts of PL/SQL and To Understand Advanced Database Techniques.
2. Understand the concept of a database transaction and advanced database topics, such as distributed database systems and the data warehouse.

Unit No.	Name of Unit	Topic No.	Content	Hours
1	Fundamentals of PL/SQL	1.1	Introduction to PL/SQL: PL/SQL Overview, Benefits of PL/SQL, SQL Identifiers List the different Types of Identifiers in a PL/SQL subprogram, Identify Scalar Data Types, The %TYPE Attribute, Bind Variables, Sequences in PL/SQL Expressions.	10
		1.2	Write Executable Statements:Describe Basic PL/SQL Block Syntax Guidelines, Comment Code, Deployment of SQL Functions in PL/SQL, Nested Blocks, Identify the Operators in PL/SQL.	
		1.3	Control Structures: Conditional processing Using IF Statements, Conditional processing Using CASE Statements, Use simple Loop Statement,	

			Use While Loop Statement, Use For Loop Statement, Describe the Continue Statement	
2	DBMS with PL/SQL	2.1	Stored Procedures and Functions: Create a Simple Procedures, Create a Simple Procedure with IN parameter, Create a Simple Function, Execute a Simple Procedure, Execute a Simple Function.	10
		2.2	Cursor: Introduction to Cursor ,Types of Cursor,Attributes of Cursor,Cursor FOR loop, Explicit Cursor Attributes, FOR UPDATE Clause and WHERE CURRENT Clause	
		2.3	Exception Handling :Understand Exceptions, Handle Exceptions with PL/SQL, Trap Predefined Oracle Server Errors, Trap Non-Predefined Oracle Server Errors, Trap User-Defined Exceptions,	
3	Advanced Database Techniques	3.1	Package: Components of a Package, Package Specification and Body, Package Constructs,	10
		3.2	Triggers: Concepts of Triggers, Create Trigger, Insert Trigger and Delete Trigger Statement, Statement Level Triggers Versus Row Level Triggers, Create Instead of and Disabled Triggers, Managing Testing and Removing Triggers.	

		3.3	NoSQL Database Concepts: Structured Vs Unstructured data, NoSQL Database concepts:NoSql Databases,NoSql Data Modeling, Benefits of NoSql,Sql Vs NoSql Database Systems.	
4	Advances in Databases	4.1	NoSql Using MongoDB: Introduction to MongoDB Shell,MongoDB Client,Basic Operation with MongoDB Shell,basic datatypes.	10
		4.2	Introduction to Datawarehouse: Characteristics, Types of Datawarehouse, Datawarehouse architecture, Datawarehouse lifecycle,Datawarehouse development.	
		4.3	Introduction to Multimedia Databases ,Mobile Databases ,Digital Databases.	
Total No. of Lectures				**40**

Course Outcomes:

1. Describe fundamental concepts of PL/SQL & Advanced Database Techniques.
2. Explore database Management Systems with PL/SQL..
3. Demonstrate PL/SQL ,Advanced Database Management System Techniques.
4. Apply fundamental concepts of PL/SQL..
5. Manipulate Data using PL/SQL,MongoDB Commands.
6. Research, analyze and use emerging technologies such as NoSQL, On-Line Analytical Processing (OLAP) and Data Warehouses

References:

1. Ramakrishnam, Gehrke, “Database Management Systems”, McGraw- Hill.
2. Ivan Bayross, “SQL,PL/SQL -The Programming language of Oracle”, B.P.B. Publications
3. Michael Abbey, Michael J. Corey, Ian Abramson, Oracle 8i – A Beginner’s Guide, TataMcGraw-Hill.
4. Joel Murach, Murach’s MySQL, Mike Murach & Associates
5. A. Silberschatz, H. Korth, S. Sudarshan, Database system concepts, 5/e, McGraw Hill, 2008

Case Study:

1. XYZ hospital is a multi specialty hospital that includes a number of departments, rooms, doctors, nurses, compounders, and other staff working in the hospital. Patients having different kinds of ailments come to the hospital and get checkup done from the concerned doctors. If required they are admitted in the hospital and discharged after treatment. The aim of this case study is to design and develop a database for the hospital to maintain the records of various departments, rooms, and doctors in the hospital. It also maintains records of the regular patients, patients admitted in the hospital, the check up of patients done by the doctors, the patients that have been operated, and patients discharged from the hospital.

2. The Career Advising Center at a University would like a "Career Advising Website" to be created so they can better manage the student requests for career advising appointments. The Career Advising Center would like to assign appropriate Industry Advisors with students based on career area.
   At various times, the Career Advising Center would want to gather information about the number of advising sessions that took place, the number of advising sessions that took place per career area, the total number of unique students who requested advising sessions (students can request multiple advising sessions during an academic year), the average rating given, or the Industry Advisor who was rated the highest, etc.

BOS	Computer Science
Class	T.Y.B.Sc.C.S
Semester	V
Subject Name	Advanced Database Management System
Subject code	PUSCS508P
Level of The Subject	Medium

Practical No	**Details**
1.	Writing Anonymous PL/SQL Block with basic programming construct by including following: a.Sequential Statements b. unconstrained loop c.% TYPE d.%ROWTYPE
2.	Writing PL/SQL Blocks with basic programming constructs by including following: If...then...Else, IF...ELSEIF...ELSE... END IF Case statement FOR-LOOP WHILE -LOOP
3.	Writing Exception Handling with PL/SQL. a. Exception Types (implicitly raised, Explicitly raised) b. Trapping Exceptions (WHEN exception1, WHEN OTHERS) c. Predefined Exception – NO_DATA_FOUND – TOO_MANY_ROWS – INVALID_CURSOR – ZERO_DIVIDE – DUP_VAL_ON_INDEX

4.	Writing Procedures in PL/SQL Block (IN, OUT, INOUT parameter) a. Create an empty procedure, replace a procedure and call procedure b. Create a stored procedure and call it c. Define procedure to insert data d. A forward declaration of procedure
5.	Writing Functions in PL/SQL Block. a. Define and call a function b. Define and use function in select clause, c. Call function in dbms_output.put_line d. Recursive function e. Count Employee from a function and return value back f. Call function and store the return value to a variable
6.	Writing PL/SQL Block for: a. Declare and use Association Array b. Varray c. Nested Tables
7.	writing PL/SQL Block for Cursors a. Cursor attributes:%ROWCOUNT,%FOUND,%NOTFOUND,%ISOPEN b. Cursor with sub queries c. Combination of PL/SQL, cursor and for loop d. Parameterized cursors, Cursor Variables
8.	Study of transactions and locks.
9.	Creating and Handling Deadlock situations.
10.	Packages 1: a. Working with oracle supplied packages like DBMS_OUTPUT , etc b.Forward Declaration of packages Packages 2: a. Create and invoke a package that contains private and public constructs. b.Implement Package Functions in SQL
11	Study Basics of MongoDB: ● Start the mongo shell ● Quit the mongo shell

	• Display database and collection
	Total no of Lectures:20

BOS	**Computer Science**
Class	**T.Y.B.Sc. C.S.**
Semester	**V**
Course Name	**Next Generation Technologies**
Course Code	**PUSCS503**
Level of the Subject	**Advanced**

Course Objectives:

1. To be familiarized with big data using MongoDB.
2. It helps query large data sets in near real time.

Unit No.	Name of Unit	Topic No.	Content	Hours
1	Big Data NoSQL MongoDB Introduction	1.1	Big Data: Getting Started, Big Data, Facts About Big Data, Big Data Sources, Three Vs of Big Data, Volume, Variety, Velocity, Usage of Big Data, Visibility, Discover and Analyze Information, Segmentation and Customizations, Aiding Decision Making, Innovation, Big Data Challenges, Policies and Procedures, Access to Data, Technology and Techniques, Legacy Systems and Big Data, Structure of Big Data, Data Storage, Data Processing, Big Data TechnologiesI	10
		1.2	NoSQL: SQL, NoSQL, Definition, A Brief History of NoSQL, ACID vs. BASE, CAP Theorem (Brewer's Theorem), The BASE, NoSQL Advantages and Disadvantages, Advantages of NoSQL, Disadvantages of NoSQL, SQL vs. NoSQL Databases, Categories of NoSQL Databases	

		1.3.	Introducing MongoDB: History, MongoDB Design Philosophy, Speed, Scalability, and Agility, Non-Relational Approach, JSON-Based Document Store, Performance vs. Features, Running the Database Anywhere, SQL Comparison	
2	MongoDB Data Model Architecture Shell Programming Storage Engine	2.1	The MongoDB Data Model: The Data Model, JSON and BSON, The Identifier (_id), Capped Collection, Polymorphic Schemas, Object- Oriented Programming, Schema Evolution	10
		2.1	Using MongoDB Shell: Basic Querying, Create and Insert, Explicitly Creating Collections, Inserting Documents Using Loop, Inserting by Explicitly Specifying _id, Update, Delete, Read, Using Indexes, Stepping Beyond the Basics, Using Conditional Operators, Regular Expressions, MapReduce, aggregate(), Designing an Application's Data Model, Relational Data Modeling and Normalization, MongoDB Document Data Model Approach	
		2.3	MongoDB Architecture: Core Processes, mongod, mongo, mongos, MongoDB Tools, Standalone Deployment, Replication, Master/Slave Replication, Replica Set, Implementing Advanced	

			Clustering with Replica Sets, Sharding, Sharding Components, Data Distribution Process, Data Balancing Process, Operations, Implementing Sharding, Controlling Collection Distribution (Tag-Based Sharding), Points to Remember When Importing Data in a ShardedEnvironment, Monitoring for Sharding, Monitoring the Config Servers, Production Cluster Architecture, Scenario 1, Scenario 2, Scenario 3, Scenario 4	
3	MongoDB Use Cases Limitations Best Practices MongoDB connectivity	3.1	MongoDB Storage Engine: Data Storage Engine, Data File (Relevant for MMAPv1), Namespace (.ns File), Data File (Relevant for WiredTiger), Reads and Writes, How Data Is Written Using Journaling, GridFS – The MongoDB File System, The Rationale of GridFS, GridFSunder the Hood, Using GridFS, Indexing, Types of Indexes, Behaviors and Limitations MongoDB Use Cases: Use Case 1 -Performance Monitoring, Schema Design, Operations, Sharding, Managing the Data, Use Case 2 – Social Networking, Schema Design, Operations, Sharding	10

		3.2	MongoDB Limitations: MongoDB Space Is Too Large (Applicable for MMAPv1), Memory Issues (Applicable for Storage Engine MMAPv1), 32-bit vs. 64-bit, BSON Documents, Namespaces Limits, Indexes Limit, Capped Collections Limit - Maximum Number of Documents in a Capped Collection, Sharding Limitations, Shard Early to Avoid Any Issues, Shard Key Can't Be Updated, Shard Collection Limit, Select the Correct Shard Key,	
		3.2	Security Limitations, No Authentication by Default, Traffic to and from MongoDB Isn't Encrypted, Write and Read Limitations, Case-Sensitive Queries, Type- Sensitive Fields, No JOIN, Transactions, MongoDB Not Applicable Range	
		3.3	MongoDB Best Practices: Deployment, Hardware Suggestions from the MongoDB Site, Few Points to be Noted, Coding, Application Response Time Optimization, Data Safety, Administration, Replication Lag, Sharding, Monitoring	

4	In-Memory Databases jQuery JSON	4.1	The End of Disk? SSD and In-Memory Databases: The End of Disk?, Solid State Disk, The Economics of Disk, SSD-Enabled Databases, In-Memory Databases, TimesTen, Redis, SAP HANA, VoltDB, Oracle 12c "in-Memory Database, Berkeley Analytics Data Stack and Spark, Spark Architecture	10
		4.2	jQuery: Introduction, Traversing the DOM, DOM Manipulation with jQuery, Events, Ajax with jQuery, jQuery Plug-ins, jQuery Image Slider	
		4.3	JSON: Introduction, JSON Grammar, JSON Values, JSON Tokens, Syntax, JSON vs XML, Data Types, Objects, Arrays, Creating JSON, JSON Object, Parsing JSON, Persisting JSON, Data Interchange, JSON PHP, JSON HTML, JSONP	
Total No. of Lectures				**40**

Course Outcomes:

1. Describe the concept and challenge of big data and why traditional technology is inadequate to analyze the big data
2. Understand how to collect, manage, store, query, and analyze various form of big data.
3. Identify & learn MongoDB best practices like Replication, Sharding, Monitoring, SSD & In-Memory database.
4. Understand the impact of big data for business decisions and strategy
5. Evaluate the role of JQuery & JSON
6. Develop an application to work with MongoDB database

References:

1. Beginning jQuery (Jack Franklin Russ Ferguson) Apress 2nd
2. Beginning JSON (Ben Smith)Michael Abbey, Michael J. Corey, Ian Abramson, Oracle 8i – A Beginner's Guide, TataMcGraw-Hill.
3. Next Generation Databases NoSQL, NewSQL, and Big Data (Guy Harrison)
4. Practical MongoDB (Shakuntala Gupta Edward Navin Sabharwal) Apress

5. "Head First Java" by Kathy Sierra and Bert Bates, "Effective Java" by Joshua Bloch, and "Java: The Complete Reference" by Herbert Schildt.

Case Studies:

1. A large e-commerce retailer faced challenges in managing its extensive product catalog, which included millions of items across various categories. The existing relational database was struggling to handle the rapidly growing catalog size and complex relationships between products, reviews, and user data. The company decided to explore alternatives and chose MongoDB for its flexibility and performance.
2. A social media platform needed to improve the efficiency and performance of its data management and API communication. The platform's existing data format and communication protocols were causing delays in data retrieval and response times, affecting the user experience. The company decided to standardize its data format using JSON for its flexibility and ease of use.

BOS	Computer Science
Class	T.Y.B.Sc. C.S.
Semester	V
Course Name	Next Generation Technologies Practical
Course Code	PUSCS509P
Level of the Subject	Advanced

Practical No.	**Details**
1.	MongoDB Basics a. Write a MongoDB query to create and drop databases. b. Write a MongoDB query to create, display and drop collection c. Write a MongoDB query to insert, query, update and delete a document.
2.	Simple Queries with MongoDB
3.	Implementing Aggregation a. Write a MongoDB query to use sum, avg, min and max expressions. b. Write a MongoDB query to use push and addToSet expressions. c. Write a MongoDB query to use the first and last expression.

4.	Replication, Backup and Restore a. Write a MongoDB query to create Replica of existing database. b. Write a MongoDB query to create a backup of existing database c. Write a MongoDB query to restore the database from the backup.
5.	Java and MongoDB a. Connecting Java with MongoDB and inserting, retrieving, updating and deleting.

6.	PHP and MongoDB a. Connecting PHP with MongoDB and inserting, retrieving, updating and deleting.
7.	Python and MongoDB a. Connecting Python with MongoDB and inserting, retrieving, updating and deleting.
8.	Programs on Basic jQuery a. jQuery Basic, jQuery Events b. jQuery Selectors, jQuery Hide and Show effects c. jQuery fading effects, jQuery Sliding effects
9.	jQuery Advanced a. jQuery Animation effects, jQuery Chaining b. jQuery Callback, jQuery Get and Set Contents c. jQuery Callback, jQuery Get and Set Contents
10.	JSON a. Creating JSON b. Parsing JSON c. Persisting JSON
11.	Create a JSON file and import it to MongoDB a. Export MongoDB to JSON. b. Write a MongoDB query to delete JSON object from MongoDB

BOS	Computer Science
Class	T.Y.B.Sc.C.S
Semester	V
Subject Name	Game Programming
Subject code	PUSCS503
Level of The Subject	Medium

Course objectives:

1. Students should get the understanding of computer Graphics programming using Directx or Opengl.
2. Students should also be aware of GPU, newer technologies and programming using most important API for windows along with the concept of VR and AR

Unit No.	Name of Unit	Topic No.	Contents	No.of Lectures
1	Mathematics for Computer Graphics	1.1	Cartesian Coordinate system: The Cartesian XY-plane, Function Graphs, Geometric Shapes, Polygonal Shapes, Areas of Shapes, Theorem of Pythagoras in 2D, Coordinates, Theorem of Pythagoras in 3D, 3D Polygons, Euler's Rule	10
		1.2	Vectors: Vector Manipulation, multiplying a Vector by a Scalar, Vector Addition and Subtraction, Position Vectors, Unit Vectors, Cartesian Vectors, Vector Multiplication, Scalar Product, Example of the Dot Product, The Dot Product in Lighting Calculations, The Dot Product in Back-Face Detection, The Vector Product, The Right-Hand Rule, deriving a Unit	
			Normal Vector for a Triangle Areas, Calculating 2D Areas	

		1.3	Transformations:2D Transformations, Matrices, Homogeneous Coordinates, 3D Transformations, Change of Axes, Direction Cosines, rotating a Point about an Arbitrary Axis, Transforming Vectors, Determinants, Perspective Projection, Interpolation	
2	DirectX Pipeline and Programming	2.1	DirectX: Understanding GPU and GPU architectures. How are they different from CPU Architectures? Understanding how to solve by GPU?	10
		2.2	DirectX Pipeline and Programming: Introduction To DirectX 11: COM, Textures and Resources Formats, The swap chain and Page flipping, Depth Buffering, Texture Resource Views, Multisampling Theory and MS in Direct3D, Feature Levels	
		2.3	Direct3D 11 Rendering Pipeline: Overview, Input Assembler Stage (IA), Vertex Shader Stage (VS), The Tessellation Stage (TS), Geometry Shader Stage (GS), Pixel Shader Stage (PS), Output merger Stage (OM), Understanding Meshes or Objects, Texturing, Lighting, Blending.	
3	Interpolation and Character Animation	3.1	Trigonometry: The Trigonometric Ratios, Inverse Trigonometric Ratios, Trigonometric Relationships, The Sine Rule, The Cosine Rule, Compound Angles, Perimeter Relationships	10
		3.2	Interpolation: Linear Interpolant, Non-Linear Interpolation, Trigonometric Interpolation, Cubic Interpolation, Interpolating Vectors, Interpolating Quaternions	
		3.3	Curves: Circle, Bezier, B-Splines	

		3.4	Analytic Geometry: Review of Geometry, 2D Analytic Geometry, Intersection Points, Point in Triangle, and Intersection of circle with straight line.	
4	Introduction to Rendering Engines, Unity	4.1	Introduction to Rendering Engines: Understanding the current market Rendering	10
	Engine, Scripting and XR		Engines. Understanding AR, VR and MR.Depth Mappers, Mobile Phones, Smart Glasses, HMD's	
		4.2	Unity Engine: Multi-platform publishing, VR + AR: Introduction and working in Unity, 2D, Graphics, Physics, Scripting, Animation, Timeline, Multiplayer and Networking, UI, Navigation and Pathfinding, XR, Publishing.	
		4.3	Scripting: Scripting Overview, Scripting Tools and Event Overview	
		4.4	XR: VR, AR, MR, Conceptual Differences. SDK, Devices Other Game Engines: A-Frame (VR), Gamvas, Three.js,PlayN, TOSHI, DX Studio	
		Total No. of Lectures		**40L**

Course Outcomes:

1. Memorize the Cartesian Coordinate systems and Fundamentals of Vectors.
2. Discuss the DirectX and Direct 3D 11 pipeline.
3. Demonstrate the 2D and 3D Transformation on the given shapes.
4. Classify the various Curves and Interpolation types.
5. Build the various games and models using Unity tool.
6. Test the various XR in terms of AR, MR and VR.

References:

1. Mathematics for Computer Graphics, John Vince, Springer-Verlag London, 5th Edition,2017

2. Mathematics for 3D Game Programming and Computer Graphic, Eric Lengyel, DelmarCengage Learning, Delmar Cengage Learning,2011
3. Introduction To 3D Game Programming With Directx® 11,Frank D Luna, Mercury Learning And Information,2012.
4. https://docs.unity3d.com/Manual/index.html - Free
5. https://www.revolvy.com/page/List-of-game-engine.

Case Study 1:-

Star Wars is an American epic space opera multimedia franchise created by George Lucas, which began with the eponymous 1977 film and quickly became a worldwide pop culture phenomenon. The franchise has been expanded into various films and other media, including television series, video games, novels, comic books, theme park attractions, and themed areas, comprising an all-encompassing fictional universe. Star Wars is one of the highest-grossing media franchises of all time. For excellent cinematographic delivery has a specially developed rendering engine Clarrisee ,it is the best as it has adaptable features which give real look and feel and also supports capturing physical based materials to depict a real entity into animated form.

Case Study 2:-

The game industries have been growing rapidly since the last decade. The main objective of this case was to develop a game from scratch to have a deeper look at the game development process, attempts to answer the following questions; what are the essential elements for game design, how to generate revenue through games by using different monetization models, what are the tools and software available today to create a game, what is game testing methodology and how it is implemented, and, finally, how to manage customer service. To learn about the whole game design process, one simple mobile game called“EvilHuman” was designed. A fully functional game was completed using the Unity3D game engine and was published in Google Play Store to receive comments and feedback from the users. The game was downloaded between 100 – 500 times. The users who downloaded the game wrote reviews in Google Play Store, and the average rating was 4.6 out of 5. There were many challenges during the practical part of this case. The main challenge for this game was learning Unity3D, C# programming, game designing and modeling. However, some assets were used from the premade assets from the Unity3D asset store, which had made the design process easier. The publishing of this game in Google Play has motivated the author to continue in the game development field because of suggestions and positive feedback, which were provided by the real users who downloaded the game and played it.

BOS	Computer Science
Class	T. Y. B. Sc.C.S
Semester	V
Subject Name	Game Programming Practical
Subject code	PUSCSP509P
Level of the Subject	Moderate

Practical No	**Details**
1	ISetup DirectX 11, Window Framework and Initialize Direct3D Device
2	Buffers, Shaders and HLSL (Draw a triangle using Direct3D 11)
3	Texturing (Texture the Triangle using Direct 3D 11)
4	Lightning (Programmable Diffuse Lightning using Direct3D 11)
5	Specular Lightning (Programmable Spot Lightning using Direct3D 11)
6	Loading models into DirectX 11 and rendering.
7	https://unity3d.com/learn/tutorials/s/2d-ufo-tutorial
8	https://unity3d.com/learn/tutorials/s/space-shooter-tutorial
9	https://unity3d.com/learn/tutorials/s/roll-ball-tutorial
10	https://unity3d.com/learn/tutorials/topics/vr/introduction?playlist=22946
	Total Lectures :20

BOS	**Computer Science**
Class	**T.Y.B.Sc. C.S.**
Semester	**V**
Course Name	**Artificial Intelligence**
Course Code	**PUSCS504(D)**
Level of the Subject	**Advanced**

Course Objectives:

1. To explore the applied branches of artificial intelligence and to solve the problem aligned with derived branches of artificial intelligence.
2. To enable the learner to understand applications of artificial intelligence,Identify and describe problems that are amenable to solution by AI methods.

Unit No.	Name of Unit	Topic No.	Content	Hours
1	An Introduction to AI & Expert System	1.1	Artificial Intelligence : Role of AI in engineering, AI in daily life, Intelligence and Artificial Intelligence, Different task domains of AI, Programming methods, Limitations of AI	10
		1.2	Expert System and Applications: Phases in Building Expert System, Expert System Architecture, Expert System versus Traditional Systems, Rule based Expert Systems, Blackboard Systems, Truth Maintenance System, Application of Expert Systems, Shells and Tools	

2	Introduction to Soft Computing, Fuzzy Logic & Defuzzification	2.1	Importance of soft computing; Soft computing versus hard computing; Supervised and unsupervised learning; Introduction to main components of soft computing: Fuzzy logic, Neural networks, Genetic algorithms	10
		2.2	Fuzzy Sets and Fuzzy Logic: Fuzzy Sets, Fuzzy set operations, Types of Membership Functions, Multivalued Logic, Fuzzy Logic, Linguistic variables and Hedges, Fuzzy propositions, inference rules for fuzzy propositions, fuzzy systems, possibility theory and other enhancement to Logic	
3	Neural Network, Genetic Algorithm & ANN	3.1	Basic concepts of Neural network; Overview of learning rules and parameters; Activation functions; Single layer perceptron and multilayer perceptron.	10
		3.2	Basic concepts Genetic Algorithms : What is Genetic Algorithm, Difference between traditional algorithms and Genetic Algorithm (GA); Basic concepts of GA; GA Operators: Reproduction, Crossover, Mutation; Convergence of GA.	
		3.3	Artificial Neural Network: Introduction, Fundamental Concept, Artificial Neural Network, Brain vs. Computer - Comparison Between Biological Neuron and Artificial Neuron, Basic Models of Artificial Neural Network	

4	Intelligent Agents and Artificial Intelligence on the Cloud	4.1	Intelligent Agents: Agents vs software programs, classification of agents, working of an agent, single agent and multiagent systems, performance evaluation, architecture, agent communication language, applications.	10
		4.2	Artificial Intelligence on the Cloud Why are companies migrating to the cloud? The top cloud providers Amazon Web Services: Amazon SageMaker Microsoft Azure: Machine Learning Studio	
		Total No. of Lectures		**40**

Course Outcomes:

1. Discuss in detail different domains where AI is used.
2. Understand the fundamentals concepts of the expert system and its applications.
3. Analyze the concept of fuzzy sets and Defuzzification for solving AI based problems.
4. Acquire the knowledge of the Machine Learning applications .
5. Understand applications of genetic algorithms in different problems related to artificial intelligence.
6. Elaborate and articulate the significance of Artificial Neural Networks in Artificial Intelligence..

References:

1. Artificial Intelligence: A modern approach by Stuart Russel and Peter Norvig, Pearson 3 rd edition.
2. A First Course in Artificial Intelligence by Deepak Khemani,TMH First Edition
3. Artificial Intelligence by Elaine Rich, Kelvin Knight and Shivshankar Nair,TMH,3rd edition.
4. Artificial Intelligence: A Rational Approach by Rahul Deva ,Shroff publishers 1 st edition
5. Artificial Intelligence & Soft computing for Beginners by Anandita Das ,Bhattacharjee,SPD,1st edition

Case Studies:

1. In a recent discussion paper, NITI Aayog has chalked out an ambitious strategy for India to become an artificial intelligence (AI) powerhouse. AI is the use of computers to make decisions that are normally made by humans. Many forms of AI surround Indians already, including chatbots on retail websites and programs that flag fraudulent bank activity. But NITI Aayog envisions AI solutions for India on a scale not seen anywhere in the world today, especially in five key sectors — agriculture, healthcare, education, smart cities and infrastructure, and transport. In agriculture, for example, machines will provide information to farmers on the quality of soil, when to sow, where to spray herbicide, and when to expect pest infestations. It's an idea with great potential: India has 30 million farmers with smartphones, but poor extension services. If computers help agricultural universities advise farmers on best practices, India could see a farming revolution.

   However, there are formidable obstacles. AI start-ups already offer some solutions, but the challenge lies in scaling these to cover the entire value chain, as NITI Aayog envisions. The first problem is data. Machine learning, the set of technologies used to create AI, is a data-guzzling monster. It takes reams of historical data as input, identifies the relationships among data elements, and makes predictions. More sophisticated forms of machine learning, like "deep learning", attempt to mimic the human brain. And even though they promise greater accuracy, they also need more data than what is required by traditional machine learning. Unfortunately, India has sparse data in sectors like agriculture, and this is already hampering AI-based businesses today.

2. Suppose a genetic Algorithm uses chromosomes of the form x = abcdefgh with a fixed length of eight genes. Each gene can be any digit between 0 and 9 . let the fitness of individual c be calculated as:

$$f(x) = (a+b) - (c+d) + (e+f) - (g+h) \ ,$$

   And let the initial population consist of four individuals with the following chromosomes .

$$x_1 = 65413532$$
$$x_2 = 87126601$$
$$x_3 = 23921285$$
$$x_4 = 41852094$$

BOS	Computer Science
Class	T.Y.B.Sc. C.S.
Semester	V
Course Name	Artificial Intelligence Practical
Course Code	PUSCS504(D)
Type of course	Advanced
Level of the Subject	Advanced

Practical No.	**Details**
1.	Write a program to implement Exploratory Data Analysis (EDA)& Data Preprocessing (Outlier Detection, Handling Missing Data, Encoding Categorical Data) using univariate analysis and bivariate analysis
2.	Write a program to Implement Expert System.
3.	Write a Program in python to perform different operations on a fuzzy set.
4.	Perform Feature Engineering and Feature Transformation on a dataset
5.	Create Intelligent Agents with Reinforcement Learning
6.	Write a program to implement of Logic gates(XOR gate) in Neural Network
7.	Write a Python program to implement simple Chatbot.
8.	Write a Python program to implement a Tic-Tac-Toe game.
9.	Case Study on ANN
10.	Case Study on Genetic Algorithm

BOS	Computer Science
Class	T.Y.B.Sc. C.S.
Semester	V
Course Name	Hybrid Application Development
Course Code	PUSCS504(F)
Level of the Subject	Advanced

Course Objectives:

1.Understand Hybrid Application Development using Flutter and Dart Programming.

2.Create Hybrid Applications Development using Flutter widgets, Routing and Database.

Unit No.	Name of Unit	Topic No.	Name of Topic	Hours
I	**Introduction to Dart**	**1.1**	Introduction to The Dart Language, What is Dart? Dart Installation,Dart Syntax,History,Features,Data Types, Variables and Functions.	**10**
		1.2	Operators,Decision Making and Loops,Continue and Break,final and Const Keyword,Object-Oriented Programming	
II	**Introduction to Flutter**	**2.1**	What is Flutter?Features,History ,Flutter Architecture.Flutter vs React Native.	**10**
		2.2	Flutter Installation,Flutter First Application.	
		2.3	Flutter Widgets,Flutter Layouts,Flutter Gestures,Flutter State Management.	
III	**Flutter widgets**	**3.1**	Flutter Scaffold, container,row and column,text,textfield,buttons,forms,	**10**

		3.2	Flutter images, icons, list, Toast, Grid view, Checkbox,Radio buttons	
IV	**Flutter Routing and Database**	**4.1**	Flutter Packages,Flutter Navigation and Routing,Navigator.pop() method, Navigation with Named Routes	**10**
		4.2	SQLite Database , Firebase database	
			Total Lectures	**40**

Course Outcomes:

1. Design and develop User Interfaces for Hybrid Application development. (CO1)
2. Apply Flutter concepts to Hybrid app development. (CO2)
3. Understand Dart Programming(CO3)
4. Create interactive applications using flutter with multiple activities including layouts (CO4)
5. Use of Packages in Flutter App Development (CO5)
6. Implement Routing and Navigation features (CO6)

References:

1. Dieter Meiller “Modern App Development with Dart and Flutter 2”.
2. Griffiths, M., & Griffiths, S. (2018). Learn Hybrid Mobile Application Development: A Hands-On Guide to Building Apps with Ionic, Angular, and Cordova. Apress.
3. Lee, J.G., & Park, J. (2016). Mastering PhoneGap Mobile Application Development. Packt Publishing.
4. Koshy, S. (2017). Mastering React Native. Packt Publishing.
5. Zepeda, B. (2018). Ionic Framework: Building Mobile Apps with Ionic 3, Angular 4, and TypeScript. Packt Publishing.
6. “Beginning Flutter: A Hands On Guide to App Development” by Marco L. Napoli.

Case Study 1 AppGenius, a startup specializing in mobile app development, aimed to create a feature-rich application that could be accessed by users on both iOS and Android devices. To streamline development efforts and maximize resource utilization, the company opted for a hybrid approach, combining elements of web and native app development to create a cross-platform solution.
Case Study 2 This case study examines the implementation of a basic hybrid application development project for a fictional small business, TechConnect Solutions, aiming to create a simple mobile app for both iOS and Android platforms. By leveraging hybrid development techniques, the company achieved

cost-effectiveness and faster deployment while maintaining a consistent user experience across different devices.
TechConnect Solutions, a startup specializing in IT services, recognized the need to establish a mobile presence to better engage with its clients and streamline service delivery. With limited resources and a desire to reach users on both major mobile platforms, the company decided to pursue hybrid application development as a cost-effective solution.

BOS	Computer Science
Class	T.Y.B.Sc. C.S.
Semester	V
Course Name	Hybrid Application Development Practical
Course Code	PUSCS504(F)
Level of the Subject	Advanced

Practical No	**Details**
1.	Demonstrate the Installation of Dart Programming.
2.	Demonstrate the Installation of Flutter.
3.	Implements the basic material design visual layout structure using Flutter Scaffold.
4.	Create an app that demonstrates use of Containers in Flutter application.
5.	Create an app that demonstrates use of Colors and Fonts.
6.	Create an app that demonstrates use of Buttons and Icons.
7.	Create an app that demonstrates use of lists of data in Flutter application.
8.	Create an app that demonstrates use of two routes in the Flutter application.
9.	Create an app that demonstrate use of two routes in the Flutter application

10.	Create an app to show how we can store and fetch data in the Flutter.
	Total Lectures:20

BOS	Computer Science
Class	T.Y.B.Sc.C.S.
Semester	V
Course Name	Web Services
Course Code	PUSCS505
Type of course	Discipline Specific Elective
Level of the Subject	Moderate

Course Objectives:

1. To understand the details of web services technologies like SOAP, WSDL, and UDDI,To learn how to implement and deploy web service clients and servers.
2. To understand the design principles and application of SOAP and REST based web services (JAX-Ws and JAX-RS).To understand WCF service and to design secure web services and QoS of Web Services

Unit No.	Name of Unit	Topic No.	Content	Hours	
1	Web services basics	1.1	What Are Web Services? Types of Web Services Distributed computing infrastructure	10	
		1.2	Overview of XML, SOAP, Building Web Services with JAX-WS		
		1.3	Registering and Discovering Web Services, Service Oriented Architecture		
2	The REST Architectural style	2.1	Web Services Development Life Cycle, Developing and consuming simple Web Services across platform	10	
		2.2	Introducing HTTP, The core architectural elements of a RESTful system,		

			Description and discovery of RESTful web services		
		2.3	Java tools and frameworks for building RESTful web services, JSON message format and tools and frameworks around JSON		
		2.4	Build RESTful web services with JAX-RS APIs, The Descriptionand Discovery of RESTful Web Services		
3	Developing Service-Oriented Applications with WCF	3.1	Secure RESTful web services: Design guidelines for building RESTful web services	10	
		3.2	What Is Windows Communication Foundation, Fundamental Windows Communication Foundation Concepts		
		3.3	Windows Communication Foundation Architecture		
4	WCF and .NET Framework	4.1	WCF and .NET Framework Client Profile, Basic WCF Programming, WCF Feature Details	10	
		4.2	Web Service QoS: Develop Asynchronous web Services WCF Transactions & Sessions		
		4.3	Hosting WCF services		
	Total No. Of Lectures				**40**

Course Outcomes:

1. Overview of web service,XML and Distributed computing Infrastructure
2. Illustrate the SOAP protocol
3. Create, read and understand the Web Services Description Language files
4. Analyze where Web services fit in the Java EE framework
5. Evaluate alternative architectures such as REST for Web services
6. Understand Windows Communication Foundation

References:

1. Web Services: Principles and Technology, Michael P. Papazoglou, Pearson Education Limited, 2008
2. RESTful Java Web Services, Jobinesh Purushothaman, PACKT Publishing,2nd Edition, 2015
3. Developing Service-Oriented Applications with WCF, Microsoft,
    a. 2017 https://docs.microsoft.com/en-us/dotnet/framework/wcf/index
4. Allemang, D., & Hendler, J. (2011). Semantic Web for the Working Ontologist: Effective Modeling in RDFS and OWL (2nd ed.). Morgan Kaufmann.
5. Bouguettaya, A., Sheng, Q.Z., & Daniel, F. (2013). Web Services Foundations. Springer.
6. Cerami, E. (2002). Web Services Essentials: Distributed Applications with XML-RPC, SOAP, UDDI & WSDL. O'Reilly Media.

Case Study 1:

Himalaya publication provides book-pricing data from various vendors and book search functionality based on any combination of factors, such as author, title, publisher, keyword and ISBN.

The purpose of this project is to provide a publicly accessible book broker that is superior in functionality to existing book brokers today, to enable developers to integrate my Web Service into their own applications, promoting data exchange regardless of the platform or programming language being used and lastly, to provide a good case study of how to bring out the best in Web Services

Case Study 2:

DAV International School provides result data of students and student search functionality based on any combination of factors, such as roll no, name, Admission No. The purpose of this project is to provide a publicly accessible result that is superior in functionality to existing Students, to enable developers to integrate my Web Service into their own applications, promoting data exchange regardless of the platform or programming language being used and lastly, to provide a good case study of how to bring out the best in Web Services.

BOS	Computer Science
Class	T.Y.B.Sc.C.S.
Semester	V
Course Name	Web Services Practical
Course Code	PUSCS509P
Type of course	Discipline-Specific Elective
Level of the Subject	Moderate

Practical No.	**Details**
1.	Write a program to implement to create a simple web service that converts the temperature from Fahrenheit to Celsius and vice versa.
2.	Write a program to implement the operation and can receive requests and will return a response in two ways. a) One - Way operation b) Request –Response
3.	Write a program to implement business UDDI Registry entry.
4.	Develop a client which consumes web services developed in different platforms.
5.	Write a JAX-WS web service to perform the following operations. Define a Servlet / JSP that consumes the web service.
6.	Define a web service method that returns the contents of a database in a JSON string. The contents should be displayed in a tabular format.
7.	Define a RESTful web service that accepts the details to be stored in a database and performsCRUD operation.
8.	Implement a typical service and a typical client using WCF.
9.	Use WCF to create a basic ASP.NET Asynchronous JavaScript and XML (AJAX) service.

10.	Demonstrates using the binding attribute of an endpoint element in WCF.
	Total Lectures:20

BOS	Department of Skill Development & Entrepreneurship
Class	T.Y.B.Sc. C.S.
Semester	V
Course Name	Emotional Intelligence
Course Code	PUSCS506
Type of course	Skill Enhancement
Level of the Subject	Basic

Course Objectives:

1. To learn how to lead with emotional intelligence, To become familiar with Emotional Intelligence Competencies, To learn how to manage our emotions & relationships with others.
2. To study different aspects of self-management, building on the foundation of (i) self awareness (ii) self-regulation (iii) Social skills and empathy and (iv) Relationship Management.

Unit No.	Name of Unit	Topic No.	Content	Hours
1.	Introduction to Emotional Intelligence and Self awareness	1.1	Introduction to Emotional Intelligence. Dimensions of Emotional Intelligence. Difference between EQ v/s IQ.	15
		1.2	Emotional Competencies. Importance of EI. The concept of Emotional Hijacking	
		1.3	Meaning of Self-Awareness, benefits of Self-awareness, Self-Awareness Strategies, Self-Awareness Skills.	
2	Self-Regulation & Elements.	2.1	Introduction to Self-Regulation Self-regulation strategies.	15
		2.2	Self-Control, Meaning of Self-Control, Three Habits of Self-Control, assessing your	

			Self-Control, Developing Self Control	
		2.3	Concepts of Trustworthiness, Conscientiousness & Adaptability.	
		2.4	Innovation and Innovation Skills	
3	Social Skills and empathy	3.1	Social Skills in EI, Meaning, Elements: Persuasion and Influencing Skills, Communication Skills, Conflict Management Skills, Leadership Skills, Change Management Skills, Building Bonds (Rapport), Collaboration and Cooperation Team-Working Skill	15
		3.2	Empathy: Meaning, Types, Elements, Tactics.	
4	Relationship Management	4.1	Relationship Management in EI: Understanding Relationship management, Strategies, Relationship management Skills.	15
		4.2.	The competencies associated with relationship management, Influence, Leadership, Developing Communication, Change Catalyst. Four criteria for effective relationship management: Decision, interaction, Outcome, Needs.	
Total No. of Lectures				**60**

Course Outcomes:

1. Describe the value of emotional intelligence for professional success.
2. Relate the impact of self-awareness & self-control on others.
3. Develop strategies for strengthening empathy.
4. Examine capabilities to demonstrate social awareness through empathy.
5. Justify actions to create connections and build relationships for greater professional effectiveness.
6. Construct methodology for managing emotions.

References:

1. Emotional Intelligence, Daniel Goleman, Bloomsbury Publishing
2. Emotional Intelligence: Why It Can Matter More Than IQ,Daniel Goleman, Bantam
3. Emotional Intelligence 2.0, by Travis Bradberry, Jean Greaves, Perseus Books Group

Web links:

1. https://www.skillsyouneed.com/ps/self-control.html
2. https://www.passingthebatonpodcast.com/relationship-management/
3. http://www.free-management-ebooks.com/faqpp/developing-05.htm
4. https://www.skillsyouneed.com/general/emotional-intelligence.html

Evaluation Pattern:

Sr. No	Particulars	Marks
1.	7 Quizzes x 5marks each (5 questions-1mark each)	35
2.	Presentation, Podcasting, Short videos, Posters, Articles for Newsletters (Any 2 for 15 marks each)	30
3.	Situational Awareness test (Quiz in Google form – 2 test of 15 marks each (15 questions of one marks each 15 marks)	30
4.	Active Participation	05
	TOTAL	**100**

BOS	**Computer Science**
Class	**T.Y.B.Sc.C.S.**
Semester	**V**
Course Name	**Internship**
Course Code	**PUSCS507**
Type of course	**Skill Enhancement**
Level of the Subject	**Moderate**
Credit points	**2**

- Students need to do regular Internship program in IT industry of 60 Hrs in Semester VI
- At the end of the program report should be submitted to the Teacher-in-Charge at the semester end
- External examiner will be appointed to conduct Viva-voce for 50 marks

Format of the Report to be Submitted at the End of Internship Program

Da te:

CERTIFICATE OF APPROVAL

This is to certify that the project report titled

Name of the Project

Is a bona-fide record of the work done by

<Seal of College>

Company Certificate format:

Company Letterhead

Under the guidance of

<Prof. **Name of the internal Guide**>

Direc tor	External Examiner	Internal Guide

Date:

CERTIFICATE

This is to certify that (**Name of the student)** , student of **Pillai College , New Panvel** , studying in Semester VI , Roll No. **20** has worked under the guidance and mentorship of (**In-charge Namae)** on the project titled "Campus Recruitment System." as part of final year B.Sc. in Computer Science project of University Of Mumbai for the Academic year **2019-2020**.

Further, I certify that the information provided about this project is true, complete and correct to the best of my knowledge.

We have monitored her progress and ensured that she obtained sufficient advice and assistance during the project. She has worked **80 Hrs** on the project from 1 February 2018 to 30 June 2018.

(Name of the Manager).

<Seal of the Company>

Performance Appraisal from Project Employees:

PERFORMANCE APPRAISAL FROM PROJECT EMPLOYEES INSTRUCTIONS: The immediate supervisor is asked to evaluate the student objectively comparing <him/her> with other students of comparable academic records with other personnel assigned to the same on similarly classified or with corporate standards.

Name of the Student :

Course Title : BSc.C.S. .

College Name : Pillai College of Arts Commerce & Science,

New Panvel Name of Project :

Name of Project Guide

: Company Name

:

Signature :

Seal Of Company :

Evaluation Criteria	Exceptional	Very Good	Average	Marginal	Unacceptable	Non-Applicable	Comments (if needed, write on back side of the page or on fresh new sheet then attach the same)
Relations with others							
Judgments							
Ability to Learn							
Communication Skills							
Technical Skills							
Teamwork Skills							
Dependability							
Quality of Work							
Educational Preparation for the Assignment							
Potential for Greater Responsibility							
Comparison with students is at the same level from other Institutions							
Overall performance							

Attendance: Regular/Irregular**Punctuality**: Regular/Irregular

SEMESTER-VI

BOS	**Computer Science**
Class	**T.Y.B.Sc.C.S**
Semester	**VI**
Subject Name	**Software Testing and Quality Assurance**
Subject code	**PUSCS601**
Level of The Subject	**Medium**

Course Objectives:

1. To understand how testing can be used in providing quality assurance concerning software.
2. To provide skills to design test case plan for testing software and To Understand the importance of software quality and assurance software systems development.

Unit No.	Name of Unit	Topic No.	Content	Hours
1	Introduction to Software Testing	1.1	Software Testing : Introduction, Nature of errors, an example for Testing.	10
		1.2	Introduction to quality : Definition of Quality , QA, QC, QM and SQA , Software Development Life Cycle, Software Quality Factors	
		1.3	Verification and Validation : Definition of V &V , Different types of V & V Mechanisms,	
		1.4	Software Review: Concepts of Software Reviews, Inspection and Walkthrough	
2	Introduction to Testing Techniques	2.1	Software Testing Techniques : Testing Fundamentals, Test Case Design.	10
		2.2	Testing: White Box Testing and its types, Black Box Testing and its types	

		2.3	Software Testing Strategies : Strategic Approach to Software Testing, Unit Testing, Integration Testing, Validation Testing, System Testing	
		2.4	Software Metrics : Concept and Developing Metrics, Different types of Metrics, Complexity metrics	
3	Software Quality Assurance	3.1	Defect Management: Definition of Defects, Defect Management Process, Defect Reporting, Metrics Related to Defects, Using Defects for Process Improvement.	10
		3.2	Software Quality Assurance : Quality Concepts, Quality Movement, Background Issues, SQA activities, Formal approaches to SQA, Statistical Quality Assurance, Software Reliability,	
		3.3	Formal Technical Reviews: The ISO 9000 Quality Standards, , SQA Plan , Six sigma, Informal Reviews	
4	Introduction to Quality Improvement	4.1	Quality Improvement : Introduction, Pareto Diagrams, Cause-effect Diagrams, Scatter Diagrams, Run charts	10
		4.2	CMM – Requirements management (RM), software configuration management (SCM), software product engineering (SPE).	
		4.3	peer reviews (PR), quantitative process management (QPM), defect prevention (DP), process change management	
Total No. of Lectures				**40**

Course Outcomes:

1. Describe fundamental concepts of software quality assurance.
2. Explore test planning and its management.

3. Demonstrate the quality management, assurance, and quality standard to the software system.
4. Apply fundamental concepts of software automation.
5. Assess Software Quality Tools and analyze their effectiveness.
6. Evaluate different quality Improvement techniques .

References:

1. Software Engineering for Students, A Programming Approach, Douglas Bell, 4th Edition,, Pearson Education, 2005
2. Software Engineering – A Practitioner's Approach, Roger S. Pressman, 5th Edition, Tata McGraw Hill, 2001
3. Quality Management, Donna C. S. Summers, 5th Edition, Prentice-Hall, 2010.
4. Total Quality Management, Dale H. Besterfield, 3rd Edition, Prentice Hall, 2003.
5. Dix, A., Finlay, J., Abowd, G., & Beale, R. (2003). Human-Computer Interaction (3rd ed.). Pearson Education.

Case Study:

1)TechSolutions encountered challenges such as software defects, usability issues, and customer dissatisfaction. Recognizing the need to prioritize QA, the company embarked on a journey to revamp its testing methodologies and quality assurance practices to improve the overall quality of its software products.
Challenges:

1. Software Defects: The company experienced a high number of defects in its software releases, leading to frequent bug fixes and patches post-deployment.
2. Inconsistent Testing Processes: Testing processes varied across teams and projects, resulting in inconsistency and inefficiency in identifying and addressing software defects.
3. Limited Test Coverage: Testing efforts often focused on functional testing, neglecting non-functional aspects such as performance, security, and usability.
4. Time and Resource Constraints: Tight project timelines and resource constraints posed challenges in allocating sufficient time and resources for comprehensive testing activities.

2)Online mobile shop management system is an application developed by ABC pvt ltd .with user requirement. Application allow user to create his account and sign in ,view products, purchase ,add in cart ,sign out .
The application is ready for deployment before that 4-level testing need to be performed for user satisfaction.

BOS	**Computer Science**
Class	**T.Y.B.Sc.C.S**
Semester	**VI**
Subject Name	**Software Testing and Quality Assurance Practical**
Subject code	**PUSCSP607P**
Level of The Subject	**Medium**

Practical No	Details
1.	Install Selenium IDE; Write a test suite containing minimum 4 test cases for different formats.
2.	Conduct a test suite for any two web sites.
3.	Install Selenium server (Selenium RC) and demonstrate it using a script in Java/PHP.
4.	Write and test a program to login to a specific web page.
5.	Write and test a program to update 10 student records into table into Excel file
6.	Write and test a program to select the number of students who have scored more than 60 in any one subject (or all subjects).
7.	Write and test a program to provide a total number of objects present / available on the page.
8.	Write and test a program to get the number of items in a list / combo box.
9.	Write and test a program to count the number of check boxes on the page checked and unchecked count.

10.	Load Testing using JMeter.
	Total Lectures:20

BOS	**Computer Science**
Class	**T.Y.B.Sc.C.S**
Semester	**VI**
Subject Name	**Cloud Computing**
Subject Code	**PUSCS602**
Level of the Subject	**Medium**

Course Objectives:

1. Computing concepts, technologies, architecture, implantations and applications.
2. To expose the learners to frontier areas of Cloud Computing, while providing sufficient foundations to enable further study and research.

Unit No.	Name of Unit	Topic No.	Content	Hours
1	Introduction to Cloud Computing	1.1	Introduction to Cloud Computing,Characteristics and benefits of Cloud Computing,	10
		1.2	Basic concepts of Distributed Systems, Web 2.0, Service-Oriented Computing, Utility-Oriented Computing	
		1.3	Elements of Parallel Computing, Elements of Distributed Computing. Technologies for Distributed Computing	
		1.4	Cloud Computing Architecture. The cloud reference model. Infrastructure as a service. Platform as a service. Software as a service	

2	Virtualization	2.1	Types of clouds, Characteristics of Virtualized Environments.	10
		2.2	Taxonomy of Virtualization Techniques, Virtualization and Cloud Computing.	
		2.3	Pros and Cons of Virtualization, Virtualization using KVM, Creating virtual machines	
3	Introduction to OpenStack	3.1	oVirt - management tool for virtualization environment. Open Challenges of Cloud Computing	10
		3.2	Introduction to OpenStack, OpenStack test-drive, Basic OpenStack operations,	
		3.3	OpenStack CLI and APIs, Tenant model operations, Quotas, Private cloud building blocks	
4	Cloud Security Mechanisms	4.1	Controller deployment, Networking deployment, Block Storage deployment, Compute deployment	10
		4.2	Deploying and utilizing OpenStack in production environments, Building a production environment, Application orchestration using OpenStack Heat	
		4.3	Cloud Security Mechanisms -Encryption, Hashing, Digital Signature, Public Key Infrastructure (PKI), Identity and Access Management (IAM), Single Sign-On (SSO),Cloud-Based Security Groups	
Total No of Lectures				**40**

Course Outcomes:

1. Understand the concepts, characteristics, delivery models and benefits of cloud computing
2. Understand the different characteristics of public, private and hybrid cloud deployment models including SaaS, PaaS, IaaS
3. Understanding virtualization and various ways of using virtualization
4. Implementation of private cloud platform using virtualization
5. Explore OpenStack architecture with both CLI and API functionalities
6. Understand the key security and compliance challenges of cloud computing

References :

1. Mastering Cloud Computing, RajkumarBuyya, Christian Vecchiola, S ThamaraiSelvi, Tata McGraw Hill Education Private Limited, 2013
2. OpenStack in Action, V. K. CODY BUMGARDNER, Manning Publications Co, 2016
3. OpenStack Essentials, Dan Radez, PACKT Publishing, 2015
4. OpenStack Operations Guide, Tom Fifield, Diane Fleming, Anne Gentle, Lorin Hochstein, Jonathan Proulx, Everett Toews, and Joe Topjian, O'Reilly Media, Inc., 2014
5. https://go.qwiklabs.com/hey-student?utm_source=gcp_edu&utm_medium=newsletter&utm_campaign=ahef(add in theory and practical)

Case study 1 :

HDFC General Insurance offers a wide range of general insurance products. The company offers a complete suite of products ranging from Motor, Health, Personal Accident, Travel and Home Insurance in the retail space and products like Aviation, Fire, Marine, Package, Construction & Engineering and Liability Insurance in the commercial space. Today, HDFC General's Distribution family includes over 21,000 IRDAI certified employees including the State Bank Group employees, and over 8,000 Agents to make insurance easily available even in the remote areas of the country. HDFC General Insurance has established its presence in over 23000 branches of State Bank Group and over 5500 Regional Rural Banks (RRBs). The company's current geographical exposure covers 110+ cities pan India with a presence of another 350+ locations through satellite resources.
solve following Challenges

Case study 2:
RBL Bank is one of India's fastest growing private sector banks with an expanding presence across the country. The Bank offers specialized services under six business verticals namely: Corporate & Institutional Banking, Commercial Banking, Branch & Business Banking, Retail Assets and Treasury and Financial Markets Operations. It currently services over 9.63 million customers through a network of 429 CR business correspondent branches (of which 260 banking outlets) and 412 ATMs spread across 28 Indian states and Union Territories.

BOS	**Computer Science**
Class	**T.Y.B.Sc.C.S**
Semester	**VI**
Subject Name	**Cloud Computing**
Subject Code	**PUSCS607P**
Level of the Subject	**Medium**

Practical No	Details
1.	Study of Cloud Computing & Architecture
2.	Installation and Configuration of virtualization using KVM.
3.	Study and implementation of Infrastructure as a Service
4.	Study and implementation of Storage as a Service
5.	Study and implementation of identity management
6.	Study Cloud Security management
7.	Write a program for web feed.
8.	Study and implementation of Single-Sign-On.
9.	User Management in Cloud.
10.	Case study on Amazon EC2/Microsoft Azure/Google Cloud Platform
	Total Lectures:20

BOS	**Computer Science**
Class	**T.Y.B.Sc.C.S**
Semester	**VI**
Subject Name	**Android Programming**
Subject code	**PUSCS603**
Level of The Subject	**Medium**

Course Objectives:

1. To provide comprehensive insight into developing applications running on smart mobile devices and demonstrate programming skills for managing tasks on mobile.
2. To provide a systematic approach for studying definition, methods and its applications for Mobile-App development.

Unit No.	Name of Unit	Topic No.	Content	Hours
1	Introduction to Android	1.1	What is Android: Android, Obtaining the required tools, creating first android app, understanding the components of screen, adapting display orientation	10
		1.2	Action bar, Activities and Intents, Activity Lifecycle and Saving State, Basic Views: TextView, Button, ImageButton, EditText, CheckBox, ToggleButton, RadioButton, and RadioGroup Views	
		1.3	ProgressBar View, AutoCompleteTextView, TimePicker View, DatePicker View, ListView View,Spinner View	
2	Menus, Themes and Styles	2.1	Menus, Screen Navigation, RecyclerView, Drawables, Themes and Styles, Material design	10
		2.2	AsyncTask and AsyncTaskLoader, Connecting to the Internet	

		2.3	Broadcast receivers, Services, Notifications.	
3	Data – saving, Multimedia	3.1	Alarm managers, Transferring data efficiently Data - saving, retrieving and loading:	10
		3.2	Overview to storing data, Shared preferences, Internal Storage	
		3.3	Playing Audio and Video in Android	
4	SQLite	4.1	SQLite primer, store data using SQLite database	10
		4.2	Content Providers, loaders to load and display data	
		4.3	Permissions, performance and security, Firebase and AdMob, Publish your app	
		Total No of Lectures		**40**

Course Outcomes:

1. Design and develop User Interfaces for the Android platform. (CO1)
2. Apply Java programming concepts to Android app development. (CO2)
3. Implement a menu bar in your activity (CO3)
4. Create interactive applications in android with multiple activities including audio, video and animation (CO4)
5. Use of Services, Broadcast Receiver, Notification (CO5)
6. Saving user data (CO6)
7. How to create applications using SQLite database (CO7)

References:

1. “Beginning Android 4 Application Development”, Wei-Meng Lee, March 2012,WROX
2. Phillips, B., Hardy, C., & Marsicano, K. (2017). Android Programming: The Big Nerd Ranch Guide (3rd ed.). Big Nerd Ranch.
3. Stroud, J., & Conder, S. (2018). Android Apps for Absolute Beginners: Covering Android 7. Apress.
4. Griffiths, D., & Griffiths, D. (2017). Head First Android Development: A Brain-Friendly Guide (2nd ed.). O'Reilly Media.
5. Meier, R. (2018). Android 8 Development: Oreo Edition. Addison-Wesley Professional.

Case Study :

1. ABC University has a well-established library with a vast collection of books, journals, and other educational resources. The university administration wants to modernize the existing library system by introducing a Library Management System (LMS) that can efficiently handle various tasks such as book borrowing, returning, cataloging, and user management. The university aims to develop a user-friendly Android application to make library services more accessible to students and staff.

2. XYZ Corporation, a medium-sized company with a diverse range of projects and departments, faces challenges in managing its expenses effectively. Currently, employees rely on manual methods, such as spreadsheets and paper receipts, to track their expenses. This approach is time-consuming, error-prone, and lacks real-time visibility into expenditure patterns. To address these challenges, XYZ Corporation has decided to develop an Expense Tracking System (ETS) to streamline expense management processes and enhance financial transparency.

BOS	**Computer Science**
Class	**T.Y.B.Sc.C.S**
Semester	**VI**
Subject Name	**Android Programming Practical**
Subject code	**PUSCSP608P**
Level of The Subject	**Medium**

Practical No	Details
1.	Java Android Program to Perform all Operations using Calculators (addition, subtraction, multiplication, and division, Log, Clear)
2.	Create an android app that demonstrates Activity Lifecycle and Instance State.
3.	Create an android app with Interactive User Interface using different Layouts.
4.	Create an android app to create registration activity using different views and show data in another activity. and use Intent to transfer details to another activity
5.	Create an android app that demonstrates the use of Keyboards, Input Controls, Alerts , Pickers and Options Menu.
6.	Create an android app for Audio and Video
7.	Create an android app to Connect to the Internet and use BroadcastReceiver.
8.	Create an android app to show Notifications and Alarm manager.
9.	Create an android app that demonstrate Shared Preferences and Internal storage
10.	Create an android app to save user data in a database and use of different queries.
	Total Lectures:20

BOS	**Computer Science**
Class	**T.Y.B.Sc. C.S.**
Semester	**VI**
Course Name	**Application Deployment**
Course Code	**PUSCS604(F)**
Type of course	**Advanced**
Level of the Subject	**Advanced**

Course Objectives:

1. Describe fundamental concepts of software testing ,Explore test planning and its management.Understanding usage of Git repositories and github
2. Deploying an web application on AWS,Deployment of apps using docker container

Unit No.	Name of Unit	Topic No.	Content	Hours
1	Software Testing	1.1	Software Testing : Introduction, Nature of errors, an example for Testing. Software Testing Techniques : Testing Fundamentals, Test Case Design	10
		1.2	Testing: White Box Testing and its types, Black Box Testing and its types Software Testing Strategies : Strategic Approach to Software Testing, Unit Testing, Integration Testing, Validation Testing, System Testing	
		1.3	Software Metrics : Concept and Developing Metrics, Different types of Metrics, Complexity metrics	

2.	Git and Deployment on AWS	2.1	Understanding Git and Github: 5	10
		2.2	AWS: What is AWS, what is Virtual Machine, setting up a personal cloud.	
		2.3	AWS components: EC2, amazon lightsail, AWS lambda, Elastic Load Balancing, Amazon S3, AWS Amplifying Hosting	
3.	Deployment using Docker Tool	3.1	Introduction to Docker: What is Docker, Docker vs virtual Machine ,Features of Docker, Components of Docker, Hub, Images, Container,	10
		3.2	Docker File: File, Building File, Managing Ports, Private Registry, Building Web Server Files,	
		3.3	Docker Container: Instruction Commands, Container Linking, Storage, Networking, Toolbox Docker Cloud- Setting Up for a specific language/platform app.	
4.	Mobile App Deployment	4.1	Introduction: What is mobile app deployment, Understanding process, methods:IaaS, BaaS, Mobile app deployment platforms.	10
		4.2	Android App Deployment: Prepare the app for release, Release the app to users, Version your app, Sign your app,Upload your app to the Play Console.	

		4.3	Flutter App Deployment: obfuscating dart code, What are flavors, Build and release an Android app: Adding a launcher icon, Enabling Material Components, Signing the app, Configure signing in gradle, Building the app for release, Build an APK, Publishing to the Google Play Store.	
			Total Lectures	40

Course Outcomes:

1. Describe fundamental concepts of software testing
2. Explore test planning and its management.
3. Understanding usage of Git repositories and github
4. Deploying an web application on AWS
5. Deployment of apps using docker container
6. Evaluating the requirements of mobile application deployment.

References :

1. Software Engineering for Students, A Programming Approach, Douglas Bell, 4th Edition,, Pearson Education, 2005
2. Git Essentials: Developer's Guide to Git by François Dupire
3. Docker Deep Dive: Zero to Docker in a single book by Nigel Poulton
4. Aws: The Ultimate Guide From Beginners To Advanced For The Amazon Web Services (2020 Edition) by Theo H King
5. Allemang, D., & Hendler, J. (2011). Semantic Web for the Working Ontologist: Effective Modeling in RDFS and OWL (2nd ed.). Morgan Kaufmann.

Reference Links:

- https://www.w3schools.com/git/
- https://aws.amazon.com/free/webapps
- https://www.udemy.com/course/aws-fast-track-to-deploying-a-web-app-the-right-way
- https://www.tutorialspoint.com/docker/index.htm
- https://docs.docker.com/get-started/
- https://medium.com/@tian3401/understanding-the-web-application-deployment-process-8b7017e99c10
- https://www.freecodecamp.org/news/lessons-learned-from-deploying-my-first-full-stack-web-application-34f94ec0a286/
- https://buddy.works/guides/5-ways-to-deploy-php-applications
- https://developer.android.com/studio/publish
- https://docs.flutter.dev/deployment

Case Studies:

1

Introduction:
In today's fast-paced digital landscape, efficient application deployment is crucial for businesses to remain competitive. This case study delves into the challenges faced by a mid-sized software company, XYZ Solutions, and how they streamlined their application deployment processes to improve efficiency and reduce time to market.
Company Background:
XYZ Solutions is a software development company specializing in enterprise-level applications for various industries. With a diverse client base and a portfolio of complex software solutions, XYZ faced challenges in deploying applications seamlessly across different environments.

2
Application deployment is the pivotal juncture where code transitions from development to production, impacting the user experience and business outcomes. This descriptive case study explores the intricate journey of application deployment, examining the processes, challenges, and strategies employed by a fictional company, TechSprint Inc., as they navigate the complexities of deploying their flagship product.
Company Overview:
TechSprint Inc. is a dynamic tech startup specializing in mobile application
development. Their flagship product, "SwiftCart," is an innovative e-commerce platform designed to revolutionize online shopping experiences.

BOS	**Computer Science**
Class	**T.Y.B.Sc. C.S.**
Semester	**VI**
Course Name	**Application Deployment Practical**
Course Code	**PUSCS610P**
Type of course	**Advanced**
Level of the Subject	**Advanced**

○

Practical No	Details
1.	Install Selenium server (Selenium RC) and demonstrate it using a script in Java/PHP.
2.	Conduct a test suite for any two web sites.
3.	Perform Testing for specific web app to be deployed using JIRA tool
4.	Setup a virtual machine on aws
5	Deploying Static app on S3
6	Deployment of backend on cloud/vm
7	Demonstrate the basic functionalities of Docker
8	Deployment of application on docker.
9	Demonstrate the process of Android App Deployment
10	Demonstrate the process of Flutter App Deployment
	Total Lectures:20

BOS	**Computer Science**
Class	**T.Y.B.Sc. C.S.**
Semester	**VI**
Course Name	**Machine Learning**
Course Code	**PUSCS604(D)**
Level of the Subject	**Advanced**

Course Objectives:

1. Understanding Human learning aspects.
2. Understanding primitives in the learning process by computer.nature of problems solved with Machine Learning

Unit No.	Name of Unit	Topic No.	Content	Hours
1	Introduction to Machine Learning, models & features.	1.1	Introduction: Machine learning, Examples of Machine Learning Problems, Learning versus Designing, Training versus Testing, Characteristics of Machine learning tasks, Predictive and descriptive tasks.	10
		1.2	Machine learning Models:Geometric Models, Logical Models, and Probabilistic Models.	
		1.3	Features: Featuretypes, Feature Construction and Transformation, Feature Selection.	

2	Classification & Regression	2.1	Classification: Binary Classification- Assessing Classification performance, Class probability Estimation, Assessing class probability Estimates, Multiclass Classification.	10
		2.2	Regression: Assessing performance of Regression- Error measures, OverfittingCatalysts for Overfitting, Case study of Polynomial Regression.	
3	Linear Model & Distance Based Model ,	3.1	Linear Models: Least Squares method, Multivariate Linear Regression, Regularized Regression, Using Least Square regression for Classification.	10
		3.2	Perceptron, Support Vector Machines, Soft Margin SVM, Obtaining probabilities from Linear classifiers, Kernel methods for non-Linearity.	
		3.3	Distance Based Models: Neighbors and Examples, Nearest Neighbors Classification, Distance based clustering-K means Algorithm, Hierarchical clustering,	
4	Rule Based Model , Tree Based Model & Probabilistic Model	4.1	Rule Based Models: Rule learning for subgroup discovery, Association rule mining.	10
		4.2	Tree Based Models: Decision Trees, Ranking and Probability estimation Trees, Regression trees, Clustering Trees.	
		4.3	Probabilistic Model: Normal Distribution and Its Geometric Interpretations, Naïve Bayes Classifier, Discriminative learning with Maximum likelihood	
Total No. of Lectures				**40**

Course Outcomes:

1. Understand the key issues in Machine Learning and its associated applications in intelligent business and scientific computing.
2. Acquire the knowledge about classification and regression techniques where a learner will be able to explore his skill to generate database knowledge using the prescribed techniques.
3. Illustrate polynomial regression technique over degree 2, degree 3 and so on.
4. Understand and implement the techniques for extracting the knowledge using machine learning methods.
5. Achieve adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.
6. Understand the statistical approach related to machine learning. He will also apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

References :

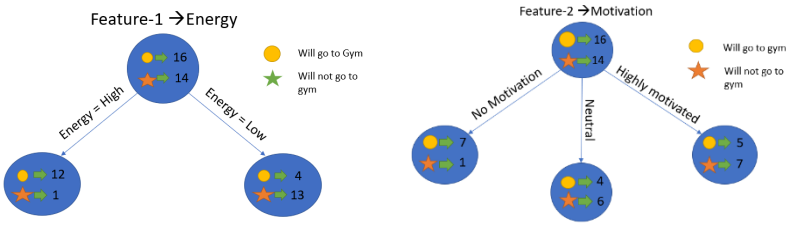
1. Machine Learning :The Art and Science of Algorithms that Make Sense of Data by Peter Flach,Publisher Cambridge University Press,2012.
2. Introduction to Statistical Machine Learning with Applications in R ,Hastie Tibshirani,Friedman ,Publisher Springer ,2nd Edition 2012.
3. Introduction to Machine Learning ,Author EthemAlpaydin ,Publisher PHI ,2nd Edition,2013
4. https://www.w3schools.com/git/
5. https://aws.amazon.com/free/webapps
6. https://www.udemy.com/course/aws-fast-track-to-deploying-a-web-app-the-right-way

Case Studies:

1. Suppose our entire population has a total of 30 instances. The dataset is to predict whether the person will go to the gym or not. Let's say 16 people go to the gym and 14 people don't. Consider the following two features to predict whether he/she will go to the gym or not.

   Feature 1 is "Energy" which takes two values "high" and "low"

   Feature 2 is "Motivation" which takes 3 values "No motivation", "Neutral" and "Highly motivated".



2 .A marketing company aims to identify potential customers for their recently launched product. Employees are eager to pinpoint a specific group of customers likely to be interested in purchasing the new product. The provided customer data will be analyzed to determine and target individuals who are more inclined to buy the newly launched product.

CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
C1	Male	19	15	39
C2	Male	21	15	81
C3	Female	20	16	6
C4	Female	23	16	77
C5	Female	31	17	40
C6	Female	22	17	76
C7	Female	35	18	6
C8	Female	23	18	94
C9	Male	64	19	3
C10	Female	30	19	72

Cluster 1 Centroid(K1) is C2 and Cluster 2 centroid(K2) is C7

BOS	**Computer Science**
Class	**T.Y.B.Sc. C.S.**
Semester	**VI**
Course Name	**Machine Learning Practical**
Course Code	**PUSCS610P**
Level of the Subject	**Advanced**

Practical No	**Details**
1	Feature Engineering
2	Linear Regression
3	Comparison between Linear , polynomial ,Lasso and Ridge Regression
4	Support Vector Machine (SVM)
5	K-Nearest Neighbors
6	K-Mean Clustering
7	Hierarchical Clustering (AgglomerativeSingle Linkage)
8	Apriori Algorithm
9	Probabilistic Model - Naive Bayes
10	Random Forest Algorithm (Bagging)
	Total lectures:20

BOS	**Computer Science**
Class	**T.Y.B.Sc.C.S**
Semester	**VI**
Subject Name	**Ethical Hacking**
Subject code	**PUSCS605**
Level of The Subject	**Medium**

Course Objectives:

1. To understand the ethics, legality, methodologies and techniques of hacking.
2. To understand security concepts,vulnarabilities ,testing tools,hacking techniques to provide security to an application.

Unit No.	Name of Unit	Topic No.	Contents	Hours
1	Information	1.1	Attacks and Vulnerabilities	10
	Security		Introduction to information security : Asset, Access Control, CIA, Authentication, Authorization, Risk, Threat, Vulnerability, Attack, Attack Surface, Malware, SecurityFunctionality-Ease of Use Triangle	
		1.2	Types of malware :Worms, viruses, Trojans, Spyware, Rootkits Types of vulnerabilities : OWASP Top 10 : cross-site scripting (XSS), cross site request forgery (CSRF/XSRF), SQL injection, input parameter manipulation	
		1.3	Broken authentication, sensitive information disclosure, XML External Entities, Broken access control, Security Misconfiguration, Using components with known vulnerabilities, Insufficient Logging and monitoring, OWASP Mobile Top 10, CVE Database	

2	Ethical	2.1	Case-studies : Recent attacks – Yahoo, Adult	10
	Hacking – I (Introduction and preattack)		Friend Finder, eBay, Equifax, WannaCry, Target Stores, Uber, JP Morgan Chase, Bad Rabbit	
		2.2	Introduction: Black Hat vs. Gray Hat vs. White Hat (Ethical) hacking, Why is Ethical hacking needed?, How is Ethical hacking different from security auditing and digital forensics?	
		2.3	Signing NDA, Compliance and Regulatory concerns, Black box vs. White box vs. Black box, Vulnerability assessment and Penetration Testing.	
3	Ethical Hacking	3.1	Approach : Planning - Threat Modeling, set up security verification standards, Set up security testing plan – When, which systems/apps, understanding functionality, black/gray/white, authenticated vs. unauthenticated, internal vs. external PT, Information gathering, Perform Manual and automated (Tools: WebInspect/Qualys, Nessus, Proxies, Metasploit) VA and PT, How WebInspect/Qualys tools work: Crawling/Spidering, requests forging, pattern matching to known vulnerability database and Analyzing results, Preparing report, Fixing security gaps following the report	10

		3.2	Enterprise strategy : Repeated PT, approval by security testing team, Continuous Application Security esting.	
		3.3	Phases:Reconnaissance/footprinting/Enumeration, Phases:Scanning, Sniffing	
4	Enterprise Security	4.1	Phases : Gaining and Maintaining Access : Systems hacking – Windows and Linux – Metasploit and Kali Linux, Keylogging, Buffer Overflows, Privilege Escalation, Network hacking -ARP Poisoning, Password Cracking, WEP Vulnerabilities, MAC Spoofing, MAC Flooding, IPSpoofing, SYN Flooding, Smurf attack,	10
		4.2	Applications hacking : SMTP/Email-based attacks, VOIP vulnerabilities, Directory traversal, Input Manipulation, Brute force attack, Unsecured login mechanisms, SQL injection, XSS, Mobile apps security, Malware analysis : Netcat Trojan, wrapping definition, reverse engineering	
		4.3	Phases : Covering your tracks : Steganography, Event Logs alteration Additional Security Mechanisms : IDS/IPS,	
			Honeypots and evasion techniques, Secure Code Reviews (Fortify tool, OWASP Secure Coding Guidelines)	
	Total No of Lectures			**40**

Course Outcomes:

1. Discuss different Ethical hacking and penetration testing techniques.
2. Understand various types of attacks, attackers and security threats and vulnerabilities present in the computer system.

3. Analyze social engineering attacks to gain access to useful & sensitive information.
4. Evaluate different cryptographic, and web application attacks.
5. Illustrate different tools used in webinspect.
6. Create and Understand different protection tools.

References:

1. Certified Ethical Hacker Study Guide v9, Sean-Philip Oriyano, Sybex; Study Guide Edition,2016
2. CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, 2007
3. Certified Ethical Hacker: Michael Gregg, Pearson Education,1st Edition, 2013
4. Certified Ethical Hacker: Matt Walker, TMH,2011
5. http://www.pentest-standard.org/index.php/PTES_Technical_Guidelines
6. https://www.owasp.org/index.php/Category:OWASP_Top_Ten_2017_Project

Case study 1

Data breach occurred on Yahoo! servers in August 2013.Yahoo! stated this was a separate breach from the late 2014 one and was conducted by an"unauthorized third party".Yahoo revealed the breach on December 14th via Tumblr. It affected over 3 billion user accounts, but last year Yahoo said the 2013 attack on its network had affected 1 billion user account.Three months before that, the company disclosed a separate attack, which occurred in 2014, that had affected 500 million accounts.They believe that the two breaches are unrelated.The 2014 breach had been taken from over 500 million user accounts, including unencrypted security questions and answers.The hackers were able to take the names, telephone number, email address, date of birth, and even hashed passwords were taken.They have even found that it is possible that encrypted and unencrypted security questions and answers were accessed.However, the stolen information did not include payment or bank account details.Yahoo forced all affected users to change passwords, and to reenter any unencrypted security questions and answers to make them encrypted in the future.The bit.ly URL that is used in the attachment to the affected users.The URL redirects you to a fake MSNBC page that reportedly hijacks your Yahoo Mail account immediately if you are logged in.

Case study 2

Equifax, one of the three major consumer credit reporting agencies on May 13, the hacker hit the jackpot with Equifax's dispute portal, where people could go to argue about claims.There, hackers used an Apache Struts vulnerability, a months-old issue that Equifax knew about but failed to fix, and gained access to login credentials for three servers. They found that those credentials allowed them to access another 48 servers containing personal information.The thieves spent 76 days within Equifax's network before they were detected. According to the report, the hackers stole the data piece by piece from 51 databases so they wouldn't raise any alarms.Equifax didn't know about the attack until July 29, more than two months later, and cut off access to the thieves on July 30.On September 7, 2017, Equifax announced some troubling information for consumers – a cybersecurity failure had led to hackers gaining access to the information of about 143 million people.Hackers were able to get people's names, addresses, birth dates and Social Security numbers.They got some people's driver's license numbers, and for about 209,000 people, they also stole credit card numbers.Equifax security first noticed the suspicious traffic related to its online

dispute’s portal on July29. It blocked that traffic, but there was more suspicious traffic the next day, at which point they took that disputes app down entirely.Next, the credit agency hired Mandiant, an independent cybersecurity firm, to investigate what happened. That investigation started on August 2.Equifax made its announcement regarding the breach and the scope of it on September 7. The fact that it waited that long has also led to quite a bit of criticism, although Equifax claims this is because it needed to gather data.

BOS	**Computer Science**
Class	**T.Y.B.Sc.C.S**
Semester	**VI**
Subject Name	**Ethical Hacking Practical**
Subject code	**PUSCS609P**
Level of The Subject	**Medium**

Practical No	Details
1.	Use Google and Whois for Reconnaissance
2.	Use CrypTool a. to encrypt and decrypt passwords using RC4 algorithm b. Use Cain and Abel for cracking Windows account password using Dictionary attack and to decode wireless network passwords
3.	a. Run and analyze the output of following commands in Linux – ifconfig, ping, netstat, traceroute b. Perform ARP Poisoning in Windows
4.	Use NMap scanner to perform port scanning of various forms – ACK, SYN, FIN, NULL, XMAS
5.	a. Use Wireshark (Sniffer) to capture network traffic and analyze b. Use Nemesy to launch DoS attack
6.	Simulate persistent cross-site scripting attack
7.	Session impersonation using Firefox and Tamper Data add-on
8.	Perform SQL injection attack
9.	Create a simple keylogger using python
10.	Using Metasploit to exploit (Kali Linux)
	Total lectures:20

BOS	**Computer Science**
Class	**T.Y.B.Sc.C.S.**
Semester	**VI**
Course Name	**Project Implementation**
Course Code	**PUSCS606**
Type of course	**Skill Enhancement**
Level of the Subject	**Moderate**

	Project Implementation Guidelines
•	A learner is expected to carry out one project: in Semester V
•	A learner can choose any topic which is covered in Semester I- semester V or any other Topic with the prior approval from the head of the department/ project in charge.
•	The Project has to be performed individually.
•	The project can be application oriented/web-based/database/research based.
•	It has to be an implemented work; just theoretical study will not be acceptable.
•	A learner can choose any programming language, computational techniques and tools Which have been covered during BSc course or any other with the prior permission of head of the department/ project guide
•	A project guide should be assigned to a learner. He/she will assign a schedule for the Project and hand it over to a learner. The guide should oversee the project progress on a weekly basis

•	A learner has to maintain a project report with the following subsections a) Title Page b) Certificate A certificate should contain the following information -The fact that the student has successfully completed the project as per the syllabus and that it forms a part of the requirements for completing the BSc degree in computer science. ➢ The name of the student and the project guide ➢ The academic year in which the project is done ➢ Date of submission, ➢ Signature of the project guide and the head of the department with date along with the department stamp, Space for signature of the university examiner and date on which the project is evaluated. c) Self-attested copy of Plagiarism Report from any open source tool. d) Index Page detailing description of the following with their subsections: ➢ Title: A suitable title giving the idea about what work is proposed. ➢ Introduction: An introduction to the topic giving proper background of the topic. ➢ Requirement Specification: Specify Software/hardware/data requirements. ➢ System Design details : ➢ Methodology/Architecture/UML/DFD/Algorithms/protocols etc. used(whichever is applicable) ➢ System Implementation: Code implementation ➢ Results: Test Cases/Tables/Figures/Graphs/Screenshots/Reports etc. ➢ Conclusion and Future Scope: Specify the Final conclusion and ➢ future scope ➢ References: Books, web links, research articles, etc.
	The size of the project report shall be , excluding the code.
•	Project two copies should be submitted one as a black book and one in spiral bound form
•	The Project should be certified by the concerned Project guide and Head of the department.
•	A learner has to make a presentation of a working project and which will be evaluated .

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