D Y PATIL
COLLEGE of
ENGINEERING & TECHNOLOGY
(AN AUTONOMOUS INSTITUTE)
KASABA BAWADA, KOLHAPUR

D. Y. Patil College of Engineering and Technology

Kasaba Bawada, Kolhapur

(An Autonomous Institute)

NBA Accredited

Accredited by NAAC with 'A' Grade

Structure and Syllabus

(As per NEP 2020)

for

Third Year B. Tech in Computer Science and Engineering

Department of Computer Science and Engineering

W. e. f. 2025-26

SEMESTER-V													
				Teaching Scheme				Theory			Practical		Total Marks
Course Code	Course Category	Course Type	Course Name	Credits	L	P	T	ISE	MSE	ESE	INT	OE/ PoE	
231CSEPCCL301	Program Core Courses	PCC	Cloud Computing	3	3	-	-	20	30	50	-	-	100
231CSEPCCP302			Cloud Computing Laboratory	1	-	2	-	-	-	-	50	-	50
231CSEPCCL303			Design and Analysis of Algorithms	3	3	-	-	20	30	50	-	-	100
231CSEPCCP304			Advanced Programming Concepts	3	2	2	-	-	-	-	50	50	100
231CSEPCCP305			Advanced Java Technologies	2	1	2	-	-	-	-	25	25	50
231CSEMDML301	Multidisciplinary Minor	MDM-3	Software Testing using Programming (ODL)	4	2$	-	-	20	30	50	25	-	125
231CSEOECL301	Open Elective Course	OEC-III	Security and Privacy in Social Media	2	2	-	-	-	-	50	-	-	50
231CSEOECL302			Android App Development										
231CSEOECL303			SQL Programming										
231CSEPECL301-306	Professional Elective	PEC-1	List is attached	4	3	2	-	20	30	50	25	-	125
231CSEMCL301	Mandatory Course	MC	Finishing School Training V	Audit	3*	-	-	50	-	-	-	-	Grade
231CSECCAP301	Co-Curricular Activities	CCA	Liberal Learning	Audit	2	-	-	50	-	-	-	-	Grade
			Total	**22**	**16**	**8**	**-**	**80**	**120**	**250**	**175**	**75**	**700**
231CSEHCL301A/ 301B/301C	Honors Courses/Double (Minor)	HC (Optional)	Honors Paper- II (ODL)	04	3	1	-	20	30	50	25	-	125

Professional Elective Course -1

Course Code	Course Name	Course Code	Course Name	Course Code	Course Name
231CSEPECL301	Introduction to Artificial Intelligence	231CSEPECL303	Information Security	231CSEPECL305	Introduction to IoT
231CSEPECL302	Introduction to Data Science	231CSEPECL304	Software Engineering	231CSEPECL306	Business Analytics

SEMESTER- VI													
				Teaching Scheme				Theory			Practical		Total Marks
Course Code	Course Category	Course Type	Course Name	Credits	L	P	T	ISE	MSE	ESE	INT	OE/ PoE	
231CSEPCCL306	Program Core Courses	PCC	Compiler Design	3	3	-	-	20	30	50	-	-	100
231CSEPCCL307			Structured Database	3	3	-	-	20	30	50	-	-	100
231CSEPCCP308			Structured Database Laboratory	1	-	2	-	-	-	-	50	-	50
231CSEPCCP309			Scripting Concepts	3	2	2	-	-	-	-	50	50	100
231CSEMDML302	Multidisciplinary Minor	MDM-4	Selenium Framework	2	2	-	-	-	-	50	-	-	50
231CSEPECL307-312	Professional Elective	PEC-2	List is attached	4	3	2	-	20	30	50	25	-	125
231CSEPECL313-318		PEC-3	List is attached	4	3	2	-	20	30	50	25	-	125
231CSEVSECL301	Vocational Skills Enhancement Course	VSEC	Mobile Application Development	2	1	2	-	-	-	-	25	25	50
231CSEMCL302	Mandatory Course	MC	Finishing School Training VI	Audit	3*	-	-	50	-	-	-	-	Grade
231CSECCAP302	Co-Curricular Activities	CCA	Liberal Learning	Audit	2	-	-	50	-	-	-	-	Grade
			Total	**22**	**17**	**10**	**-**	**80**	**120**	**250**	**175**	**75**	**700**
231CSEHCL302A/302B/302C	Honors Courses/Double (Minor)	HC (Optional)	Honors Paper- III	04	3	1	-	20	30	50	25	-	125

Professional Elective Course -2

Course Code	Course Name	Course Code	Course Name	Course Code	Course Name
231CSEPECL307	Introduction Machine Learning	231CSEPECL309	Web and Network Security	231CSEPECL311	Introduction to Social Media Analytics
231CSEPECL308	Data Visualization Techniques	231CSEPECL310	Software Architecture	231CSEPECL312	Software Defined Network

Professional Elective Course -3

Course Code	Course Name	Course Code	Course Name	Course Code	Course Name
231CSEPECL313	Prompt Engineering	231CSEPECL315	Cyber Security and Digital Forensics	231CSEPECL317	High Performance Computing
231CSEPECL314	Big Data Analytics	231CSEPECL316	Software Testing	231CSEPECL318	Search Engine Optimization

Honors Courses					
Semester-V			Semester-VI		
Domain	**Course Code**	**Course Name**	**Domain**	**Course Code**	**Course Name**
Cyber Security	231CSEHCL301A	Data Security Systems	**Cyber Security**	231CSEHCL302A	Security Incident and Event Management
Full Stack Web Development	231CSEHCL301B	ReactJS with MUI	**Full Stack Web Development**	231CSEHCL302B	Back End Development
Full Stack Mobile Development	231CSEHCL301C	Hybrid Platform Mobile App Development	**Full Stack Mobile Development**	231CSEHCL302C	Backend with Google Firebase-I

Third Year CSE B. Tech. Syllabus

Semester-V

Course Title: Cloud Computing	
Course Code: 231CSEPCCL301	Semester: V
Teaching Scheme: L-T-P: 3-0-0	Credits: 3
Evaluation Scheme: ISE + MSE Marks: 20+30=50	ESE Marks: 50

Prerequisite:	Basics of Computer Networks, Operating Systems

Course Description:

This course provides students with an insight of architecture of cloud computing and virtualization. The course covers key cloud service models—IaaS, PaaS, and SaaS—along with cloud deployment strategies and migration processes. It also includes the important aspects of security and future trends in cloud computing environment

Course Objectives:

1	To understand Cloud Computing and its ecosystem.
2	To learn the basics of virtualization and its importance.
3	To understand the arrangement of various cloud computing platforms.
4	To study the operation of cloud deployment.
5	To understand security and future trends in cloud computing.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
PCC301.1	Describe the evolution of cloud, architecture and role of virtualization in cloud computing.
PCC301.2	Exploring the architecture and infrastructure of cloud computing including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud etc.
PCC301.3	Study of the deployment parameters of cloud computing.
PCC301.4	Understand cloud computing security.
PCC301.5	Explore and assess future trends in cloud computing such as AI integration, serverless computing, and edge computing.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PCC301.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1
PCC301.2	2	-	-	-	-	-	-	-	-	-	-	-	-	2	2
PCC301.3	-	-	2	-	-	-	-	-	-	-	-	-	-	-	2
PCC301.4	-	-	2	-	-	-	-	-	-	-	-	-	1	-	2
PCC301.5	2	1	-	1	2	-	-	-	-	-	-	-	-	-	3

Contents	Duration
Unit 1: Cloud Basics & its Architecture Grid Computing vs. Cloud Computing, Evolution of Cloud Computing- From Mainframes to Cloud Computing, Key Benefits of Cloud Computing- Scalability, Cost Efficiency, SOA, and Resource Sharing, Challenges in Cloud Computing, Cloud Architecture- NIST Cloud Computing Model, Essential Characteristics of Cloud Computing, Cloud Service Models (IaaS, PaaS, SaaS), Cloud Deployment Models (Public, Private, Hybrid, Multi-Cloud), Cloud Reference Model, Cloud Computing Platforms: OpenStack, OpenNebula, Eucalyptus	**8 Hrs**
Unit 2: Virtualization – Need for Virtualization, Types of Virtualizations- Server Virtualization, Network Virtualization (SDN, NFV), Storage Virtualization, Desktop Virtualization, Hypervisors: Type 1 vs. Type 2 Hypervisors (VMware ESXi, KVM, Xen, Hyper-V), Implementation Levels of Virtualization, Virtualization Mechanisms, Open-Source Virtualization Technologies, Xen Virtualization Architecture, Full Virtualization vs. Paravirtualization, Introduction to Virtual Networking: SDN (Software-Defined Networking), NFV (Network Functions Virtualization), Virtual Private Cloud (VPC)	**6 Hrs**
Unit 3: Cloud Computing Platforms & Cloud-Native Technologies Cloud Computing Stack: Composability, Infrastructure, Platforms, Virtual Appliances, Cloud Service Models: Infrastructure as a Service (IaaS), Software as a Service (SaaS), Platform as a Service (PaaS), Identity as a Service (IDaaS), Compliance as a Service (CaaS), SaaS: Overview, Advantages, Challenges, PaaS: Overview, Functionalities,	**8 Hrs**

Application Frameworks, Cloud-Native Technologies: Containers vs. Virtual Machines, Docker: Architecture, Workflow, Benefits, Kubernetes: Introduction, Architecture, Components (Pods, Nodes, Clusters, Deployments, Services), Container Orchestration and Management, Serverless Computing and FaaS (Function as a Service)	
Unit 4: Deploying Cloud Solutions & Practical Implementations Cloud Deployment Strategies: Public, Private, Hybrid, Multi-Cloud Approaches, Deploying Cloud Datacenters using OpenStack, OpenNebula, Virtualization in Cloud Data Centers, Hands-on Deployment with Open-Source Tools: Setting Up Private/Public Cloud Environments, Deploying Virtual Machines and Containers, Managing Cloud Resources using Terraform, Major Cloud Service Providers & Offerings: Amazon Web Services (AWS), Google Cloud Platform (GCP), Microsoft Azure, Cloud Application Development & Management: SaaS, PaaS, IaaS Implementations, DevOps in Cloud Computing, CI/CD Pipelines with Jenkins, Docker, Kubernetes, Serverless Computing and Cloud Functions	**8 Hrs**
Unit 5: Security in Cloud Computing – Cloud Security Fundamentals, Data Security in the Cloud: Encryption, Key Management, Access Control, Identity and Access Management (IAM), Security Challenges in Cloud Computing: Threats & Vulnerabilities in Cloud Environments, Patch and Configuration Management, Security-as-a-Service (SECaaS), Zero Trust Security in Cloud Computing, Container Security: Best Practices for Securing Docker & Kubernetes Environments	**7 Hrs**
Unit 6: Future of Cloud Computing Emerging Cloud Trends: Edge Computing & Fog Computing, AI & Machine Learning in Cloud Computing, Multi-Cloud & Hybrid Cloud Strategies, Quantum Computing & Cloud Integration, Cloud-Native Development & Future Architectures: Microservices & Serverless Computing, Cloud-Based AI/ML Workloads, Cloud for IoT & 5G Integration, Intelligent Cloud Fabrics & Smart Computing Environments, Case Study: Docker at a Glance: Process Simplification, Architecture, Best Practices, Kubernetes for Enterprise Workloads: Advantages & Challenges	**5 Hrs**

Text Books:

1	Rajkumar Buyya, James Broberg, A. Goscinski, "Mastering cloud computing", 1st edition,2017 (Unit 1, 2, 3)
2	Gautam Shroff, "Enterprise Cloud Computing: Technology, Architecture, Applications", Cambridge University press, 2010. (Unit 4 and 5)
3	Anthony T. Velte Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", 2010, The McGraw-Hill. (Unit 6)

Reference Books:

1	Ronald Krutz and Russell Dean Vines, "Cloud Security", Wiley-India.
2	Thomas Erl, Zaigham Mahmood and Ricardo Puttini, Cloud Computing: Concepts, Technology & Architecture, Pearson, ISBN :978 9332535923, 9332535922, 1st Edition

Useful Link /Web Resources:

1. https://www.geeksforgeeks.org/cloud-computing/
2. https://www.pluralsight.com/cloud-guru
3. https://www.datacamp.com/courses/understanding-cloud-computing
4. https://onlinecourses.nptel.ac.in/noc21_cs15/preview

*****

Course Title: Cloud Computing Laboratory	
Course Code: 231CSEPCCP302	Semester: V
Teaching Scheme: L-T-P: 0-0-2	Credits: 1
Evaluation Scheme: ISE Marks: NA INT Marks: 50	ESE Marks: NA

Prerequisite:	Basics of Computer Networks, Operating Systems

Course Description:

This hands-on cloud computing course offers practical experience in configuring and managing cloud infrastructure, covering essential topics such as NTP client/server setup, Type 1 (ESXi) and Type 2 (VMware, VirtualBox) hypervisor implementations, and the deployment of Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) models. Participants will engage in labs focused on Docker for containerization, along with deployment and configuration exercises across major cloud platforms like AWS, Google Cloud, and Microsoft Azure. By the end of the course, students will gain competencies in hybrid cloud architectures, troubleshooting, security hardening for virtualization environments, and cost-optimized resource provisioning strategies, culminating in lab exercises using the available technologies.

Course Objectives:

1	To configuring and managing cloud infrastructure including virtualization.
2	To implement and analyze the various services of the cloud computing environment.
3	To study cloud deployment from proprietary services like Amazon, Microsoft, Google etc.
4	To provide hands-on user interface experience of cloud service.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
PCC302.1	Understand and configure the cloud services such as virtualization.
PCC302.2	Install and configure services like Google App engine.
PCC302.3	Study and implement infrastructure as Service using OpenStack

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PCC302.1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2
PCC302.2	2	1	-	-	-	-	-	-	-	-	-	-	2	-	3
PCC302.3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	3

List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	Configuring the Client/Server for NTP	O	2
2	Installing OS on a Virtual Machine Monitor.	O	2
3	Installation and configuration of type 1 Hypervisor. (Esxi)	S	2
4	Installation and configuration of type 2 Hypervisor (VMware, Virtual Box, etc.)	O	2
5	Working and Implementation of Infrastructure as a service.	O	2
6	Working and Implementation of Software as a service.	O	2
7	Working and Implementation of Platform as a service.	O	2
8	Study and configuration of docker.	S	2
9	Hands on containerization using Docker.	O	2
10	Deployment and Configuration options in Amazon (AWS).	O	2
11	Deployment and Configuration options in Google Cloud.	O	2
12	Deployment and Configuration options in Microsoft Azure.	O	2
13	Implementation and analysis of OpenStack for IaaS.	O	2
14	Study and implement Dashboard (Horizon): Web-based management interface for OpenStack.	O	2

S-STUDY, O-OPERATIONAL

Note: The instructor should take at least 10 to 12 experiments from the list.

Text Books:

1	Rajkumar Buyya, James Broberg, A. Goscinski, "Mastering cloud computing", 1st edition, 2017
2	Gautam Shroff, "Enterprise Cloud Computing: Technology, Architecture, Applications", Cambridge University press, 2010
3	Anthony T. Velte Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", 2010, The McGraw-Hill

Reference Books:

1	Ronald Krutz and Russell Dean Vines, "Cloud Security", Wiley-India.
2	Thomas Erl, Zaigham Mahmood and Ricardo Puttini, Cloud Computing: Concepts, Technology & Architecture, Pearson, ISBN :978 9332535923, 9332535922, 1st Edition

Useful Link /Web Resources:

1. https://www.geeksforgeeks.org/cloud-computing/
2. https://www.pluralsight.com/cloud-guru
3. https://www.datacamp.com/courses/understanding-cloud-computing
4. https://onlinecourses.nptel.ac.in/noc21_cs15/preview

*****

Course Title: Design and Analysis of Algorithms	
Course Code: 231CSEPCCL303	Semester: V
Teaching Scheme: L-T-P: 3-0-0	Credits: 3
Evaluation Scheme: ISE + MSE Marks: 20+30=50	ESE Marks: 50

Prerequisite:	Data Structures, Discrete Mathematics, Engineering Mathematics, Programming Concepts.

Course Description:

This course introduces basic methods for the design and analysis of efficient algorithms. Different algorithms for a given computational task are presented and their relative merits evaluated based on performance measures. It introduces the fundamental techniques for designing and analyzing algorithms, including asymptotic analysis, divide-and-conquer algorithms, greedy algorithms, dynamic programming, traversal methods and even backtracking approach. It also provides an introduction to NP-completeness.

Course Objectives:

1	To introduce algorithm design methods / techniques with analysis.
2	To devise algorithm for given problem statement and compute its complexity.
3	To introduce complex computational problems.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
PCC303.1	Understand and demonstrate algorithm design methods namely divide and conquer, greedy and backtracking with complexity analysis.
PCC303.2	Devise an algorithm for a given problem statement and analyze its space and time complexity.
PCC303.3	Apply and analyze graph traversal and Dynamic programming algorithmic approach.
PCC303.4	Understand the terms P, NP, NP Hard, NP Complete problems.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PCC303.1	3	3	-	-	-	-	-	-	-	1	-	-	2	-	3
PCC303.2	3	3	-	-	-	-	-	-	-	1	-	-	2	-	4
PCC303.3	3	3	-	-	-	-	-	-	-	1	-	-	2	-	3
PCC303.4	3	3	-	-	-	-	-	-	-	-	-	-	1	-	2

Contents	Duration
Unit 1: Divide and Conquer What is algorithm, Algorithm Specification, Recurrence relations, Performance Analysis, Randomized Algorithms, Divide and Conquer: The general method, Binary search, Finding the maximum and minimum, Merge sort, Quick sort, DC Selection Algorithm, analysis of Divide and Conquer algorithms.	**10 Hrs**
Unit 2: The Greedy Method The general method, Knapsack problem, Job sequencing with deadlines, minimum-cost spanning trees – Prim's and Kruskal's Algorithms, Optimal storage on tapes, Optimal merge Patterns, Single source shortest paths	**7 Hrs**
Unit 3: Backtracking The general method, 8-queen problem, sum of subsets, Knapsack Problem, Hamiltonian Cycle, and Graph Coloring	**7 Hrs**
Unit 4: Basic Traversal and Search Techniques Techniques for Binary Trees, Game Tree; Techniques for Graphs – Breadth First Search & Traversal, Depth First Search & Traversal, AND/OR graphs; Connected components and Spanning Trees; Bi-connected components and depth first search.	**6 Hrs**
Unit 5: Dynamic Programming The general method, Multistage graphs, All pair shortest paths, 0/1 knapsack, Reliability design, Traveling Salesperson problem	**7 Hrs**
Unit 6: NP Hard, NP Complete Problems Basic Concepts, Introduction to NP Hard Graph Problems.	**6 Hrs**

Text Books:

1	Ellis Horowitz, Satraj Sahani, Saguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Second Edition, "Universities Press", (All Units).

Reference Books:

1	Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, and Clifford Stein , "Introduction to Algorithms", " MIT Press"
2	Gilles Brassard, Paul Bratley, "Fundamentals of Algorithmics", "Pearson Education"
3	Kyle Loudon, "Mastering Algorithms with C"', "SPD O'Reilly".
4	Allen Van Gelder, Sara Baase, "Computer Algorithms- Introduction to Design and Analysis", "Pearson Education".

Useful Link /Web Resources:

1. NPTEL course: https://onlinecourses.nptel.ac.in/noc20_cs10/preview
2. Virtual Lab Links for practicing various problems:

   https://ds2-iiith.vlabs.ac.in/exp/min-spanning-trees/index.html

*****

Course Title: Advanced Programming Concepts	
Course Code: 231CSEPCCP304	Semester: V
Teaching Scheme: L-T-P: 2-0-2	Credits: 3
Evaluation Scheme: ISE + MSE Marks: NA INT Marks: 50	ESE POE Marks: 50

Prerequisite:	Knowledge of any programming language like C/C++.

Course Description:

Python is a high-level programming language that helps in developing a wide variety of applications, including web applications, network programming, graphical user interfaces (GUIs), scientific and numeric applications. It also has a strong community around machine learning, data modeling, data analysis and artificial intelligence (AI), with extensive resources and libraries.

Course Objectives:

1	To make the student learn the basics of Python programming language.
2	To expose the students to various data structures.
3	To make the students aware of various Object-Oriented concepts.
4	To expose the students to advanced concepts in Python

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
PCC304.1	Summarize the basic concepts in python.
PCC304.2	Identify the data structures to solve a problem.
PCC304.3	Demonstrate the use of Object-Oriented concepts in problem solving.
PCC304.4	Apply Python concepts in web applications using the Django framework.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PCC304.1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	2
PCC304.2	3	3	2	1	1	-	-	-	-	-	-	-	2	-	3
PCC304.3	3	3	2	2	1	-	-	-	-	-	-	-	2	3	3
PCC304.4	3	3	1	1	1	-	-	-	3	-	-	-	3	3	3

Contents	Duration
Unit 1: Getting started with Python basics: Python Installation and Working of it, Data types in python, Operators in python, Input and Output, detail study of python blocks, Control statements, Branching statements, String and Character in python, List and Tuples, Sets, Dictionaries, Arrays in python, Functions, Lambda Functions.	**10 Hrs**
Unit 2: Files in Python: Files in Python, Directories, Building Modules, Packages, Exception Handling	**7 Hrs**
Unit 3: OOP Concepts and Python Libraries: Procedural and Object-Oriented Programming, Objects, class, Method overloading, Polymorphism, Inheritance. Introduction to python libraries like NumPy, Pandas, Matplotlib, NLTK, Regular expression (re) **Case Study** – Scikit-learn, PyGame (Self Study)	**8 Hrs**
Unit 4: Advanced Python: Introduction to tkinter for GUI, Introduction to Django, Installation, Creation of local server, projects and apps using Django, **Case Study** - Database connectivity in Django (Self Study)	**5 Hrs**

List of Experiments			
Exp. No.	Name of Experiment	S/O	Hours
1	Study Python basics.	S	2
2	Installation and Configuration of python with IDE's.	O	2
3	Implementation of List, Tuples and Array.	O	2
4	Implementation of String, Set and Dictionaries.	O	2
5	Implementation of functions and lambda functions.	O	2
6	Write a program for demonstration on File and directory handling.	O	2
7	Implementation of classes and objects, constructors and destructors.	O	2
8	Implementation of inheritance, polymorphism.	O	2
9	Implementation of Array operations using NumPy and Pandas.	O	2
10	Implementations of Different graphs in Matplotlib.	O	2
11	Implementation of GUI using Tkinter.	O	2
12	Creating applications using Django web framework to demonstrate functionality of user login and its validation using regular expression.	O	2
13	Create the Mini project using python programming for solving real time problems.	O	6

❖ **S-STUDY, O-OPERATIONAL**

Text Books:

1	"Python Crash Course- a Hands-On Project Based Introduction to Programming", Eric Matthes, No starch press, San Francisco.

Reference Books:

1	"Learn Python", Mark Lutz, 4th Edition, O'REILLY Publication.
2	"Think Python", Allen B. Downey, 2nd Edition, O'REILLY Publication
3	"Python Projects", Laura Cassell, Alan Gauld, Wrox Publication

Useful Link /Web Resources:

1. https://nptel.ac.in/courses/106/106/106106182
2. https://www.python.org/

*****

Course Title: Advanced Java Technologies	
Course Code: 231CSEPCCP305	Semester: V
Teaching Scheme: L-T-P: 1-0-2	Credits: 2
Evaluation Scheme: ISE + MSE Marks: NA INT Marks:25	ESE POE Marks: 25

Prerequisite:	Basic understanding of Core Java (OOPs, Collections, Exception Handling), Fundamentals of HTML, CSS, JavaScript, Basic knowledge of SQL and Database Management Systems

Course Description:

This course introduces advanced Java technologies for enterprise application development, covering Servlets, JSP, Java EE, Hibernate, Spring Boot, and Microservices. It provides hands-on experience in building scalable, secure, and high-performance web applications using industry-standard frameworks and tools.

Course Objectives:

1	To understand Java Servlets and JSP for web application development.
2	To explore Enterprise Java concepts including JavaBeans and WebSockets.
3	To implement ORM techniques using Hibernate.
4	To develop RESTful APIs using Spring Boot.
5	To introduce Microservices architecture and cloud deployment.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
PCC305.1	Develop dynamic web applications using Java Servlets and JSP.
PCC305.2	Implement enterprise applications using Java EE technologies.
PCC305.3	Apply Hibernate ORM techniques for efficient database handling.
PCC305.4	Build and deploy RESTful APIs using Spring Boot.
PCC305.5	Design Microservices-based applications and deploy them on cloud platforms.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PCC305.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	2
PCC305.2	-	2	-	-	-	-	-	-	-	-	-	-	2	-	3
PCC305.3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	3
PCC305.4	1	3	2	-	-	-	-	-	-	-	-	-	1	-	4
PCC305.5	-	2	-	-	-	-	-	-	-	-	-	-	-	-	4

Contents	Duration
Unit 1: Java Servlets Introduction to Java EE and Servlets, Servlet Lifecycle & Request Handling, Session Management (Cookies, URL Rewriting, HttpSession API), Servlet Collaboration & Filters	**2 Hrs**
Unit 2: Java Server Pages (JSP) and Java EE (Enterprise Edition) JSP Lifecycle & Directives, Scriptlets, Declarations, and Expressions, MVC Architecture with JSP & Servlets, JDBC Integration with JSP, Enterprise JavaBeans (EJB) and JavaBeans, JavaMail API for Email Services, Web Sockets & JSON Processing	**4 Hrs**
Unit 3: Hibernate & ORM Introduction to Hibernate and ORM, Hibernate Architecture & Configuration, Hibernate Query Language (HQL), Caching in Hibernate, Spring Boot Integration with Hibernate.	**3 Hrs**
Unit 4: Spring Boot and Microservices Spring Framework Basics (IoC, Dependency Injection), Spring Boot Starters and Auto-Configuration, Developing RESTful APIs with Spring Boot, Logging and Testing with JUnit and Mockito, Spring Boot Security (JWT, OAuth2), Spring Boot with Databases (MySQL, PostgreSQL, Spring Data JPA), Microservices with Spring Boot, Spring Cloud (Eureka, API Gateway, Resilience4J), Cloud Deployment (AWS, Docker, Kubernetes, Jenkins CI/CD).	**6 Hrs**

List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	Implement a Java Servlet to handle HTTP requests.	O	2
2	Develop a user session management system using HttpSession API.	O	2
3	Create a JSP page with form handling.	O	2
4	Implement a database-driven web application using JSP and Servlets	O	2
5	Configure JavaMail API to send emails from a web application.	O	2
6	Develop a real-time chat application using WebSockets	O	2
7	Implement Hibernate ORM and perform basic CRUD operations	O	2
8	Enable Hibernate caching and compare performance.	O	2
9	Build a RESTful API using Spring Boot	O	2
10	Secure a Spring Boot API using JWT authentication	O	2
11	Develop a Microservice for product management.	O	2
12	Deploy a Spring Boot application using Docker.	O	2

S-STUDY, O-OPERATIONAL

Note: The instructor should take at least 10 to 12 experiments from the list.

Text Books:

1	Bruce Eckel, "Thinking in Java", Fourth Edition President, MindView, Inc.
2	Benjamin J. Evans, "Java: The Legend", Released September 2015, O'Reilly Media, Inc., ISBN: 9781491934661
3	Arun Gupta, "Java EE 7 Essentials", Released August 2013, O'Reilly Media, Inc., ISBN: 9781449370602
4	Marty Hall, Larry Brown, Yaakov Chaikin," Core Servlets and JavaServer Pages-Volume-1", Prentice Hall Professional, 2004 -
5	Christian Bauer, Gavin King, and Gary Gregory, "Java Persistence with Hibernate", Second Edition, Manning publications.

Reference Books:

1	Craig Walls, "Spring in Action", Third Edition, Manning publications.
2	Dinesh Rajput, "Mastering Spring Boot 2.0", O'Reilly
3	Sam Newman, "Building Microservices", O'Reilly

Useful Link /Web Resources:

1. https://www.manning.com/books/spring-in-action-fifth-edition

*****

Course Title: Software Testing using Programming (ODL)	
Course Code: 231CSEMDML301	Semester: V
Teaching Scheme: L-T-P: 2$-0-0	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks:25	ESE Marks: 50

Prerequisite:	Proficiency in at least one Programming language and basic understanding of SDLC

Course Description:

It covers the fundamentals of manual and automated testing, programming essentials for test automation, and the application of testing frameworks in each language. Learners will gain hands-on experience with unit testing, web UI testing, API testing, performance testing, and continuous integration (CI/CD) pipelines.

Course Objectives:

1	To develop basic programming skills in Java, Python, and JavaScript.
2	To automate test execution and generate test reports.
3	To understand CI/CD principles and their role in test automation.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
MDM301.1	Understanding of Java, Python, and JavaScript for software testing
MDM301.2	Implementation in unit, API, web, and performance testing
MDM301.3	Implementation testing frameworks (JUnit, PyTest, Jest, Cypress)
MDM301.4	Explore CI/CD integration for automated testing

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
MDM301.1	2	-	-	-	2	-	-	-	-	-	-	-	-	-	2
MDM301.2	3	2	-	-	2	-	-	-	-	1	-	2	-	2	3
MDM301.3	3	2	-	-	2	-	-	-	-	2	-	1	-	2	3
MDM301.4	2	3	-	-	3	-	-	-	-	-	-	-	-	-	3

Contents	Duration
Week 1 - Software Testing & Programming Basics Importance of software testing in SDLC, Types of testing (Functional, Non-functional, Manual, Automated), Black-box vs. White-box testing, Common testing methodologies (Agile, Waterfall, DevOps), Link : https://www.youtube.com/watch?v=6rNgPXz9A9s	**3Hrs**
Week 2 - Software Testing & Programming Basics Introduction to test automation frameworks- Selenium, JUnit, TestNG, PyTest, Jest, Cypress, Basics of Java, Python, and JavaScript, Variables, data types, operators, Control structures (loops, conditionals), and Functions and methods. Links: • https://www.youtube.com/watch?v=2idCKxbhXOk • https://www.youtube.com/watch?v=vZm0lHciFsQ • https://www.youtube.com/watch?v=LQ72KZAg0QE&list=PLacgMXFs7kl97cZzKPIc4VqLtcqVSs07j	**3Hrs**
Week 3. Java for Test Automation Object-oriented programming (OOP) basics, Exception handling, File handling and logging, Introduction to JUnit &TestNG, Link: • https://www.youtube.com/watch?v=lIBM0aptpFA&list=PLL34mf651faMJLCF4nK6Z4MyGli8fJz8H	**3Hrs**

Week 4. Java for Test Automation Writing test cases using JUnit/TestNG, and Assertions and test annotations, Running and debugging test cases, Generating test reports. Links: • https://www.youtube.com/watch?v=MKmlbsrlS1w • https://www.youtube.com/watch?v=_yjcTM6ZHlo • https://www.youtube.com/watch?v=6BSdeN3EltA	**3Hrs**
Week 5. Python for Test Automation Python syntax and data structures, Error handling and debugging, File operations, Introduction to PyTest&Unittest, Links: • https://www.youtube.com/playlist?list=PL6tu16kXT9PqeBsa05mZoIWJLlYmkdQR2 • https://www.youtube.com/watch?v=L6N3BgZh2AA&list=PLyb_C2HpOQSBWGekd7PfhHnb9GnqDgrxS	**3Hrs**
Week 6. Python for Test Automation Writing test cases and assertions, Using fixtures for test setup and teardown, and Parameterized testing Link: • https://www.youtube.com/watch?v=aj-87rnD_tM	**3Hrs**
Week 7. JavaScript for Test Automation JavaScript fundamentals, ES6 features for automation, Callbacks, Promises, async/await for handling asynchronous code, Error handling in JavaScript Link: • https://www.youtube.com/watch?v=FgnxcUQ5vho	**3Hrs**
Week 8. JavaScript for Test Automation Introduction to Jest & Mocha, writing unit tests with assertions, Test coverage analysis, Mocking dependencies Link: • https://www.youtube.com/watch?v=NBjYY8P08lI&list=PLgbtO1Bez4C-vU0JLfDBsZGbSUdNX4mQ8	**3Hrs**

Week 9. Web & API Testing with Java, Python, and JavaScript Web testing fundamentals, Selenium WebDriver for Java and Python, Cypress for JavaScript testing, Handling locators, waits, pop-ups, and alerts, REST API testing fundamentals Link: • https://www.youtube.com/watch?v=69SFwgWHUig&list=PLUDwpEzHYYLvA7QFkC1C0y0pDPqYS56iU	**3Hrs**
Week 10. Web & API Testing with Java, Python, and JavaScript Using Postman for manual API testing, Automating API tests with RestAssured (Java), Requests (Python), and SuperTest (JavaScript), Validating response codes, headers, and payloads Link: • https://www.youtube.com/watch?v=OM4mr3PKgcQ&list=PLUDwpEzHYYLvLZX_QEGTNolPvNADXid0I • https://www.youtube.com/watch?v=FKnzS_icp20&list=PLlxGQpt_kNBcVSpnseYS7_zTO-NmxHLKl	**3Hrs**
Week 11. Performance & Continuous Integration Testing Performance testing fundamentals, JMeter for performance and load testing (Java), Locust for load testing (Python), Introduction to CI/CD in test automation, Link: • https://www.youtube.com/watch?v=CypSI1Fn2w4 • https://www.youtube.com/watch?v=SOu6hgklQRA • https://www.youtube.com/watch?v=8-TUqYYXF_8&list=PL5fOKT7XR42Po4zh8nHCozrcsMboLNXjF	**3Hrs**
Week 12. Performance & Continuous Integration Testing Integrating tests with Jenkins, GitHub Actions, Running automated tests in Dockerized environments, Reporting and test case management. Link: • https://www.youtube.com/watch?v=zZfhAXfBvVA&list=PLdpzxOOAlwvJDIAQZtMjUUbiVUDfGaCIX • https://www.youtube.com/watch?v=R8_veQiYBjI • https://www.youtube.com/watch?v=C-bX86AgyiA	**3Hrs**

List of Experiments			
Exp. No.	Name of Experiment	S/O	Hours
1	Install Java, Python, and JavaScript runtime environments	S	2
2	Set up IDEs (Eclipse, IntelliJ, PyCharm, VS Code)	O	2
3	Write a simple program in Java, Python, and JavaScript to print test results	O	2
4	Debugging using print statements and logging	O	2
5	Write a Java program to read and write test cases from a file	O	2
6	Implement exception handling in test automation scripts	O	2
7	Write unit tests using JUnit, Automate test execution using TestNG and Generate test reports in HTML	O	2
8	Write a Python script to extract test data from a CSV file and Implement exception handling in Python test scripts	O	2
9	Write and execute unit tests using PyTest and Generate and analyze test reports	O	2
10	Write JavaScript code to simulate a test case execution	O	2
11	Implement test cases using Jest and Run tests and analyze coverage reports	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 8 to 10 experiments from the list.

STUDENTS ACTIVITIES THAT CAN BE CONDUCTED:

1. Group Discussions
2. Presentation
3. Report Writing

Text Books:

1	Yogesh Singh, "SOFTWARE TESTING", Cambridge University Press.
2	Srinivas Desikan, Gopalswamy Ramesh, "Software Testing Principles and Practices", Pearson Publication.
3	Selenium Web Browser Automation Tutorials point, simply learning.

Reference Books:

1	Paul C. Jorgensen, "Software Testing A Craftsman's Approach", CRC Press Taylor & Francis Group, Fourth Edition, (Chapter 1, 2, and 3)
2	Mauro Pezze, and Michal Young, "Software Testing and Analysis: Process, Principles, and Techniques", WILEY (Chapter 1,2,3,and 4)

*****

Course Title: Security and Privacy in Social Media	
Course Code: 231CSEOECL301	Semester: V
Teaching Scheme: L-T-P: 2-0-0	Credits: 2
Evaluation Scheme: ISE + MSE Marks: NA	ESE Marks: 50

Prerequisite:	Basic knowledge of Networking, Information Security and Social Sites.

Course Description:

This course introduces students to a variety of existing, new and emerging concepts, strategies, and technologies utilized in today's online environment. It covers various social networking platforms, content and related security and privacy issues in social media. Students will learn how to use social media to reach personal and professional goals.

Course Objectives:

1	To gain knowledge of social network framework and its problems.
2	To understand web based social networks.
3	To understand Security and Privacy Issues in Mobile Social Networks.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
OEC301.1	Understand social network framework.
OEC301.2	Identify the threats and defence mechanisms of social network.
OEC301.3	Use privacy and trust management in social networks.
OEC301.4	Resolve Security and Privacy Issues in Mobile Social Networks.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
OEC301.1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	2
OEC301.2	2	3	-	-	-	-	-	-	-	-	-	-	1	-	2
OEC301.3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	3
OEC301.4	2	2	-	-	-	-	-	-	-	-	-	-	1	-	3

Contents	Duration
Unit 1. Introduction to Security and Privacy in Social networks What Is a Social Network? Online Social Networks, How to Represent a Social Network? Social Network Data: Opportunities and Challenges, Social Network Analysis: Measures and Threats, Link Mining: Tasks and Threats, Open Challenges.	**7 Hrs**
Unit 2. Online Social Networks: Privacy Threats and Defence Definitions of Privacy, Privacy Threat: Users' Limitations, Design Flaws and Limitation, Defence Mechanism: Usable Privacy Through Visual and Interactive Flow of Information.	**7 Hrs**
Unit 3. Privacy Preserving Reputation Management in Social Networks Characteristics of Social Relationships, Strength of Social Relationships, Modelling Trust, Characteristics of Trust, Inferring Trust.	**8 Hrs**
Unit 4. Security and Privacy Issues in Mobile Social Networks Introduction, Security and Privacy Issues in Online Social Networks, Privacy Issues in Context-Aware MSNs, Security and Privacy Support in MSNs Middleware.	**8 Hrs**

Text Books:

1	Security and Privacy Preserving in Social Networks by Richard Chbeir Bechara Al Bouna Editors, 2013. (Unit 1 to 4)

Reference Books:

1	Social Media Security - Leveraging Social Networking While Mitigating Risk by Michael Cross, Paperback 1st Edition.
2	Security and Trust in Online Social Networks by Barbara Carminati Elena Ferrari Marco Viviani , Morgan & Claypool Publishers

Useful Link /Web Resources:

1. https://www.coursera.org/lecture/social-network-analysis
2. https://onlinecourses.nptel.ac.in/noc23_cs13/preview
3. https://www.mooc-list.com/tags/social-network-analysis.

*****

Course Title: Android App Development	
Course Code: 231CSEOECL302	Semester: V
Teaching Scheme: L-T-P: 2-0-0	Credits: 2
Evaluation Scheme: ISE + MSE Marks: NA	ESE Marks: 50

Prerequisite:	Basics of the Java language, XML

Course Description:

This course provides the knowledge about creation of Android Mobile Applications using JAVA and XML. This can be used for developing the different android applications with activities and fragments. The course also includes designing of own applications with the help of XML and databases applied to various domains. This course will help to gain the skills and project-based experience needed for a mobile application and development career.

Course Objectives:

1	To expose the students with XML and Java concepts and its applications.
2	To introduce the concepts of object-oriented programming using JAVA programming constructs.
3	To facilitate students to understand android SDK and help to gain a basic understanding of Android application development
4	To inculcate working knowledge of Android Studio development tool
5	To expose the students with XML and Java concepts and its applications.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
OEC302.1	Use the different XML concepts for building the XML structure.
OEC302.2	Use the java programming constructs for solving the problems.
OEC302.3	Understand the android basics and able to use the tools for developing the android applications.
OEC302.4	Design and develop the android application with UI, Layouts and intents

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
OEC302.1	2	-	-	-	2	-	-	-	-	-	-	-	-	-	3
OEC302.2	2	2	1	-	-	-	-	-	-	-	-	-	2	-	3
OEC302.3	3	1	1	-	-	-	-	-	1	-	-	-	1	-	2
OEC302.4	2	1	1	-	-	-	-	-	1	-	-	-	1	-	4

Contents	Duration
Unit 1: Fundamentals of XML XML document structure, What XML is, benefits of XML, Portable Data, How XML Works, XML Documents and XML Files, Elements, Tags and Character Data, Attributes, XML Names, References, CDATA Sections, Comments, Processing Instructions, The XML Declaration, Checking Documents for well-formedness.	**3 Hrs**
Unit 2: Fundamental Programming in Java: The Java Buzzwords, The Java Programming Environment- JVM, JIT Compiler, Byte Code Concept, A Simple Java Program, Source File Declaration Rules, Comments, Data Types, Variables, Operators, Strings, Input and Output, Control Flow, Array. Objects and Classes: Object-Oriented Programming Concepts, Declaring Classes, Declaring Member Variables, Defining Methods, Constructor, Passing Information to a Method or a Constructor, Creating and using objects, Controlling Access to Class Members, Static Fields and Methods, this keyword.	**5 Hrs**
Unit 3: Introduction to Android OS Overview of Android, History, Android Versions, Android OS stack, Activity, Activity life cycle, Fragments, Fragment Lifecycle. Android Development Environment, Introduction to Android SDK, Android Emulator, creating a Project, Project Directory Structure, Android Manifest File, Permissions.	**6 Hrs**
Unit 4: Views and Layouts XML introduction, Android View Hierarchies, Linear Layouts, Relative Layout, Table Layout, List View, Frame Layout Sliding, Using Padding and Margins with Layouts.	**6 Hrs**
Unit 5: Intents What Is Intent? Android Intent Messaging via Intent Objects, Types of Intents, Using Intents with Activities.	**4 Hrs**

Unit 6: Input Controls, Input Events, Dialogs: Buttons, Text Fields, Checkboxes, Radio Buttons, Toggle Buttons, Spinners, Event Listeners, Event Handlers, Touch Mode, Handling Focus, Dialogs: Alerts, Rating Bar, Progress bar, Pop Ups, Toasts.	**6 Hrs**

Text Books:

1	Atul Kahate, "XML and Related Technologies", Pearson
2	Cay Horstmann and Gary Cornell, Core Java- Volume I Fundamentals Pearson, Eight edition
3	Wei-Mag Lee, "Beginning Android application development", WROX
4	Wallace Jackson, "Android Apps for Absolute Beginners", APRESS, SECOND EDITION

Reference Books:

1	Elliotte Rusty Harold, W. Scott Means, "XML in a Nutshell", O'Reilly Publication, 3rd Edition
2	Herbert Schildt, JAVA-The Complete Reference, Mcgraw Hill, Ninth edition.
3	Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd
4	James Steele, "The Android Developer's Cook book: Building Applications with the Android SDK", Paperback

Useful Link /Web Resources:

1. https://www.w3c.org
2. https://developer.android.com/studio

*****

Course Title: SQL Programming	
Course Code: 231CSEOECL303	Semester: V
Teaching Scheme: L-T-P: 2-0-0	Credits: 2
Evaluation Scheme: ISE + MSE Marks: NA	ESE Marks: 50

Prerequisite:	Set Theory and Data Structures

Course Description:

This course introduces the fundamental concepts, principles and tools of database system. The course includes relational data model and languages. This course is designed to provide an introduction to the SQL programming language, which is the standard language for relational database management systems. This course covers the basics of SQL, including creating tables, manipulating data, and querying databases. Students who complete the course will be equipped to write SQL queries, work with Microsoft SQL Server or MySQL

Course Objectives:

1	To demonstrate fundamental concepts of database systems.
2	To gain familiarity with SQL and DBMS.
3	To understand various queries syntax and its use.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
OEC303.1	Understand fundamental concepts of database systems.
OEC303.2	Study and apply SQL queries to design & manage the database with DDL and DML Commands.
OEC303.3	Understand the retrieval data with aggregate functions, Set and Join Operations and sub queries
OEC303.4	Apply TCL to maintain database consistency.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
OEC303.1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	2
OEC303.2	1	3	2	1	-	-	-	-	-	-	-	2	-	-	3
OEC303.3	1	3	2	1	-	-	-	-	-	-	-	2	2	-	2
OEC303.4	1	2	2	1	-	-	-	-	-	-	-	2	-	-	2

Contents	Duration
Unit 1: Introduction to Basic Database Concepts and SQL What is Data, Field, Record and database, Limitations of File Management System, Basic Concepts of Advantages of DBMS, Exploring Relational DBMS, Understanding Client and Server, Basics of SQL Types of SQL Statements, DDL, DML, DQL, DCL and TCL, Create Database using Management Studio, Datatypes in SQL Server, Exploring DDL Statements on Table using Management Studio	**10 Hrs**
Unit 2: DDL and DML Statements Create, Alter and Drop Table Insert, Update and Delete Statement Truncate Statement Constraints: Unique, Not NULL, Primary Key, Default Check Foreign Key, Understanding Select Statement, Usage of Top, Distinct, Null etc... keywords, Using String and Arithmetic Expressions, Exploring Where Clause with Operators, Using Advanced Operators, sorting data using Order By clause, Working with basic of Sub Queries.	**10 Hrs**
Unit 3: Aggregate Functions and Joins Using functions in Queries, Count, Sum, Min, Max, Avg Group by and Having Clause, Introduction to Joins Cross Joins, Inner Join, Outer Join, Self-Join Co-Related Sub Queries, Set Operations using Unions, Intersect and Except	**5 Hrs**
Unit 4: Transaction Transaction concept, A Simple Transaction model, ACID properties of Transaction, Transaction concurrency control, TCL Commands: Commit, Rollback, Savepoint	**5 Hrs**

Text Books:

1	A. Silberschatz, H.F. Korth, S. Sudarshan, "Database System Concepts", 6th Edition, McGraw Hill Education. (Unit 1 to Unit 6)
2	Thomos Connolly, Carolyn Begg, "Database Systems - A practical approach to Design, Implementation and Management", 3rd Edition, Pearson Education. (Unit 1 to Unit 6)

Reference Books:

1	Ramez Elmasri and Shamkant Navathe, "Fundamentals of Database Systems", Pearson Education, Fifth Edition. (Unit 1 to Unit 6)
2	Raghu Ramakrishnan, Johannes Gehrke, "Database Management System", Fourth Edition, McGraw Hill Education. (Unit 1 to Unit 6)

Useful Link /Web Resources:

1. https://onlinecourses.nptel.ac.in/noc19_cs46/preview

*****

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
KASABA BAWADA, KOLHAPUR
D.Y. PATIL COLLEGE OF ENGG. & TECH.

Course Title: Introduction to Artificial Intelligence	
Course Code: 231CSEPECL301	Semester: V
Teaching Scheme: L-T-P: 3-0-2	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks: 25	ESE Marks: 50

Prerequisite:	Basic understanding of mathematics (including probability and linear algebra), programming fundamentals (Python or similar), computer algorithms, and logic.

Course Description:

This course introduces the fundamentals of Artificial Intelligence (AI), covering its history, core concepts, intelligent agents, search strategies, and knowledge representation. It explores rule-based expert systems, uncertainty management, AI applications, ethics, and an introduction to machine learning. Students will gain foundational AI knowledge and problem-solving skills.

Course Objectives:

1	To introduce students to the foundations, history, and key concepts of Artificial Intelligence
2	To develop an understanding of knowledge representation techniques and heuristic search strategies for problem-solving.
3	To explore rule-based expert systems and methods for handling uncertainty in AI.
4	To examine real-world AI applications, ethical concerns, and basic machine learning concepts.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
PEC301.1	Explain the core concepts of Artificial Intelligence.
PEC301.2	Apply knowledge representation and search techniques in AI to solve problems.
PEC301.3	Analyze different AI representation schemes and their applications.
PEC301.4	Examine rule-based expert systems, their inference mechanisms, and uncertainty management in AI reasoning.
PEC301.5	Identify AI applications and ethical concerns in AI development, and explain basic machine learning concepts.
PEC301.6	Implement AI concepts such as search techniques, knowledge representation, expert systems, and other using Python in practical lab exercises.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PEC301.1	3	2	-	-	-	-	-	-	-	-	-	1	3	-	2
PEC301.2	3	3	3	2	-	-	-	-	-	-	-	2	3	2	3
PEC301.3	3	3	3	3	-	-	-	-	-	-	-	2	3	3	4
PEC301.4	3	3	3	3	-	-	-	-	-	-	-	2	3	3	4
PEC301.5	3	3	2	2	-	2	2	-	-	-	-	2	3	2	2
PEC301.6	3	3	3	3	3	2	-	-	-	-	-	2	3	3	6

Contents	Duration
Unit 1: Introduction What is AI? The foundations of AI, The history of AI, Overview of AI application areas, Intelligent agents, Agents and environments, The nature of environments, The structure of agents.	**6 Hrs**
Unit 2: AI as Representation and Search Propositional calculus, Predicate Calculus, Using inference rules to produce predicate calculus expression, Graph theory, Strategies for state space search, Heuristic Search: Hill-Climbing and dynamic programming, Best-First search algorithm, Using heuristics in games.	**7 Hrs**
Unit 3: Representation and Intelligence: The AI Challenge Issues in knowledge representation, A Brief history of AI representational schemes, Conceptual graphs: the Type hierarchy, Individuals and Names, Generalization & specialization.	**6 Hrs**
Unit 4: Rule based expert system What is knowledge? Rules as a knowledge representation technique, Expert system development team, Structure of a rule-based expert system, Characteristics of an expert system, Forward chaining and backward chaining inference techniques, MEDIA ADVISOR: a demonstration rule-based expert system, Conflict resolution, Advantages and disadvantages of rule-based expert systems.	**7 Hrs**

Unit 5: Uncertainty management in rule-based expert systems What is uncertainty? Basic probability theory, Bayesian reasoning, FORECAST: Bayesian accumulation of evidence, Bias of the Bayesian method, Certainty factors theory and evidential reasoning, Comparison of Bayesian reasoning and certainty factors.	**6 Hrs**
Unit 6: AI Applications, Ethics, & Introduction to Machine Learning Applications: Robotics, Healthcare, Finance, etc, The ethics and risks developing AI, Introduction to machine learning, Applications of ML, Types of ML: Supervised and Unsupervised, ML Process.	**6 Hrs**

List of Experiments

Exp. No.	Name of Experiment	S/O	Hours
1	Implementation of (a) Propositional Logic and (b) Predicate Logic.	O	2
2	Implementation of Breadth-First Search (BFS).	O	2
3	Implementation of Depth-First Search (DFS).	O	2
4	Implementation of Best-First Search.	O	2
5	Implementation of Tic-Tac-Toe (a) using heuristics and (b) without heuristics.	O	2
6	Study experiment on Conceptual Graphs.	S	2
7	Case study on Expert Systems.	S	2
8	Development of a Simple Expert System (e.g. Traffic Light Controller, Financial Investment Advisor, Diagnosing a Medical Condition, etc.).	O	2
9	Implementation of Forward and Backward Chaining for Rule-Based Systems.	O	2
10	Implementation of Bayesian Reasoning for Uncertainty Handling in AI.	O	2
11	Study experiment on Machine Learning Concepts.	S	2
12	Study experiment on AI Applications: AI in Robotics.	S	2
13	Case study on MYSIN and AI SHELL	S	2

S-STUDY, O-OPERATIONAL

Note: The instructor should take at least 10 to 12 experiments from the list.

Text Books:

1	George F. Luger, "Artificial Intelligence; Structures and Strategies for Complex Problem Solving", Pearson Education, 5th Edition. [Units 1, 2, 3, and 6]
2	Michael Negnevistsky, "Artificial Intelligence: A guide to intelligent systems", Pearson, 3rd Edition. [Units 4, 5]
3	Stuart J. Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd Edition. [Unit 1, 6]

Reference Books:

1	Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", Pearson Education India, 6 January 2015

Useful Link /Web Resources:

1. https://nptel.ac.in/courses/106106126 – Artificial Intelligence: Search Methods for Problem Solving. By Prof. Deepak Khemani, IIT Madras
2. https://nptel.ac.in/courses/106/102/106102220/ – An Introduction to Artificial Intelligence, By Prof. Mausam, IIT Delhi.
3. https://onlinecourses.nptel.ac.in/noc21_ge20/preview – Fundamentals of Artificial Intelligence, By Prof. Shyamanta M. Hazarika, IIT Guwahati

*****

Course Title: Introduction to Data Science	
Course Code: 231CSEPECL302	Semester: V
Teaching Scheme: L-T-P: 3-0-2	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks: 25	ESE Marks: 50

Prerequisite:	Knowledge of Statistics, Data Structures and Algorithms

Course Description:

The goal is to familiarize them with commonly used tools for data science application development. It provides an introduction to the fundamentals of data science, including programming for data analytics.

Course Objectives:

1	To introduce students with basic knowledge of Data Science.
2	To enable students to find solutions using Data Science tools.
3	To introduce students to Python packages and their practical applications.

Course Outcomes (COs): Upon successful completion of this course, the students will be able to

PEC302.1	Summarize the fundamentals of data science and its workflow.
PEC302.2	Solve the given problems using data science tools.
PEC302.3	Implement problem-solving approaches using the NumPy package.
PEC302.4	Describe the functionalities of key Python libraries.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PEC302.1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	2
PEC302.2	2	3	1	1	1	-	-	-	-	-	-	-	2	-	3
PEC302.3	2	3	2	-	2	-	-	-	-	-	-	-	-	1	3
PEC302.4	2	3	1	-	-	-	-	-	-	-	-	-	-	-	2

Content	Duration
Unit 1: Introduction Introduction to Data Science, A Brief History, Difference between Data Science and Data Analytics, Data Science Roles, Stages in a Data Science Project, Applications of Data Science in various fields, Technologies used in Data Science, Benefits and uses of Data Science, Data Security Issues	**7 Hrs**
Unit 2: Data Science Process Overview, Data Collection Strategies, Data Pre-Processing, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization.	**6 Hrs**
Unit 3: Data Visualization Overview of Data Visualization, Types of Data Visualizations, Visual Representation Techniques, Tools for Data Visualization, Geospatial Data Visualization, Libraries for Data Visualization.	**7 Hrs**
Unit 4: Data Analysis Tools for Data Science and Analytics **Data Analysis Using Excel**: Introduction, Getting Started with Excel, Format Data as a Table, Filter and Sort, Perform Simple Calculations, Data Manipulation Sorting and Filtering Data Derived Data, Highlighting Data, **Aggregating Data**: Count, Total Sum Basic Calculation using Excel, Analyzing Data using Pivot Table/Pivot Chart, Descriptive Statistics using Excel, Visualizing Data using Excel Charts and Graphs, **Visualizing Categorical Data**: Bar Charts, Pie Charts, Cross Tabulation, Exploring the Relationship between Two and Three Variables: Scatter Plot Bubble Graph and Time-Series Plot.	**7 Hrs**
Unit 5: Data Manipulation with Pandas Introducing Pandas Objects, Data Indexing and Selection, Operating on Data in Pandas, Handling Missing Data, Hierarchical Indexing. Combining Datasets: Concat and Append, Combining Datasets: Merge and Join, Aggregation and Grouping, Pivot Tables.	**6 Hrs**
Unit 6: Visualization with Matplotlib General Matplotlib Tips, Simple Line Plots, Simple Scatter Plots, Visualizing Errors, Density and Contour Plots, Histograms, Bindings, and Density.	**6 Hrs**

List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	Study assignment on Data science Process.	S	2
2	Implementation of Data manipulation and using Excel.	O	2
3	Implementation of Data Visualization using Excel.	O	2
4	Study assignment on Kaggle.	S	2
5	Implementation of Array operations using Numpy.	O	2
6	Implementation of universal function in Numpy.	O	2
7	Implementation of Data Operation in Pandas.	O	2
8	Implementation of Dataset Operations in Pandas.	O	2
9	Implementations of Different graphs in Matplotlib.	O	2
10	Implementations of Different chart, plots in Matplotlib.	O	2
11	Implementations of Histogram in Matplotlib.	O	2
12	Implementation of Data preprocessing on dataset in Kaggle.	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 to 12 experiments from the list.

Text Books:

1	Davy Cielen, Arno D. B. Meysman, Mohamed Ali , "Introducing Data Science", Manning Publications. [Unit 1 and 2]
2	Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", O'REILLY Publication. [Unit 3,4,5]
3	Dr. Amar Sahay, "Essentials of Data Science and Analytics", O'REILLY Publication. [Unit 1,3]

Reference Books:

1	Data Science from Scratch: First Principles with Python, O'Reilly Media, 2015.
2	Glenn J. Myatt John, Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, Wiley Publishers, 2000.

Useful Link /Web Resources:

1.https://nptel.ac.in/courses/106/106/106106212/

*****

Course Title: Information Security	
Course Code: 231CSEPECL303	Semester: V
Teaching Scheme: L-T-P:3-2-0	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks: 25	ESE Marks: 50

Prerequisite:	Computer Networks, Programming Fundamentals of C, C++ and Java.

Course Description:

This course provides a comprehensive overview of network and system security concepts and cryptographic techniques. It begins with foundational security principles, types of attacks, services, and mechanisms, along with a model for network security. Cryptographic basics like encryption methods, substitution and transposition techniques, and both symmetric and asymmetric cryptography are covered. The course explores symmetric key algorithms like DES, AES, and RC5, and asymmetric methods such as RSA, ElGamal, and ECDH. Authentication, hash functions, digital signatures, and key management protocols including Kerberos and PKI are discussed. Email and IP security mechanisms like PGP, S/MIME, and IPsec are examined. Transport-level security protocols such as SSL/TLS, HTTPS, and SSH are also included. Wireless network security standards like IEEE 802.11 and mobile device protection are addressed. The module concludes with system security, covering intruders, malware, intrusion detection systems, antivirus solutions, and firewalls with various configurations and policies.

Course Objectives:

1	To understand fundamental information security concepts, including confidentiality, integrity, and availability.
2	To apply classical and modern cryptographic techniques to secure data.
3	To analyze and implement network security protocols and mechanisms
4	To evaluate and enhance system and application security

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
PEC303.1	Explain basic security concepts, cryptographic techniques, and analyze common attacks and its security mechanisms to safeguard network communications.
PEC303.2	Apply symmetric and asymmetric cipher techniques for secure data encryption and key exchange.
PEC303.3	Apply cryptographic hash functions, digital signatures, and key distribution methods to ensure secure authentication.
PEC303.4	Explain and apply PGP, S/MIME, and IPsec protocols to ensure secure email and IP communications.
PEC303.5	Identify and evaluate security measures for transport-level protocols and wireless network environments.
PEC303.6	Analyze various system security threats and apply suitable countermeasures to ensure system integrity.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PEC303.1	3	2	1	1	-	-	-	-	-	-	-	-	3	-	2
PEC303.2	3	3	3	3	-	-	-	-	-	-	-	-	3	-	3
PEC303.3	3	3	3	1	-	-	-	-	-	-	-	-	3	-	3
PEC303.4	3	3	3	3	-	-	-	-	-	-	-	-	-	3	3
PEC303.5	3	1	3	-	-	-	-	-	-	-	-	-	-	3	4
PEC303.6	3	1	3	-	-	-	-	-	-	-	-	-	-	3	4

Contents	Duration
Unit 1: Introduction Security Concepts: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security. Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, possible types of attacks.	7 Hrs

Unit 2: Cipher Techniques Symmetric key Ciphers: Block Cipher principles, DES, AES, Blowfish, RC5, IDEA, Block cipher operation, Stream ciphers, RC4. Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, Elgamal Cryptography, Diffie-Hellman Key Exchange, Elliptic-curve Diffie–Hellman (ECDH).	**8 Hrs**
Unit 3: Authentication functions and Kebreros Cryptographic Hash Functions: Message Authentication, Secure Hash Algorithm (SHA-512), Message authentication codes: Authentication requirements, HMAC, CMAC, Digital signatures, Digital Signature Scheme. Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption, Distribution of Public Keys, Kerberos, X.509 Authentication Service, Public – Key Infrastructure	**8 Hrs**
Unit 4: Email Security Pretty Good Privacy, S/MIME IP Security: IP Security overview, IP Security architecture, Authentication Header, Encapsulating security payload, Combining security associations, Internet Key Exchange.	**6 Hrs**
Unit 5: Transport-level Security Web security considerations, Secure Socket Layer and Transport Layer Security, HTTPS, Secure Shell (SSH). Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN, IEEE 802.11i Wireless LAN Security.	**7 Hrs**
Unit 6: System Security Intruders: Types of intruders, Detection and prevention techniques, Intrusion detection systems (IDS), Viruses and Worms: Types of malware: viruses, worms, Trojans, Malware propagation and impact, Antivirus techniques and countermeasures, Firewall: Introduction to firewalls, Types of firewalls (Packet filtering, Proxy, Stateful), Firewall policies and configuration	**9 Hrs**

List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	Write a Java program for substitution Caesar Cipher Encryption and Decryption.	O	2
2	Write a Java program for substitution Hill Cipher Algorithm.	O	2
3	Write a Java program for Columnar Transposition Cipher Implementation.	O	2
4	Write a Java program for Rail Fence Transposition Cipher Implementation.	O	2
4	Write a Java program for DES (Data Encryption Standard) Algorithm.	O	2
5	Write a Java program for RSA Algorithms.	O	2
6	Write a Java program for Diffie-Hellman Key Exchange Algorithms.	O	2
7	Write a Java program for Digital Signature Generation and Verification algorithm.	O	2
8	Write a Java program for SHA-1 Hash Generation.	O	2
9	Write a Java program to implement Kerberos Authentication Protocol.	O	2
10	Write a Java program to demonstrate Pretty Good Privacy (PGP) Encryption	O	2
11	Write a Java program to demonstrate S/MIME encryption using Java Cryptography API.	O	2
12	Write a Java program for Secure Socket Layer (SSL) Protocol Simulation.	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 to 12 experiments from the list.

Text Books:

1	Cryptography and Network Security - Principles and Practice: William Stallings, Pearson Education, 6th Edition. (Unit 1, 2.3)
2	Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition. (Unit 4,5,6)

Reference Books:

1	Cryptography and Network Security by Atul Kahate, McGraw Hill, 3rd Edition.
2	Cryptography and Network Security: Forouzan Mukhopadhyay, McGraw Hill, 3rd Edition
3	Network Security and Cryptography: Bernard Menezes, CENGAGE Learning.

Useful Link /Web Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs90/preview
2. https://onlinecourses.nptel.ac.in/noc22_cs03/preview
3. https://www.coursera.org/learn/crypto

*****

Course Title: Software Engineering	
Course Code: 231CSEPECL304	Semester: V
Teaching Scheme: L-T-P:3-0-2	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks:25	ESE Marks: 50

Prerequisite:	Proficiency in at least one Programming language

Course Description:

This course contains the fundamental principles and practices of software engineering. Students will learn about the software development life cycle, software design patterns, testing and validation, and software project management. The course will also cover topics such as requirements gathering, software architecture, and deployment.

Course Objectives:

1	To expose the students to basic concepts and principles of software engineering.
2	To make the students aware of the importance of SDLC in their project development.
3	To illustrate requirements gathering and analysis.
4	To understand testing and validation techniques.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
PEC304.1	Understand systematic methodologies of SDLC.
PEC304.2	Understand project planning and scheduling.
PEC304.3	State SRS by requirements gathering and analysis.
PEC304.4	Understand Software design patterns, principles and design tools.
PEC304.5	Understand testing methods and importance of software maintenance.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PEC304.1	3	3	-	-	-	-	-	-	-	-	-	1	1	-	2
PEC304.2	3	3	-	-	2	-	-	1	2	2	-	1	-	-	2
PEC304.3	3	3	2	-	-	-	-	-	2	2	-	-	-	-	1
PEC304.4	3	3	-	-	2	-	-	2	-	2	-	1	1	2	2
PEC304.5	3	3.	-	-	2	-	-	-	2	2	1	-	-	-	2

Content	Duration
Unit 1: Introduction to Software and Processes Software Problem- Cost, Schedule & Quality, Scale and change, Software Processes- Process and Project, Component Software Processes, SDLC, Software Development Process Modules, Project Management Process. Agile Development- XP, other Agile Process Models, and Tool Set for Agile Process.	**8 Hrs**
Unit 2: Software Requirements Analysis Introduction to Requirements Engineering. Value of a good SRS, Requirements Process, Requirements Specifications, Other Approaches for Analysis, Validation. Case study on Software requirements.	**8 Hrs**
Unit 3: Software Planning & Scheduling Responsibilities of Software Project Manager, Project Planning, Project Scheduling, Project Staffing, People CMM, Risk Management.	**7 Hrs**
Unit 4: Software Design Basics of Software Design, Data Design, Architectural Design, Component Level Design, User Interface Design, Graphical User Interface, Object Oriented Design, Software Design Notations, Software Design Reviews, and Software design documentation. Case Study for Software Design.	**7 Hrs**

Unit 5: Object Modeling Using UML and OO Software Development Basic OO Concepts, UML, UML Diagrams, Use Case Model, Class Diagram, Interaction Diagram, Activity Diagram, State Chart Diagram, Postscript, Patterns and Common Design Patterns, OO Analysis and Design Methodology, Interaction Modeling, Application of analysis and Design Process.	**7 Hrs**
Unit 6: Coding & Testing Features of Software Code, Coding Guidelines, Coding Methodology, Programming Practice, Code Verification Techniques, Coding Tools, Code Documentation, Software Testing Basics, Test plan, Test case Design, Software Testing Strategies, Level of Testing, Testing Techniques, OO Testing, and Software testing Tools, Debugging, and Software Test Report. Introduction to Software Maintenance.	**8 Hrs**

List of Experiments

Exp. No.	Name of Experiment	S/O	Hours
1	Software Development Life Cycle (SDLC)- Compare and contrast different SDLC models	O	2
2	Design Patterns Implementation- Implement and compare different design patterns	O	2
3	Testing and Validation Techniques- Compare and contrast different testing and validation techniques	O	2
4	Version Control Systems Comparison- Compare and contrast different version control systems	O	2
5	Agile Development Methodologies Implementation- Implement and compare different agile development methodologies	O	2
6	Software Architecture Design- Design and compare different software architectures	O	2
7	Software Maintenance and Evolution- Compare and contrast different software maintenance and evolution techniques	O	2
8	Human-Computer Interaction (HCI) Design- Design and compare different HCI designs	O	2

9	Software Engineering Tools and Technologies- Compare and contrast different software engineering tools and technologies	O	2
10	Software Project Estimation and Scheduling- Compare and contrast different software project estimation and scheduling techniques	O	2
11	Software Quality Assurance- Compare and contrast different software quality assurance techniques	O	2
12	Software Project Planning and Scheduling- To apply software project planning and scheduling techniques to a real-world scenario.	O	2
13	Software Configuration Management- Compare and contrast different software configuration management techniques	O	2
14	Software Engineering Ethics- Understand the importance of ethics in software engineering.	O	2
15	Software Engineering Case Study- Apply software engineering principles and practices to a real-world scenario.	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 to 12 experiments from the list.

STUDENTS ACTIVITIES THAT CAN BE CONDUCTED:

Group Discussions, Presentation, Report Writing

Text Books:

1	Panjkaj Jalote, "Software Engineering- A precise approach", Wiley India, (Unit 1, 2)
2	Roger S. Pressman, "Software Engineering – A Practitioner's Approach", 7th Edition, McGraw Hill, (Unit 1, 2)
3	Rohit Khurana, "Software Engineering Principles and Practices", Vikas Publication. (Unit 3, 4, 6)
4	Ugrasen Suman, "Software Engineering concept & Practices", CENANGE Learning (Unit 6)
5	Rajib Mall, "Fundamentals of Software Engineering", PHI, Third Edition (Unit 5)

Reference Books:

1	Hansvan Vliet, "Software Engineering Principles and Practice", Willey-India Edition.
2	Sommerville, "Software Engineering", Pearson Education, India.
3	P Fleeger, "Software Engineering", Pearson Education, India.

Useful Link /Web Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs13/course
2. https://www.tpointtech.com/software-engineering.

*****

Course Title: Introduction to IoT	
Course Code: 231CSEPECL305	Semester: V
Teaching Scheme: L-T-P: 3-0-2	Credits: 4
Evaluation Scheme: ISE+MSE Marks:20+30=50 INT Marks:25	ESE Marks: 50

Prerequisite:	Computer Networks - Fundamentals of networking, protocols (TCP/IP, HTTP), and wireless communication.

Course Description:

Internet of Things known as IoT is the study that describes the network of objects that are different things which are embedded with sensors, software, and also other technologies to connect and exchange data with other systems and devices over the Internet.

Course Objectives:

1	To introduce the fundamental concepts of the Internet of Things (IoT) and its applications in various domains.
2	To familiarize students with IoT architecture, communication protocols, and hardware components.
3	To enable students to design, develop, and implement IoT-based solutions using modern tools and technologies.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
PEC305.1	Understand the basics of IoT, its architecture, and components.
PEC305.2	Explain different IoT communication technologies and protocols.
PEC305.3	Describe IoT hardware, sensors, and security challenges.
PEC305.4	Analyze real-world IoT applications and future trends.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PEC305.1	3	-	-	-	-	-	-	-	-	-	-	2	2	1	2
PEC305.2	3	2	-	-	2	-	-	-	-	-	-	2	2	1	2
PEC305.3	3	2	3	2	2	2	-	-	-	-	-	2	3	2	2
PEC305.4	3	3	3	3	3	3	2	2	2	2	2	3	3	3	2

Contents	Duration
Unit 1: Introduction to IoT What is IoT, how does it work? Difference between Embedded device and Properties of IoT device, IoT Ecosystem, IoT Decision Framework, IoT Solution Architecture Models, Major IoT Boards in Market.	**7 Hrs**
Unit 2: Setting Up Raspberry/ Arduino to Create Solutions Explore Raspberry Pi, setting up Raspberry Pi, showing working of Raspberry Pi using SSH Client and Team Viewer, Understand Sensing actions, Understand Actuators and MEMS	**7 Hrs**
Unit 3: Communication Protocols used in IoT Types of wireless communication, Major wireless short range communication devices, properties, comparison of these devices (Bluetooth, WIFI, ZigBee, 6LoWPAN), Major wireless Long-range communication devices, properties, comparison of these devices (Cellular IoT, LPWAN)	**7 Hrs**
Unit 4: IoT Applications Industrial Internet 4.0, Applications such as: Smart home, wearables, smart city, smart grid, connected car, connected health (digital health, telehealth, telemedicine), smart retail	**7 Hrs**
Unit 5: Sensors Applications of various sensors: Google Maps, Waze, WhatsApp, Ola Positioning sensors: encoders and accelerometers, Image sensors: cameras, Global positioning sensors: GPS, GLONASS, IRNSS, Galileo and indoor localization systems, Motion	**7 Hrs**

& Orientation Sensors: Accelerometer, Magnetometer, Proximity Sensor, Gyroscope Calibration, noise modeling and characterization and noise filtering and sensor data processing. Privacy & Security	
Unit 6. Prototyping Thinking about prototyping: Sketching, familiarity, Costs versus Ease of Prototyping, Prototypes and Production, Open Source versus Closed Source	**5 Hrs**

List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	LED Control Using Arduino Board	S	2
2	Potentiometer and IR Sensor Interfacing with Arduino	S	2
3	Controlling Two Actuators Using Arduino	S	2
4	Creation of Things Speak Account	S	2
5	Actuator Controlling Through Cloud	S	2
6	DHT11 sensor Data to Cloud	S	2
7	IoT Based Air Pollution Control System	O	2
8	TDS Sensor Interfacing with Arduino	O	2
9	Actuator Controlling by Mobile Using Arduino	O	2
10	Motion Detection Alert System	O	2
11	IoT-Based Smart Door Lock	O	2
12	Air Quality Monitoring System	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 to 12 experiments from the list.

Text Books:

1	Vijay Madisetti and Arshdeep Bahga, Internet of Things (A Hands-on Approach), 1st Edition, VPT, 2014

Reference Books:

1	Francis da Costa, Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, 1stEdition, A press Publications, 2014.

Useful Link /Web Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2. https://www.coursera.org/courses?query=iot
3. https://www.udemy.com/course/a-complete-course-on-an-iot-system-design-and-development/?couponCode=IND21PM

*****

Course Title: Business Analytics	
Course Code: 231CSEPECL306	Semester: V
Teaching Scheme: L-T-P: 3-0-2	Credits: 4
Evaluation Scheme: ISE+MSE Marks:20+30=50 INT Marks:25	ESE Marks: 50

Prerequisite:	Database Engineering

Course Description:

Business Analytics is the process of using statistical methods, machine learning techniques, and data analysis tools to interpret and analyze business data. This course focuses on data-driven decision-making, predictive analysis, data visualization, and the integration of data analytics tools for solving real-world business problems.

Course Objectives:

1	To understand the Analytics Life Cycle.
2	To comprehend the process of acquiring Business Intelligence.
3	To understand various types of analytics for Business Forecasting.
4	To model the supply chain management for Analytics.
5	To understand the fundamentals of business analytics and its significance in decision-making.
6	To apply various statistical and machine learning methods to analyze business data.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
PEC306.1	Understand the real-world business problems and model with analytical solutions.
PEC306.2	Identify the business processes for extracting Business Intelligence
PEC306.3	Apply predictive analytics for business fore-casting.
PEC306.4	Apply analytics for supply chain and logistics management
PEC306.5	Use analytics for marketing and sales.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PEC306.1	2	2	3	-	-	-	-	-	-	-	-	-	-	-	2
PEC306.2	3	3	3	-	-	-	-	-	-	-	-	-	1	-	2
PEC306.3	2	2	3	-	-	-	-	-	-	-	-	-	2	-	3
PEC306.4	2	1	1	-	-	-	-	-	-	-	-	2	-	-	3
PEC306.5	2	3	2	-	-	-	-	-	-	-	-	1	-	-	3

Contents	Duration
Unit 1: Introduction to Business Analytics Analytics and Data Science, Analytics Life Cycle, Types of Analytics, Business Problem Definition, Data Collection, Data Preparation, Hypothesis Generation, Modeling, Validation and Evaluation, Interpretation, Deployment and Iteration	**7 Hrs**
Unit 2: Business Intelligence Data Warehouses, ETL Process, Data Mart, Knowledge Management, Types of Decisions, Decision Making Process, Decision Support Systems, Business Intelligence, OLAP, Analytic functions	**9 Hrs**
Unit 3: Business Forecasting Introduction to Business Forecasting and Predictive analytics, Logic and Data Driven Models, Data Mining and Predictive Analysis Modelling, Machine learning: need, definition, and terminologies, process, Types of machine learning – supervised learning, unsupervised learning, semi-supervised learning, reinforcement learning, Machine Learning for Predictive analytics.	**7 Hrs**
Unit 4: HR & Supply Chain Analytics Human Resources, Planning and Recruitment, Training and Development, Supply chain network, Planning Demand, Inventory and Supply, Logistics, Analytics applications in HR & Supply Chain, Applying HR Analytics to make a prediction of the demand for hourly employees for a year.	**8 Hrs**

Unit 5: Marketing & Sales Analytics Marketing Strategy, Marketing Mix, Customer Behaviour, selling Process, Sales Planning, Analytics applications in Marketing and Sales, predictive analytics for customer's behaviour in marketing and sales	**8 Hrs**
Unit 6: Business Analytics: Emerging Trends and Future Impacts Impacts of Analytics in Organizations: An Overview, Issues of Legality, Privacy, and Ethics, An Overview of the Analytics Ecosystem	**6 Hrs**

List of Experiments

Exp. No.	Name of Experiment	S/O	Hours
1	Study of Tools Used in Business Intelligence	S	2
2	Load and clean a business dataset (e.g., sales, HR) by handling missing values, outliers, and encoding categorical features.	O	2
3	Simulate OLAP using pivot tables and group by operations.	O	2
4	Perform statistical summary, plot distributions, and generate business hypotheses (e.g., "Do discounts boost sales?")	O	2
5	Predict sales/revenue from features like marketing spend or customers.	O	2
6	Predict future sales or revenue using linear regression on historical data.	O	2
7	Predict customer churn (Yes/No) using classification models.	O	2
8	Segment customers into distinct groups based on purchasing behavior.	O	2
9	Discover item associations (e.g., "customers who buy bread also buy butter").	O	2
10	Forecast sales or demand over time using time-series models.	O	2
11	Predict if a customer will purchase again	O	2
12	Apply analytics for forecasting and inventory planning for a large retailer.	O	2
13	Predict the Customer Credit Risk for Credit card data-set using Linear Regression	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 to 12 experiments from the list.

Text Books:

1	Evans, James R., Business Analytics, Global Edition, Pearson Education, Limited, 2021
2	R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, 2016, Wiley

Reference Books:

1	S. Christian Albright, Wayne L. Winston, "Business Analytics: Data Analysis and Decision Making", Cengage, 7th edition

Useful Link /Web Resources:

1. https://onlinecourses.nptel.ac.in/noc24_cs65/preview
2. https://www.coursera.org/learn/introduction-to-business-analytics

*****

Course Title: Liberal Learning- Salesforce	
Course Code: 231CSECCAP301	Semester: V
Teaching Scheme: L-T-P: 2-0-0	Credits: Audit
Evaluation Scheme: ISE Marks:50	ESE Marks: NA

Prerequisite:	Basic knowledge of Databases, Web Technologies, and Object-Oriented Programming.

Course Description:

This course introduces students to the fundamentals of Customer Relationship Management (CRM) and the Salesforce cloud platform. It covers core concepts of cloud computing, Salesforce architecture, and its development environment. Students will learn to model data, automate business processes, and build custom applications using both declarative tools and Apex programming. The course also includes hands-on practice with Salesforce security, Lightning components, and basic integration techniques. By the end, students will be equipped to design, develop, and deploy scalable CRM solutions on the Salesforce platform.

Course Objectives:

1	To understand the fundamental concepts of CRM and cloud computing.
2	To introduce Salesforce platform architecture and services.
3	To develop skills in configuring and customizing Salesforce applications.
4	To implement Salesforce automation and workflows.
5	To explore advanced Salesforce services including AI-powered features like Einstein Assistant.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
CCA301.1	Understand the principles of CRM and cloud computing, and explain the architecture and features of the Salesforce platform.
CCA301.2	Design and configure custom data models, business logic, and security settings within Salesforce.

COs	Statements
CCA301.3	Develop and automate business processes using declarative tools like Flows, Process Builder, and Apex triggers.
CCA301.4	Build and deploy custom Salesforce applications using Apex, SOQL/SOSL, and Lightning components, and demonstrate basic integration capabilities.

Contents	Duration
Unit 1: Introduction to CRM and Cloud Computing Introduction to Customer Relationship Management (CRM), Importance and evolution of CRM systems, Overview of Cloud Computing: IaaS, PaaS, SaaS, Salesforce as a Cloud CRM Platform, Benefits and market presence of Salesforce, Salesforce Editions and Licensing Models	**4 Hrs**
Unit 2: Salesforce Basics and Developer Tools Salesforce Architecture and Multitenancy, Salesforce Development Lifecycle, Introduction to Salesforce UI – Classic vs Lightning, Creating and managing Salesforce Accounts, Overview of Salesforce Objects (Standard and Custom), Introduction to Developer Console and VS Code with Salesforce Extensions.	**4 Hrs**
Unit 3: Salesforce Data Modeling and Security Objects, Fields, Relationships: Lookup, Master-Detail, Schema Builder, Data Types and Validation Rules, Profiles, Roles, and Permission Sets, Record-level Security: OWD, Sharing Rules, Field-level Security and Login Access Policies.	**7 Hrs**
Unit 4: Business Logic and Process Automation Formula Fields and Roll-up Summary Fields, Workflow Rules and Actions, Lightning flows, Approval Processes, Apex Triggers Basics, Use cases for Automation in Enterprise Scenarios.	**7 Hrs**
Unit 5: App Development and Integration Building Custom Apps in Salesforce, Apex Programming Fundamentals (Classes, SOQL, SOSL), Lightning Web Components Overview, Introduction to APIs and External Integrations (REST/SOAP), Deployment with Change Sets and Sandboxes.	**4 Hrs**

Unit 6: Salesforce AI – Einstein Assistant and Analytics Introduction to Salesforce Einstein Platform, Einstein AI Features: Prediction Builder, Next Best Action, Use of Einstein Bots and Voice, Integration of Einstein Assistant with CRM Workflows, Einstein Analytics (Tableau CRM): Dashboards and Reports, Use Cases in Sales, Marketing, and Service Clouds.	**4 Hrs**

List of Experiments

Exp. No.	Name of Experiment	S/O	Hours
1	Setting up a Salesforce Developer Account	O	2
2	Creating and managing standard/custom objects	O	2
3	Implementing data security via profiles and roles	O	2
4	Designing automation using Flow and Process Builder	O	2
5	Creating custom apps and components using Apex/Lightning	O	2
6	Developing a chatbot using Einstein Assistant	O	2

Text Books and References:

1	Learning Salesforce Development with Apex – Paul Battisson
2	Salesforce for Dummies – Liz Kao & Jon Paz
3	Salesforce Trailhead Modules (https://trailhead.salesforce.com)
4	Salesforce Developer Documentation

*****

Course Title: Data Security Systems	
Course Code: 231CSEHCL301A	Semester: V
Teaching Scheme: L-T-P: 3-0-2	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks: 25	ESE Marks: 50

Prerequisite:	Knowledge of SQL queries and other databases, Knowledge of advanced UNIX commands, Familiarity with data protection standards

Course Description:

The Data Security System course aims to equip students with the fundamental concepts, tools, and techniques required to protect digital information from cyber threats. The course also covers risk assessment, legal and ethical considerations in data security, and the design of security policies. Through a combination of lectures, hands-on labs, and case studies, students will gain practical experience in implementing and managing data security systems in real-world environments.

Course Objectives:

1	To understand the Fundamentals of Data Security.
2	To explore Network Security Fundamentals.
3	To learn Cryptographic Techniques for Data Protection.
4	To understand Security Policies, Compliance, and Risk Management.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
HC301A.1	Understand data security and its importance.
HC301A.2	Understand different data security compliance and standard.
HC301A.3	Discover data security vulnerabilities in real-time.
HC301A.4	Protect critical data with secure solutions.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
HC301A.1	3	-	3	-	-	3	-	-	-	3	-	1	2	-	2
HC301A.2	3	2	2	-	-	3	-	-	-	2	-	2	3	-	2
HC301A.3	3	3	3	-	-	3	-	-	-	3	-	3	3	-	3
HC301A.4	3	3	3	-	-	3	-	-	-	3	-	3	2	-	3

Contents	Duration
Unit 1. Introduction to Data Security: Fundamental concepts and importance of data security, Threats to data integrity, confidentiality, and availability.	**6 Hrs**
Unit 2. Cryptography: Symmetric and asymmetric encryption techniques.Hash functions and digital signatures, Public Key Infrastructure (PKI).	**7 Hrs**
Unit 3. Network Security: Firewalls, Intrusion Detection Systems (IDS), and Intrusion Prevention Systems (IPS), Virtual Private Networks (VPNs) and secure communication protocols.	**8 Hrs**
Unit 4. Operating System and Database Security: Security mechanisms in various operating systems, Access control models and authentication methods, Securing database management systems, Data masking, encryption, and access controls.	**8 Hrs**
Unit 5. Security Policies and Management: Development and implementation of security policies, Risk assessment and management strategies.	**7 Hrs**
Unit 6. Legal and Ethical Issues: Cyber laws and regulations. Ethical considerations in data security.	**6 Hrs**

List of Experiments			
Exp. No.	Name of Experiment	S/O	Hours
1	Implementing Encryption & Decryption Techniques	O	2
2	Hashing for Data Integrity	O	2
3	Secure File Storage using Encryption	S	2
4	Setting Up a Firewall for Network Security	O	2
5	Implementing Intrusion Detection Systems (IDS)	O	2
6	SQL Injection Attack & Prevention	O	2
7	Secure User Authentication with Multi-Factor Authentication (MFA)	O	2
8	Implementing Secure Password Storage	O	2
9	Performing Steganography for Data Hiding	O	2
10	Encrypting Email Communication using PGP	O	2
11	Detecting and Preventing Phishing Attacks	O	2
12	Analyzing Malware Behaviour using Sandboxing	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 experiments from the list.

Text Books:

1	W. Stallings, Cryptography and Network Security: Principles and Practice, Pearson Education, 7th Edition, [2017].
2	W. Stallings, L. Brown, Computer Security: Principles and Practice, Pearson Education, 4th Edition, [2018].

Reference Books:

1	W. Chen, B. Barkai, J. M. DiPietro, V. Langman, D. Perlov, R. Riah, Y. Rozenblit, A. Santos, Deployment Guide for InfoSphere Guardium, IBM Redbooks, [2012].

Useful Link /Web Resources:

1. https://archive.nptel.ac.in/courses/106/106/106106129/
2. https://onlinecourses.nptel.ac.in/noc23_cs127/preview

*****

Course Title: ReactJS with MUI	
Course Code: 231CSEHCL301B	Semester: V
Teaching Scheme: L-T-P: 3-0-2	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks: 25	ESE Marks: 50

Prerequisite:	Basic knowledge of HTML, CSS, and JavaScript (ES6), Understanding of functions, objects, and asynchronous programming in JavaScript

Course Description:

This course introduces students to React.js, a popular JavaScript library for building modern web applications. The course covers fundamental concepts, component-based architecture, state management, routing, API integration, and styling using Material-UI (MUI). Students will learn how to create dynamic, interactive, and scalable front-end applications.

Course Objectives:

1	To introduce modern front-end development using React.js.
2	To understand React's component-based architecture and how it differs from traditional web development.
3	To learn state management and how React handles UI updates efficiently.
4	To explore React Router for client-side navigation.
5	To integrate REST APIs for dynamic content handling.
6	To implement Material-UI (MUI) for better UI/UX design.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
HC301B.1	Understand the React.js framework, virtual DOM, and component-based structure.
HC301B.2	Implement state management using Hooks like useState and useEffect.
HC301B.3	Create multi-page applications using React Router.
HC301B.4	Integrate and manage API data in React applications.
HC301B.5	Design responsive, modern UI using Material-UI (MUI).
HC301B.6	Deploy React applications and apply best practices for performance optimization.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
HC301B.1	3	-	2	-	2	-	-	-	-	-	-	-	-	-	2
HC301B.2	-	2	-	-	3	-	-	-	-	-	-	1	-	-	3
HC301B.3	-	-	3	-	3	-	-	-	-	2	-	-	2	2	3
HC301B.4	2	3	2	-	3	-	-	-	-	-	-	-	2	2	3
HC301B.5	-	-	3	-	2	-	-	-	2	2	-	-	-	-	3
HC301B.6	-	2	3	-	3	-	-	-	-	-	2	2	2	2	3

Contents	Duration
Unit 1: Introduction to React.js What is React.js? Why use React? Difference between traditional web development and React-based development, Understanding Virtual DOM, One-way Data Binding, and Component-Based Architecture, setting up a React project using Create React App (CRA) or Vite.	**6 Hrs**
Unit 2: Understanding Components and Props Components in React: Functional vs Class Components. What are props? Passing data between components, Using defaultProps and prop types for validation, Understanding Component Lifecycle Methods in Class Components.	**7 Hrs**
Unit 3: State Management with React Hooks Difference between props vs state, Using useState() to manage component-level state. Using useEffect() for side effects (Fetching data, event listeners), Introduction to Context API for global state management.	**7 Hrs**
Unit 4: React Router and Navigation What is client-side routing? Setting up React Router in a project, Navigating between pages using Link and NavLink, Using useParams() to access URL parameters, Redirecting users using useNavigate().	**8 Hrs**

Unit 5: Fetching Data & Handling APIs Understanding REST APIs and how React interacts with them, Fetching data using fetch() and axios, Handling API loading states and errors, Using useEffect() to make API calls dynamically.	**7 Hrs**
Unit 6: Designing UI with Material-UI (MUI) Introduction to Material-UI (MUI) for styling React apps, Understanding MUI components (Button, Card, Grid, Typography), Theming and customization using the sx prop, Building a simple responsive dashboard UI using MUI.	**7 Hrs**

List of Experiments

Exp. No.	Name of Experiment	S/O	Hours
1	Setting up a React Project and Rendering a Component	O	2
2	Creating and Using Functional Components with JSX	O	2
3	Managing Component State using useState()	O	2
4	Handling Events and Forms in React	O	2
5	Navigating Between Pages using React Router	O	2
6	Fetching and Displaying Data from an API using axios	O	2
7	Using Context API for Global State Management	O	2
8	Styling a Component using Material-UI (MUI)	O	2
9	Creating a Responsive Dashboard using MUI Components	O	2
10	Deploying a React Application on Vercel or Netlify	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 experiments from the list.

Text Books:

1	Learning React" – Alex Banks & Eve Porcello
2	"React Up and Running" – Stoyan Stefanov
3	"Fullstack React" – Anthony Accomazzo et al.

Reference Books:

1	"The Road to React" – Robin Wieruch
2	"React Cookbook" – Carlos Santana Roldán
3	"Material-UI: React Components for Faster and Easier Web Development" – MUI Docs & Community

Useful Link /Web Resources:

1. React Official Docs: https://react.dev/
2. Material-UI Official Docs: https://mui.com/
3. React Router Guide: https://reactrouter.com/

*****

Course Title: Hybrid Platform Mobile App Development	
Course Code: 231CSEHCL301C	Semester: V
Teaching Scheme: L-T-P: 3-0-2	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks: 25	ESE Marks: 50

Prerequisite:	Basic knowledge of HTML, CSS, and JavaScript, Understanding of object-oriented programming concepts, Familiarity with mobile devices and responsive web design

Course Description:

This course introduces hybrid mobile app development using frameworks like React Native and Flutter, enabling cross-platform development using a single codebase. Students will learn to build, test, and deploy mobile apps compatible with Android and iOS. Emphasis is placed on user interface design, device APIs, state management, navigation, and performance optimization.

Course Objectives:

1	To understand the architecture and principles of hybrid mobile app development.
2	To explore frameworks like React Native **and** Flutter for building cross-platform apps.
3	To learn UI/UX design, API integration, and state management in hybrid applications.
4	To gain hands-on experience in building and deploying hybrid apps for multiple platforms.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
HC301C.1	Understand the architecture and components of hybrid mobile development frameworks.
HC301C.2	Design and develop interactive and responsive UI for mobile apps using a hybrid platform.
HC301C.3	Integrate external APIs and manage data using state management techniques.
HC301C.4	Build, test, and deploy hybrid mobile applications on Android and iOS platforms.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
HC301C.1	3	2	2	-	3	-	-	-	-	-	-	1	-	-	2
HC301C.2	2	2	3	-	3	-	-	-	2	2	-	1	2	-	3
HC301C.3	2	3	3	-	3	-	-	-	-	-	-	-	2	2	3
HC301C.4	2	2	3	-	3	-	-	-	-	-	2	2	2	2	3

Contents	Duration
Unit 1: Introduction to Hybrid Mobile Development Native vs Hybrid vs Web apps, Overview of hybrid frameworks (React Native, Flutter), Environment setup	**6 Hrs**
Unit 2: UI Design & Layouts Flexbox (React Native), Widgets (Flutter), Styling, Theming, Responsive Design, Custom Components	**7 Hrs**
Unit 3: Navigation and Routing Stack Navigator, Tab Navigator, Drawer Navigator (React Navigation), Routing in Flutter, Deep Linking	**7 Hrs**
Unit 4: State Management Local State using `useState` or `setState`, Context API, Redux, Provider, Hooks (React Native), Riverpod (Flutter)	**8 Hrs**
Unit 5: API Integration REST API concepts, Using Axios or Fetch, Error Handling, Async/Await, JSON parsing, Displaying fetched data.	**7 Hrs**
Unit 6: Testing and Deployment Debugging, Emulator/Device Testing, Build process, APK/IPA generation, Publishing to Play Store/App Store, Performance optimization	**7 Hrs**

List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	Setup development environment for React Native or Flutter.	O	2
2	Create a basic "Hello World" hybrid app.	O	2
3	Design a login form with validation and styling.	O	2
4	Implement navigation using Stack/Tab Navigator (React Native) or Navigator 2.0 (Flutter).	O	2
5	Create a dynamic list using FlatList (React Native) or ListView (Flutter).	O	2
6	Manage component state using Hooks or setState.	O	2
7	Use Context API or Provider for app-wide state sharing.	O	2
8	Fetch data from a REST API and display it in the app.	O	2
9	Handle API loading states and error conditions.	O	2
10	Use device features like camera, GPS, or storage.	O	2
11	Perform unit testing or snapshot testing of UI components.	O	2
12	Build and deploy the hybrid app on a physical device or emulator.	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 experiments from the list.

Text Books:

1	Adam Boduch, Roy Derks, "React Native Cookbook" 2nd Edition, Packt Publishing, 2021
2	Jonathan S. Campos, "Flutter for Beginners", 2nd Edition, Packt Publishing, 2021

Reference Books:

1	Eric Masiello, Jacob Friedmann,
2	Marco L. Napoli, "Flutter for Dummies", 1st Edition", Wiley, 2020
3	Akshat Paul, Abhishek Nalwaya, "Learning React Native", 2nd Edition,O'Reilly Media, 2017
4	Priyanka Tyagi, Mobile Computing and App Development", 1st Edition, Katson Books, 2022
5	Michael Katz," Beginning Flutter: A Hands-On Guide to App Development", 1st Edition, Apress, 2020

Useful Link /Web Resources:

1. https://reactnative.dev
2. https://flutter.dev
3. https://expo.dev
4. https://flutter.dev/docs/codelabs

*****

Third Year CSE B. Tech. Syllabus

Semester-VI

Course Title: Compiler Design	
Course Code: 231CSEPCCL306	Semester: VI
Teaching Scheme: L-T-P: 3-0-0	Credits: 3
Evaluation Scheme: ISE + MSE Marks: 20+30=50	ESE Marks: 50

Prerequisite:	Automata theory, assembly language, high level programming language

Course Description:

The compiler is a fundamental tool for programmers, making it essential to understand its workings-even for those who may never build one. This course provides an introduction to key concepts in compiler construction, covering the basics of system programs and offering deeper insights into the various phases of a compiler. Students will explore lexical analysis, parsing, semantic analysis, intermediate code generation, code optimization, and final code generation, gaining a comprehensive understanding of the compilation process.

Course Objectives:

1	To expose the students to the fundamentals of various system programs.
2	To introduce the fundamentals of Compiler and its phases.
3	To design and implement phases of a compiler.
4	To expose the students to various compiler construction tools.

Course Outcomes (COs): Upon successful completion of this course, the students will be able to:

COs	Statements
PCC306.1	Understand the basics of system programs, assemblers, macros, linkers, loaders.
PCC306.2	Remember the compiler phases and study compiler construction tools.
PCC306.3	Design and implement basic scanner and parser.
PCC306.4	Understand and apply syntax-directed translation, intermediate code generation, and target code generation techniques.
PCC306.5	Identify appropriate code optimizing transformation for given code and perform the optimizing transformation.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PCC306.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
PCC306.2	2	-	-	-	2	-	-	-	-	-	-	-	-	-	1
PCC306.3	2	1	1	-	-	-	-	-	-	-	-	-	2	-	3
PCC306.4	1	-	-	-	-	-	-	-	-	-	-	-	-	1	3
PCC306.5	2	2	-	-	-	-	-	-	-	-	-	-	1	1	3

Contents	Duration
Unit 1: Language Processors: Introduction, language processing activities, fundamentals of language processing, Language processor development tools: LEX and YACC, compiler construction tools, cousins of the compiler, Phases of a compiler.	**8 Hrs**
Unit 2: Assemblers, Linkers, and Loaders: Elements of assembly language programming, a simple assembly scheme, pass structure of assemblers, Macros and Macro Pre-Processors: Macro definition and call, macro expansion, nested macro calls.	**8 Hrs**
Unit 3: Lexical Analysis: Role of a lexical analyzer, input buffering, specification and recognition of tokens, finite automata implications.	**6 Hrs**
Unit 4: Syntax Analysis: Role of parser, top-down parsing, recursive descent and predictive parsers (LL), bottom-up parsing, operator precedence parsing, working of LR parser and introduction to its types SLR, canonical LR, and LALR.	**8 Hrs**
Unit 5: Syntax Directed Translation and Intermediate Code Generation: Introducing Syntax directed definitions, construction of syntax tree, S-attributed definitions, L attributed definitions, intermediate languages, assignment statements, back patching.	**8 Hrs**

Unit 6: Code Generation and Code Optimization: Issues in the design of a code generator and target machine, basic blocks and flow graphs, a simple code generator, principal sources of optimization, optimization of basic blocks, peephole optimization.	**7 Hrs**

Text Books:

1	System Programming and operating systems, D. M. Dhamdhere, 2ndEdition (TMGH) (Unit 1,2)
2	Compilers - Principles, Techniques, and Tools A. V. Aho, R. Sethi and J. D. Ullman Pearson Education (Unit 3,4,5,6)

Reference Books:

1	Compiler construction D.M. Dhamdare Mc-Millan
2	Santanu Chattopadhyay, "Compiler Design", PHI Learning Pvt. Ltd., 2015

Useful Link /Web Resources:

1. NPTEL course on Compiler Design
   https://onlinecourses.nptel.ac.in/noc20_cs13/preview

*****

Course Title: Structured Database	
Course Code: 231CSEPCCL307	Semester: VI
Teaching Scheme: L-T-P: 3-0-0	Credits: 3
Evaluation Scheme: ISE + MSE Marks: 20+30=50	ESE Marks: 50

Prerequisite:	Data Structures

Course Description:

This course introduces the fundamental concepts, principles and tools of database system. The course includes relational data model and languages, database design techniques, SQL, data storage and indexing techniques. Also, the focus is given on concurrency control and recovery techniques.

Course Objectives:

1	To understand fundamental concepts of database systems.
2	To gain familiarity with SQL, PLSQL and DBMS.
3	To learn database design techniques.
4	To understand indexing, transaction management and recovery techniques.

Course Outcomes (COs): Upon successful completion of this course, the students will be able to:

COs	Statements
PCC307.1	Understand fundamental concepts of database systems, including architecture, data models, and the Entity-Relationship (ER) model.
PCC307.2	Study and apply SQL queries, PLSQL procedures to design & manage the database.
PCC307.3	Analyze & construct good database design.
PCC307.4	Understand transaction concepts and concurrency control techniques.
PCC307.5	Understand failures in the database and appropriate recovery techniques.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PCC307.1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	2
PCC307.2	-	3	3	-	-	-	-	-	-	-	-	2	2	-	3
PCC307.3	-	2	2	-	-	-	-	-	-	-	-	2	2	-	4
PCC307.4	2	2	-	-	-	-	-	-	-	-	-	-	-	-	2
PCC307.5	2	-	2	-	-	-	-	-	-	-	-	-	-	-	2

Contents	Duration
Unit 1: Introduction to databases and E-R model Purpose of Database Systems, View of data, Database architecture, Database users and administrator, E-R model: Entity sets, Relationship sets, Mapping Constraints, Keys, E-R Diagram, Reducing E-R Diagrams to relational schemas, Extended E-R features: Specialization, Generalization, and Aggregation	**7 Hrs**
Unit 2: Relational Model, SQL and PLSQL Relational Model: Structure of Relational Databases, Database Schema, Keys, Schema Diagram, Fundamental operations of Relational Algebra. SQL: Overview of the SQL Query Language, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Aggregate Functions, Nested Subqueries, Modification of the Database, Join Expressions, Views, DCL, TCL. PLSQL: Triggers, Stored Procedures, PL/SQL Processing with Cursors, PL/SQL Stored Functions	**9 Hrs**
Unit 3: Relational Database Design Referential Integrity, features of good relational designs, functional dependency, closure of a set of functional dependencies, closure of attribute sets. Normalization: Purpose of normalization, Types of decomposition, First Normal Form (1NF), Second Normal Form (2NF), Third Normal Form (3NF), Boyce-Codd Normal Form (BCNF).	**7 Hrs**

Unit 4: Data Storage and Indexing Storage and File structure: Overview of physical storage media, File Organization, Organization of Records in Files, Data Dictionary Storage. Indexing and Hashing: Basic Concepts, Ordered Indices, Multiple Key Access. Static Hashing, Dynamic Hashing, Index definition in SQL.	**8 Hrs**
Unit 5: Transaction Management and Concurrency Control Transaction concept, A Simple Transaction model, Transaction Atomicity and Durability, Serializability, Lock-Based Protocols, Time-Stamp Based Protocols, Validation-Based Protocols	**8 Hrs**
Unit 6: Recovery Systems Failure Classification, Storage Structure, Stable-Storage Implementation, Data access, Recovery methods- Shadow paging and Log based recovery, Checkpoints, Buffer Management, Failure with Loss of Non-volatile Storage, Remote Backup Systems	**6 Hrs**

Text Books:

1	A. Silberschatz, H.F. Korth, S. Sudarshan, "Database System Concepts", 6th Edition, McGraw Hill Education. (Unit 1,2, 3,4,5 ,6)
2	Thomos Connolly, Carolyn Begg, "Database Systems - A practical approach to Design, Implementation and Management", 3rd Edition, Pearson Education. (Unit 3- Normalization)
3	Coronel, Morris, Rob, "Database Systems, Design, Implementation and Management", Ninth Edition, Cengage Learning, (Unit 2- PLSQL)

Reference Books:

1	Ramez Elmasri and Shamkant Navathe, "Fundamentals of Database Systems", Pearson Education, Fifth Edition.
2	Raghu Ramkrishnan, Johannes Gehrke, "Database Management System", Fourth Edition, McGraw Hill Education.

Useful Link /Web Resources:

1. https://onlinecourses.nptel.ac.in/noc19_cs46/preview

*****

Course Title: Structured Database Laboratory	
Course Code: 231CSEPCCP308	Semester: VI
Teaching Scheme: L-T-P: 0-0-2	Credits: 1
Evaluation Scheme: ISE + MSE Marks: NA INT Marks: 50	ESE Marks: NA

Prerequisite:	Data Structures

Course Description:

This course focuses on implementation of the fundamental concepts and principles of database engineering. Focus is given on hands-on practical's considering SQL-DDL, DML commands, database connectivity and implementation of views.

Course Objectives:

1	To demonstrate fundamental concepts of database systems.
2	To gain familiarity with SQL and DBMS.
3	To construct the database for a given application.

Course Outcomes (COs): Upon successful completion of this course, the students will be able to:

COs	Statements
PCC308.1	Install and use database management systems.
PCC308.2	Represent logical design of database using E-R Diagram.
PCC308.3	Apply and demonstrate SQL queries, PLSQL Procedures to design and manage the database.
PCC308.4	Analyze and construct good database design.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PCC308.1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	2
PCC308.2	-	2	2	-	2	-	-	-	-	-	-	-	-	-	3
PCC308.3	-	3	3	-	2	-	-	-	-	-	-	2	2	-	3
PCC308.4	-	2	2	-	-	-	-	-	-	-	-	2	2	-	4

List of Experiments

Exp. No.	Name of Experiment	S/O	Hours
1	ER Diagram of an Organization- Draw an E-R Diagram for any organization like Insurance Company, Library systems, College Management systems, Hospital Management systems etc. Use data modelling tools like Oracle SQL developer, Tode etc. to draw ER diagrams.	S	2
2	Conversion of ER Diagram to Tables- Convert the above-mentioned E-R Diagrams in Relational Tables.	S	2
3	DDL Statements- Execute DDL commands to create, alter, rename, truncate and drop tables in SQL. Apply all types of constraints such as primary key, foreign key, not null, unique, check.	O	2
4	DML Statements- Use DML Queries to insert, delete, update & display records of the tables.	O	2
5	SQL character functions, String functions- Display the results using String operations.	O	2
6	Aggregate functions- Display the records using Aggregate functions and Group by, having, between, Order by clauses.	O	2

7	Join operations and set operations- Display the results of union, intersection, set difference, Cartesian product and Join operations of two different tables.	O	2
8	Views, Subqueries- Create Views for the table. Solve subqueries for given questions	O	2
9	Demonstrate PLSQL Functions and Procedures.	O	2
10	Demonstrate Cursors, and triggers using PL/SQL.	O	2
11	Database Connectivity- Write a program of Database connectivity with any object oriented language.	O	2
12	Normalize any database from first normal form to Boyce-Codd Normal Form (BCNF).	S	2
13	Functional Dependency- Write a program to find the F+ of relation schema R (A, B, C, G, H, I) and F= {A->B, A->C, CG->H, CG->I, B->H}.	O	2
14	Write a program to implement Static Hashing.	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 to 12 experiments from the list.

Text Books:

1	A. Silberschatz, H.F. Korth, S. Sudarshan, "Database System Concepts", 6th Edition, McGraw Hill Education.
2	Thomos Connolly, Carolyn Begg, "Database Systems - A practical approach to Design, Implementation and Management", 3rd Edition, Pearson Education.
3	Coronel, Morris, Rob, "Database Systems, Design, Implementation and Management", Ninth Edition, Cengage Learning.

Reference Books:

1	Ramez Elmasri and Shamkant Navathe, "Fundamentals of Database Systems", Pearson Education, Fifth Edition.
2	Raghu Ramkrishnan, Johannes Gehrke, "Database Management System", Fourth Edition, McGraw Hill Education.

Useful Link /Web Resources:

1. https://onlinecourses.nptel.ac.in/noc19_cs46/preview

*****

Course Title: Scripting Concepts	
Course Code: 231CSEPCCP309	Semester: VI
Teaching Scheme: L-T-P: 2-0-2	Credits: 1
Evaluation Scheme: ISE + MSE Marks: NA INT Marks: 50	ESE POE Marks: 50

Prerequisite:	Basic Knowledge of HTML and CSS

Course Description:

The Scripting Concepts course provides a comprehensive introduction to scripting languages with a focus on JavaScript, TypeScript, Dart and PHP. It covers fundamental scripting principles, client-side and server-side scripting, and real-world applications in web development.

Course Objectives:

1	To make the student learn the basics of scripting.
2	To expose the students to various concepts of JavaScript.
3	To make the students aware of various TypeScript and Dart concepts.
4	To expose the students to the basics and advanced concepts of the PHP.

Course Outcomes (COs): Upon successful completion of this course, the students will be able to:

COs	Statements
PCC309.1	Understand the basic concepts in scripting.
PCC309.2	Identify the JavaScripts concepts to solve a problem.
PCC309.3	Demonstrate the use of TypeScript and Dart in problem solving.
PCC309.4	Apply basic and advanced concepts for web application development using PHP.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PCC309.1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	2
PCC309.2	3	3	2	1	1	-	-	-	-	-	-	-	2	-	3
PCC309.3	3	3	2	2	1	-	-	-	-	-	-	-	2	3	3
PCC309.4	3	3	1	1	1	-	-	-	3	-	-	-	3	3	3

Contents	Duration
Unit 1: JavaScript: What are Scripting Languages, Types of Scripting Language, Features, usage of Scripting Language, Advantages, Introduction to JavaScript, Basic program of JavaScript, variables, functions, conditions, loops and repetition, Arrays, Objects, Exceptions, Event handling In JavaScript, Validating HTML form data using JavaScript.	**10 Hrs**
Unit 2: Introduction of Typescript: TypeScript basics, types, Control flows, Functions, Classes.	**5 Hrs**
Unit 3: Introduction to Dart Dart Basics, Data types, Control Statements, function, interface, classes, Collections	**5 Hrs**
Unit 4: PHP – Hypertext Pre-processor: PHP Basics, Data Types, Identifiers, Variables, Super global Variables, Constants, Expressions, and Control Structures, Functions, Array, array functions, Classes and Objects, PHP forms, State Management: what is Session Handling, Working with Sessions, PHP cookies, Uploading Files with _FILES, interacting with the Database with MySQL, Executing Database Transactions.	**10 Hrs**

List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	Study of JavaScript basics	S	2
2	Implementation of exception handling using JavaScript.	O	2
3	Implementation of event handling using JavaScript.	O	2
4	Write a code for validating the HTML form inputs using JavaScript	O	2
5	Write a program for demonstration of TypeScript concepts.	O	2
6	Write a program for demonstration of Dart concepts.	O	2
7	Study of PHP basics along with different modern tool installation and configuration.	O	2
8	Implementation of PHP array with different functions.	O	2
9	Implementation object-oriented concepts in PHP.	O	2
10	Implementation of form and extract the user input using $_GET or $_POST	O	2
11	Design and develop an application for uploading various types of files using PHP.	O	2
12	Design and develop a program for storing and retrieving the information from session and cookies using PHP	O	2
13	Design and develop an application for handling different database operations (Insert, Update, Display) using PHP.	O	2
14	Design and develop the mini project for solving the different real time problems using Scripting languages in the group of 4-5 students	O	6

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 to 12 experiments from the list.

Text Books:

1	"JavaScript: The Good Parts", Douglas Crockford, O'Reilly
2	"Programming TypeScript", Boris Cherny, O'Reilly Media, Inc.
3	"Dart Programming Language Specification" 6th edition draft Version 2.13-dev
4	"Beginning PHP and MySQL: From Novice to Professional", W. Jason Gilmore, Fourth Edition

Reference Books:

1	"JavaScript: The Definitive Guide: Master the World's Most-Used Programming Language", David Flanagan, O'REILLY Publication.
2	"Essential TypeScript 5", Adam Freeman, Third Edition, Manning
3	"Dart for Absolute Beginners", Devid Kopec (Apress,2014)
4	"PHP & MySQL: Server-Side Web Development", Jon Duckett, Paperback, 2022

Useful Link /Web Resources:

1. http://www.php.net
2. https://www.w3schools.com
3. https://www.geeksforgeeks.org/what-are-scripting-languages/
4. https://www.typescriptlang.org/docs/handbook/intro.html
5. https://www.tutorialspoint.com/dart_programming/dart_programming_collection.htm

*****

Course Title: Selenium Framework	
Course Code: 231CSEMDML302	Semester: VI
Teaching Scheme: L-T-P: 1-0-2	Credits: 2
ISE + MSE Marks: NIL INT Marks: NIL	ESE Marks: 50 M

Prerequisite:	Basic knowledge of Java/Python, HTML, CSS, XPath

Course Description:

This Selenium course provides comprehensive training in automating web application testing, covering Selenium WebDriver, IDE, and Grid, along with essential concepts like locators, synchronization, and framework development, equipping you with the skills to ensure software quality through automated testing.

Course Objectives:

1	To provide hands-on experience with Selenium IDE, WebDriver, and testing frameworks.
2	To teach user interactions like handling text fields, checkboxes, dropdowns, and mouse/keyboard actions.
3	To implement test design techniques such as Page Object Model (POM), Data-driven testing, and Selenium Grid.
4	To integrate Git and GitHub for version control and collaborative testing.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
MDM302.1	Understand and implement the Selenium framework.
MDM302.2	Execute automated test scripts using Selenium WebDriver.
MDM302.3	Implement scalable test automation solutions using POM, parameterization, and logging mechanisms.
MDM302.4	Apply Selenium Grid for parallel execution and Git for version control.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
MDM302.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
MDM302.2	2	2	-	-	2	-	-	-	-	-	-	1	-	-	3
MDM302.3	3	2	-	-	2	-	-	-	-	-	-	-	-	-	3
MDM302.4	2	3	-	-	2	-	-	-	-	-	-	1	-	-	3

Contents	Duration
Unit 1: Selenium Framework What is testing framework, Types of frameworks, Selenium Features, Configuration Components of selenium	**3 Hrs**
Unit 2: Selenium IDE Introduction, creating selenium IDE test, selenium RC, selenese commands- actions, accesses, assertions, WebDriver architecture, scripting using web driver, Locators	**4 Hrs**
Unit 3: Interactions User Interactions-Test box, Radio button selection, checkbox, dropdown item selection, synchronization, drag and drop, keyboard actions, mouse actions, multiselection, find all links.	**4 Hrs**
Unit 4: Test design Techniques Page object Model, Data drive using Excel, parameterization, Log4j Logging, Exception handling, selenium grid, working of grid, develop the script and prepare XML file, test execution, result analysis, use of Git, GIthub with selenium	**4 Hrs**

List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	Install and configure Selenium WebDriver for automation testing.	O	2
2	Use Selenium IDE to record and execute test cases.	O	2
3	Write a Selenium WebDriver script to automate Google search	S	2
4	Identify and interact with web elements using different locators	O	2

5	Fill and submit a form using WebDriver.	O	2
6	Perform advanced user interactions using Actions class.	O	2
7	Handle timing issues using waits.	O	2
8	Implement the POM design pattern for test automation.	O	2
9	Read test data from an Excel file and execute test cases.	O	2
10	Run tests on multiple browsers using Selenium Grid.	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 8 to 10 experiments from the list.

Text Books:

1	Selenium Web Browser Automation Tutorials point, simply learning

Reference Books:

1	Test Automation Using Selenium WebDriver with Java by Navneesh Garg.
2	Hands-On Selenium WebDriver with Java by Boni Garcia O'REILLY Publication

Useful Link /Web Resources:

1. https://toolsqa.com/selenium-webdriver/selenium-tutorial
2. https://www.tpointtech.com/selenium-tutorial

*****

Course Title: Introduction to Machine Learning	
Course Code: 231CSEPECL307	Semester: VI
Teaching Scheme: L-T-P: 3-0-2	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks: 25	ESE Marks: 50

Prerequisite:	Basic knowledge of Linear Algebra, Probability & Statistics, Calculus, Python programming, Data Structures, and Data Preprocessing.

Course Description:

This course introduces the fundamental concepts and techniques of Machine Learning, covering both supervised and unsupervised learning. Students will learn key algorithms such as regression, classification, and clustering, along with data preprocessing and performance evaluation methods. The course also explores practical applications in structured and unstructured data through case studies.

Course Objectives:

1	To introduce the fundamental concepts, types, and importance of Machine Learning.
2	To develop an understanding of various supervised and unsupervised learning techniques.
3	To explore different classification and clustering algorithms along with their evaluation metrics.
4	To apply Machine Learning techniques to real-world problems in structured and unstructured data.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
PEC307.1	Explain fundamental machine learning concepts and terminology.
PEC307.2	Analyze different types of machine learning models and their characteristics.
PEC307.3	Evaluate the performance of different machine learning algorithms.
PEC307.4	Explain applications, advantages, and limitations of machine learning algorithms.
PEC307.5	Apply machine learning algorithms to solve real–world problems.
PEC307.6	Design and implement custom machine learning models for specific tasks.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PEC307.1	3	2	-	-	-	-	-	-	-	-	-	1	3	-	2
PEC307.2	3	3	2	-	-	-	-	-	-	-	-	2	3	-	4
PEC307.3	3	3	3	3	-	-	-	-	-	-	-	2	3	2	5
PEC307.4	3	3	3	3	-	-	-	-	-	-	-	2	3	2	2
PEC307.5	3	3	3	3	3	-	-	-	-	-	-	2	3	3	3
PEC307.6	3	3	3	3	3	2	-	-	-	-	-	2	3	3	6

Contents	Duration
Unit 1: Introduction to Machine Learning Introduction to probability and statistics, Machine learning: need, definition, and terminologies, process, Types of machine learning – supervised learning, unsupervised learning, semi-supervised learning, reinforcement learning. Application of machine learning (overview), Tools and frameworks, Data preprocessing and preprocessing libraries, Data visualization.	**7 Hrs**
Unit 2: Supervised Learning: Linear model of Regression Introduction to simple linear regression, cost function, hypothesis, evaluation of hypothesis, performance metrics for regression (MSE, MAE, RMSE), Hyper parameters: learning with gradient descent, learning rate, implementation of simple regression algorithm. Multivariate linear regression: hypothesis, evaluation of hypothesis for multivariate data, gradient descent for multiple variables. Regularization: concepts of training error, generalization error, overfitting, underfitting, bias-variance trade-off, regularized linear regression, Feature scaling, polynomial regression analysis.	**7 Hrs**
Unit 3: Logistic regression and Naïve Bayes Logistic Regression: definition, Hypothesis, Cost function, decision boundary, Gradient Descent for Logistic Regression, Multi class classification. Regularized logistic Regression. Naive Bayes (Classifying with Bayesian decision theory, conditional probability, classifying with conditional probabilities, Document classification with Naïve Bayes).	**6 Hrs**

Unit 4: Classification Algorithms Introduction to classification, Decision trees – definition, terminologies, types, constructing decision trees, Decision tree algorithms – ID3, CART, random forest, examples. Instance-based classifier – K–Nearest Neighbour classifier. Support vector machine – SVM basic concepts, separating data with maximum margin, finding maximum margin, efficient optimization with the SMO algorithm, basics of kernel tricks. Performance metrics for classification: accuracy, Precision, Recall, F1-score, Confusion Matrix	**7 Hrs**
Unit 5: Unsupervised Learning: Clustering algorithms Introduction to clustering, types of clustering, K–Means Clustering algorithm, Hierarchical clustering, Association rule mining algorithm, Performance metrics for clustering – Silhouette score, Davies-Bouldin index, Dunn index. Introduction to reinforcement learning.	**7 Hrs**
Unit 6: Applications of Machine Learning Applications in structured data, applications in unstructured data – Image, Text, Speech. Case studies: Predicting House Prices (Regression), Spam Email Detection (Classification - Naïve Bayes, Logistic Regression), Customer Segmentation (Unsupervised - Clustering)	**6 Hrs**

List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	Installation of tools used for machine learning (Python, Jupyter Notebook, Anaconda navigator, etc.).	O	2
2	Introduction to different datasets and dataset preparation using preprocessing libraries (handling missing values, encoding categorical variables).	O	2
3	Implement feature scaling techniques and compare their effects on model performance.	O	2
4	Implement Simple Linear Regression for prediction (e.g., CGPA vs. Salary Package).	O	2
5	Implement Multiple Linear Regression for multivariate prediction (e.g., House Price Prediction).	O	2
6	Implement Logistic Regression for binary classification (e.g., Spam Detection, Loan Approval).	O	2

7	Train a Support Vector Machine (SVM) model on a real-world dataset (e.g., Handwritten Digit Recognition, Customer Churn).	O	2
8	Train a Decision Tree classifier on a real-world dataset (e.g., Loan Approval, Diabetes Prediction).	O	2
9	Implement Naïve Bayes for text classification (e.g., Spam Detection, Sentiment Analysis).	O	2
10	Implement K-Means Clustering for Customer Segmentation or Image Compression.	O	2
11	Implement Hierarchical Clustering (Agglomerative and Divisive Clustering) and compare it with K-Means.	O	2
12	Implement a simple Q-learning algorithm (e.g., Grid-world navigation or simple game AI).	O	2
13	Perform Hyperparameter Tuning for Decision Trees & SVM (using Grid Search, Random Search).	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 to 12 experiments from the list.

Text Books:

1	Anuradha Srinivasaraghvan Vincy Joseph, "Machine Learning", Wiley, 2019

Reference Books:

1	Ethem Alpaydın, "Introduction to Machine Learning", IT Press Third Edition Year 2014
2	Shai Shalev-Shwartz, "Understanding Machine Learning from Theory to Algorithms", Cambridge University Press
3	Tom M. Mitchell, "Machine Learning", McGraw Hill First Edition Year 1997

Useful Link /Web Resources:

1. https://nptel.ac.in/courses/106106139, https://onlinecourses.nptel.ac.in/noc23_cs18/preview – Introduction to Machine Learning, By Prof. Balaraman Ravindran, IIT Madras
2. https://onlinecourses.nptel.ac.in/noc25_cs50/preview, – Machine Learning, By Prof. Carl Gustaf Jansson, KTH, The Royal Institute of Technology
3. https://github.com/hemansnation/god-level-ai
4. https://www.docdroid.net/Z87gYoF/machine-learning-with-python-cookbook-en-pdf#page=3

*****

Course Title: Data Visualization Techniques	
Course Code: 231CSEPECL308	Semester: VI
Teaching Scheme: L-T-P: 3-0-2	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks: 25	ESE Marks: 50

Prerequisite:	Computer Graphics and Image Processing.

Course Description:

This course offers a thorough introduction to the fundamentals, tools, and methods of data visualization. Students will explore how to convert raw data into insightful and interactive visuals that improve decision-making.

Course Objectives:

1	Understand the fundamental concepts of exploratory data analysis using Python.
2	Find missing values in data and identify the correlation between different variables.
3	Understand the hypothesis testing and advanced at a visualization tools

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
PEC308.1	Understand the fundamental concepts of data visualization
PEC308.2	Identify and recognize visual perception and representation of data.
PEC308.3	Apply various Interaction and visualization techniques
PEC308.4	Analyze various groups for visualization

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PEC308.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	2
PEC308.2	3	2	1	-	2	-	-	-	-	-	-	-	-	-	2
PEC308.3	-	2	1	3	3	-	-	-	-	-	-	-	-	-	3
PEC308.4	3	3	-	2	2	-	-	-	-	-	-	-	-	-	4

Contents	Duration
Unit 1: Introduction to Data Visualization What Is Visualization, Relationship between Visualization and Other Fields, The Visualization Process, The Role of the User, Types of Data, Structure within and between Records, Data Pre-processing.	**6 Hrs**
Unit 2: Human Perception and Visualization Foundations What Is Perception, Perceptual Processing, Perception in Visualization, The Visualization Process in Detail, Semiology of Graphical Symbols, The Eight Visual Variables, Historical Perspective, Taxonomies.	**7 Hrs**
Unit 3: Visualization Techniques for Spatial Data One-Dimensional Data, Two-Dimensional Data, Three-Dimensional Data, Dynamic Data, Combining Techniques.	**6 Hrs**
Unit 4: Visualization Techniques for Geospatial Data Visualizing Spatial Data, Visualization of Point Data, Visualization of Line Data, Visualization of Area Data, Other Issues in Geospatial Data Visualization.	**6 Hrs**
Unit 5: Visualization Techniques for Time-Oriented and Multivariate Data Definitions: Characterizing Time-Oriented Data, Visualizing Time-Oriented Data, Point-Based Techniques, Line-Based Techniques, Region-Based Techniques, Combinations of Techniques.	**7 Hrs**
Unit 6: Visualization Techniques for Trees, Graphs, and Networks Displaying Hierarchical Structures, Displaying Arbitrary Graphs/Networks, Other Issues.	**6 Hrs**

List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	Explore and install data visualization tools	O	2
2	Create simple bar charts, line graphs, and pie charts using Microsoft Excel.	O	2
3	Create simple bar charts, line graphs, and pie charts using Python.	O	2
4	Experiment with colors, labels, and layouts to make visualizations clear and effective.	O	2
5	Plot simple maps with location points using Google Maps or Python.	O	2
6	Create a basic heatmap to visualize density distribution in a given dataset.	O	2
7	Create a basic map visualization using Python's Geopandas library.	O	2
8	Plot a time-series chart (e.g., stock prices, temperature changes) using Matplotlib.	O	2
9	Visualize a simple organizational hierarchy using a tree diagram in PowerPoint.	O	2
10	Visualize a simple organizational hierarchy using a tree diagram in Python.	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 experiments from the list.

Text Books:

1	Ward, Grinstein, Keim, Interactive Data Visualization: Foundations, Techniques, and Applications. Natick, 2nd edition, A K Peters, Ltd 2015.

Reference Books:

1	Tamara Munzner, Visualization Analysis &Design, 1st edition, AK Peters Visualization Series 2014
2	Scott Murray, Interactive Data Visualization for the Web ,2nd Edition, 2017

Useful Link /Web Resources:

1. https://www.coursera.org/learn/python-for-data-visualization

*****

Course Title: Web and Network Security	
Course Code: 231CSEPECL309	Semester: VI
Teaching Scheme: L-T-P: 3-0-2	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks: 25	ESE Marks: 50

Prerequisite:	Computer Networks, Operating Systems, Basic Cryptography, and Programming (Python, Java, or C) for implementing security algorithms.

Course Description:

This course covers web and network security, including cryptography, authentication, digital signatures, intrusion detection, SSL/TLS, IPsec, and firewalls. Students will learn to analyze threats and implement security solutions for networks, systems, and web applications.

Course Objectives:

1	To understand the principles of public key cryptosystems and their applications.
2	To explore cryptographic techniques, including hashing, message authentication codes, and digital signatures for data integrity.
3	To analyze network security threats and mitigation strategies, including firewalls, intrusion detection, and secure protocols.
4	To examine web security concerns, encryption mechanisms, and authentication methods for securing online transactions.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
PEC309.1	Explain the various concepts of web and network security.
PEC309.2	Analyze and mitigate common web security threats.
PEC309.3	Evaluate secure network communication protocols
PEC309.4	Analyze intrusion detection, prevention mechanisms, and firewall technologies.
PEC309.5	Design security solutions for cloud, API, and IoT
PEC309.6	Explain security governance frameworks and compliance standards

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PEC309.1	3	3	-	-	-	-	-	-	-	2	-	2	3	2	2
PEC309.2	3	3	2	3	-	-	-	-	-	2	-	2	3	3	4
PEC309.3	3	3	3	3	-	-	-	-	-	2	-	2	3	3	5
PEC309.4	3	3	2	3	2	-	-	-	-	2	-	2	3	3	4
PEC309.5	3	3	3	3	3	2	2	-	-	2	-	2	3	3	6
PEC309.6	3	2	-	-	-	3	2	3	2	2	-	3	3	2	2

Contents	Duration
Unit 1: Introduction to Web and Network Security Fundamentals of Web Security and Network Security, Threats, Vulnerabilities, and Risk Management, OSI & TCP/IP Security Considerations, Overview of Cyber Threat Landscape: Phishing, Social Engineering, Malware, Insider Attacks	**6 Hrs**
Unit 2: Web Security: Attacks and Defenses Web Application Security Principles, Common Web Attacks & Exploits: SQL Injection, Cross-Site Scripting (XSS), Cross-Site Request Forgery (CSRF), Broken Authentication & Session Hijacking, Man-in-the-Middle (MITM) Attacks. Secure Web Development Best Practices: Secure Coding Guidelines, Content Security Policy (CSP)	**7 Hrs**
Unit 3: Network Security: Protocols and Secure Communication Virtual Private Networks (VPNs) & Tunneling, Secure Network Protocols: Secure Sockets Layer (SSL) / Transport Layer Security (TLS), Secure Shell (SSH), IPSec – Authentication Header (AH) & Encapsulating Security Payload (ESP). Wi-Fi Security (WPA, WPA2, WPA3).	**7 Hrs**

Unit 4: Intrusion Detection, Prevention & Firewalls Intrusion Detection Systems (IDS) & Intrusion Prevention Systems (IPS), Types of Firewalls: Packet Filtering Firewall, Stateful Inspection Firewall, Application Layer Firewall, Next-Generation Firewalls (NGFW). Zero Trust Security Architecture.	**7 Hrs**
Unit 5: Advanced Web and Network Security – Security in Cloud and API Protection: Cloud Security Challenges, API Security (OAuth, OpenID, JWT). Security in IoT and Edge Computing, Web Application Firewalls (WAFs) and DDoS Mitigation, Penetration Testing and Ethical Hacking for Web & Network Security.	**7 Hrs**
Unit 6: Security Governance and Compliance – Security Frameworks and Compliance: ISO 27001, NIST, GDPR, PCI-DSS. Security Audits and Risk Assessments, Incident Response and Disaster Recovery, Case Studies: Real-World Cyber Attacks & Security Failures.	**6 Hrs**

List of Experiments

Exp. No.	Name of Experiment	S/O	Hours
1	**RSA Algorithm Presentation:** Prepare a 5-slide presentation explaining the working and structure of RSA.	S	2
2	**MD5 Hashing Experiment** - Generate an executable file from a C compiler and compute its MD5 hash. - Modify the C program slightly, recompile, and generate its new MD5 hash. - Compare both hashes to observe changes. - Repeat the process for 5 different application executables and analyze their MD5 hashes. - Reference: MD5Summer or any online MD5 generator http://www.md5summer.org/download.html.	O	2
3	**SHA-256 & SHA-512 Hashing Experiment** - Generate an executable file from a C compiler and compute its SHA-256 and SHA-512 hashes. - Modify the C program slightly, recompile, and generate new SHA-256 and SHA-512 hashes.	O	2

	- Compare both hashes to observe changes. - Repeat the process for 5 different application executables and analyze their SHA hashes. - Reference: SHA Generator (web or desktop version). http://www.xorbin.com/tools/sha256-hash-		
4	**Message Authentication Codes (MACs) Chart/Model** Prepare a chart/model explaining Message Authentication Codes (MACs) and their applications.	O	2
5	**Digital Signature Model** Prepare a chart/model explaining the importance of Digital Signatures in security.	O	2
6	**Wireshark Packet Capture** Install Wireshark and capture network packets. Identify source and destination IP addresses in IP packets using Wireshark.	O	2
7	**SSL Protocol Stack Presentation** Prepare a chart and/or presentation explaining the SSL Protocol Stack with diagrams.	S	2
8	**Antivirus Update Experiment** Download and install Avast Free Antivirus or Clam AV (open-source). Check for updates and document the anti-malware signature update process.	O	2
9	Perform SQL Injection on a vulnerable login page and secure it.	O	2
10	Create a fake login page to understand phishing.	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 experiments from the list.

Text Books:

1	Cryptography and Network Security, William Stallings, Pearson. [Unit 1, 3, 5, 6].
2	Cryptography and Network Security,Forouzan, McGraw Hill. [Unit 1, 2, 3].
3	Network Security Essentials. William Stallings, Pearson. [Unit 1, 3, 4, 5, 6].

Reference Books:

1	Network Security: Private Communication in a Public World, Charlie Kaufman, Prentice Hall.
2	Cryptography Theory and Practice, Douglas R. Stinson.

Useful Link /Web Resources:

1. https://nptel.ac.in/courses/108101585 – Network Security, by Prof. Gaurav S. Kasbekar
2. https://nptel.ac.in/courses/106105162 – Cryptography And Network Security, By Prof. Sourav Mukhopadhyay, IIT Kharagpur

List of Software/Learning Websites:

1. Download MD5 Application www.md5summer.org/download.html
2. Download Wireshark Tools https://www.wireshark.org/tools/
3. SecTools.Org: Top 125 Network Security Tools http://sectools.org/
4. SHA-256 hash calculator http://www.xorbin.com/tools/sha256-hash-calculator
5. Firewall Analyzer: Click

*****

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
KASABA BAWADA, KOLHAPUR
D. Y. PATIL COLLEGE OF ENGG. & TECH.

Course Title: Software Architectures	
Course Code: 231CSEPECL310	Semester: VI
Teaching Scheme: L-T-P: 3-0-2	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks:25	ESE Marks: 50

Prerequisite:	Software Engineering.

Course Description:

Software architecture is the set of structures needed to reason about a software system and the discipline of creating such structures and systems. It functions as the blueprints for the system and the development project, which project management can later use to extrapolate the tasks necessary to be executed by the teams and people involved. Software architecture is about making fundamental structural choices that are costly to change once implemented.

Course Objectives:

1	To introduce the student regarding the need of the software architectures.
2	To expose the students with the different software architecture patterns.
3	To aware the students regarding the software architecture requirements and design.
4	To strengthen the ability of the students for documenting, implementing and testing the software.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
PEC310.1	Understand the need and contexts of the software architectures.
PEC310.2	Design the software architecture by considering quality attributes and patterns.
PEC310.3	Design the software architecture requirement and design strategy
PEC310.4	Understand and implement documentation, implementation and testing of software architecture.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PEC310.1	2	-	-	-	-	-	-	-	-	2	-	1	-	-	2
PEC310.2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	3
PEC310.3	2	2	2	-	-	-	-	-	2	-	2	1	1	-	3
PEC310.4	2	2	2	-	-	-	-	-	2	2	2	-	1	-	3

Contents	Duration
Unit 1: Introduction of Software Architecture Introduction to Software Architecture, Architectural Structures and View, Architectural Patterns, Good Architecture, System's Quality Attributes, Managing Change, System Qualities, Enhancing Communication among Stakeholders, Carrying Early Design Decisions, Defining Constraints, Influencing the Organizational Structure, Enabling Evolutionary Prototyping, Improving Cost and Schedule Estimates, Reusable Model	**9 Hrs**
Unit 2: Contexts of Software Architecture Architecture in a Technical Context, Architecture in a Project Life-Cycle Context, Architecture in a Business Context, Architecture in a Professional Context, Stakeholders, Influence on Architecture, Architectures Influence.	**6 Hrs**
Unit 3: Quality Attributes Architecture and Requirements, Functionality, Quality Attribute Considerations, Specifying Quality Attribute Requirements, Achieving Quality Attributes through tactics, Quality Design Decisions.	**6 Hrs**
Unit 4: Architectural Patterns Architectural Patterns, Patterns Catalog, Relationships between Tactics and Patterns, Contents, Using Tactics Together.	**6 Hrs**

Unit 5: Architecture Requirements and Design Gathering, ASRs from Requirements Documents, Gathering ASRs by Interviewing Stakeholders, Gathering ASRs by Understanding the Business Goals, Capturing ASRs in a Utility Tree, Tying the Methods Together, Designing an Architecture, Design Strategy, The Attribute-Driven Design Method.	**6 Hrs**
Unit 6: Documenting Software Architectures, Implementation, and Testing Uses and Audiences for Architecture Documentation, Notations for Architecture Documentation, Views, Choosing the Views, Combining Views, Building the Documentation Package, Documenting Behavior, Architecture Documentation and Quality Attributes, Documenting Architecture in an Agile Development Project, Architecture and Testing.	**7 Hrs**

List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	Study of Software architecture paradigm.	S	2
2	Design ASRs by using requirement documents of project.	O	2
3	Study report on design pattern.	S	2
4	Implementation of any two design patterns in java.	O	2
5	Design of the Logical View of the Weather Mapping System.	O	2
6	Develop an architectural driven design for any project.	O	2
7	Design use case view for Banking system.	O	2
8	Design software architecture on any Agile development project.	O	2
9	Design software architecture for Uber application using UML.	O	2
10	Develop the documentation testing environment for software architecture.	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 experiments from the list.

Text Books:

1	Len Bass Paul Clements Rick Kazman, Software Architecture in Practice, Third Edition, Pearson Edu (2013)

Reference Books:

1	The Art of Software Architecture: Stephen T. Albin, Wiley dreamtech, (2003).
2	Pattern Oriented Software Architecture Vol. I: Buschmann, F. WSE, (1996).
3	Large Scale Software Architecture: A Practical Guide Using UM: Jeff Garland, Richard Anthony, Wiley dreamtech, (2003).
4	Software Architecture - Perspectives on an Emerging Discipline: Mary Shaw & David Garlan, PHI, (1996).

Useful Link /Web Resources:

1. https://tecnrt.org/docs/cse/materials/SADP.pdf

*****

Course Title: Introduction to Social Media Analytics	
Course Code: 231CSEPECL311	Semester: VI
Teaching Scheme: L-T-P: 3-0-2	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks: 25	ESE Marks: 50

Prerequisite:	Programming Languages, Computer Networks - Fundamentals of networking, Information Security.

Course Description:

Social media analytics is the ability to gather and find meaning in data gathered from social channels to support business decisions and measure the performance. Social media analytics is broader than metrics such as likes, follows, re-tweets, previews, clicks, and impressions gathered from individual channels. It also differs from reporting offered by services that support marketing campaigns such as LinkedIn or Google Analytics.

Course Objectives:

1	To learn the basic concept of social media analytics.
2	To develop skills required for analyzing the effectiveness of social media
3	To study different tools of social media analytics.
4	To understand and apply different visualization techniques for social media analytics.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
PEC311.1	Understand the concept of social media analytics and its significance
PEC311.2	Interpret different social media analytics
PEC311.3	Apply different social media analytics tools.
PEC311.4	Apply different effective visualization techniques to represent social media data.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PEC311.1	2	-	-	-	-	-	-	-	-	-	-	-	-	2	2
PEC311.2	2	2	-	-	-	-	-	-	-	-	-	-	-	2	2
PEC311.3	2	2	2	-	-	-	-	-	-	-	-	-	-	2	3
PEC311.4	3	2	2	-	-	-	-	-	-	-	-	-	1	3	3

Contents	Duration
Unit 1: Social Media Analytics: An Overview Introduction, Core Characteristics of social media, Types of Social Media, Purpose of Social Media Analytics, Seven Layers of Social Media Analytics, Types of Social Media Analytics, Social Media Analytics Cycle, Challenges to Social Media Analytics, Social Media Analytics Tools.	**7 Hrs**
Unit 2: Social Network Structure, Measures & Visualization: Basics of Social Network Structure - Nodes, Edges & Tie. Describing the Networks Measures Degree Distribution, Density, Connectivity, Centralization, Tie Strength & Trust Network Visualization - Graph Layout, Visualizing Network features, Scale Issues.	**7 Hrs**
Unit 3: Social Media Text, Action & Hyperlink Analytics: Social Media Text Analytics - Types of Social Media Text, Purpose of Text Analytics, Steps in Text Analytics, Social Media Text Analysis Tools. Social Media Action Analytics - Actions Analytics, Common Social Media Actions, Actions Analytics Tools. Social Media Hyperlink Analytics - Types of Hyperlinks, Types of Hyperlink Analytics, Hyperlink Analytics Tools.	**7 Hrs**
Unit 4: Social Media Location & Search Engine Analytics: Location Analytics - Sources of Location Data, Categories of Location Analytics, Location Analytics and Privacy Concerns, Location Analytics Tools. Search Engine	**7 Hrs**

Analytics - Types of Search Engines, Search Engine Analytics, Search Engine Analytics Tools.	
Unit 5: Social Network Analytics: Network Analytics – Common Network Terms, Common Social Media Network Types, Types of Networks, Common Network Terminologies, Network Analytics Tools	**7 Hrs**
Unit 6: Social Media Analytics Applications and Privacy: Social media in public sector - Analyzing public sector social media, analyzing individual users, case study. Business use of Social Media - Measuring success, Interaction and monitoring, case study. Privacy - Privacy policies, data ownership and maintaining privacy online.	**6 Hrs**

List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	Study various - i) Social Media platforms ii) Social Media analytics tools iii) Applications of Social media analytics for business	O	2
2	Data Collection-Select the social media platforms of your choice (Twitter, Facebook, LinkedIn, YouTube, Web blogs etc), connect to and capture social media data for business (scraping, crawling, parsing).	O	2
3	Data Cleaning and Storage- Pre-process, filter and store social media data for business (Using Python, MongoDB, R, etc)	O	2
4	Exploratory Data Analysis and visualization of Social Media Data for business.	O	2
5	Develop Content (text, emoticons, image, audio, video) based social media analytics model for business. (e.g. Content Based Analysis :Topic , Issue ,Trend, sentiment/opinion analysis, audio, video, image analytics)	O	2

6	Develop Structure based social media analytics model for any business. (e.g. Structure Based Models -community detection, influence analysis)	O	2
7	Develop a dashboard and reporting tool based on real time social media data.	O	2
8	Design the creative content for promotion of your business on social media	O	2
9	Analyze competitor activities using social media data	O	2
10	Develop social media text analytics models for improving existing product/ service by analyzing customer's reviews/comments.	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 experiments from the list.

Text Books:

1	Analyzing the Social Web 1st Edition by Jennifer Golbeck (Unit 1)
2	Seven Layers of Social Media Analytics_ Mining Business Insights from Social Media Text, Actions, Networks, Hyperlinks, Apps, Search Engine, and Location Data, Gohar F. Khan, (ISBN-10: 1507823207). (Unit 2, 3,4, 5)
3	Charu Aggarwal (ed.), Social Network Data Analytics, Springer, 201 (Unit 6)
4	Analyzing the Social Web 1st Edition by Jennifer Golbeck (Unit 1)

Reference Books:

1	Social Media Analytics [2015], Techniques and Insights for Extracting Business Value Out of Social Media, Matthew Ganis, Avinash Kohirkar, IBM Press
2	Social Media Analytics Strategy_ Using Data to Optimize Business Performance, AlexGonçalves, A Press Business Team
3	Mining the Social Web_ Analyzing Data from Facebook, Twitter, LinkedIn, andOther Social Media Sites, Matthew A Russell, O'Reilly (Unit 5)
4	Social Media Data Mining and Analytics, Szabo, G., G. Polatkan, O. Boykin & A. Chalkiopoulus (2019), Wiley, ISBN 978-1-118-82485-6.

Useful Link /Web Resources:

1. https://nptel.ac.in/courses/106106146
2. https://7layersanalytics.com/
3. https://onlinecourses.nptel.ac.in/noc20_cs78/preview

*****

Course Title: Software Defined Network	
Course Code: 231CSEPECL312	Semester: VI
Teaching Scheme: L-T-P: 3-0-2	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks: 25	ESE Marks: 50

Prerequisite:	Knowledge of computer networking.

Course Description:

This course begins with an overview of traditional networks, highlighting their architecture and limitations. It then introduces Software-Defined Networking (SDN), explaining its key concepts, message structures, and table matching mechanisms. The course also covers OpenFlow, a widely used SDN protocol, and demonstrates its implementation using an emulator. Finally, it explores real-world SDN applications and case studies, showcasing how SDN is transforming modern networking.

Course Objectives:

1	To learn the basic concept of social media analytics.
2	To develop skills required for analyzing the effectiveness of social media
3	To study different tools of social media analytics.
4	To understand and apply different visualization techniques for social media analytics.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
PEC312.1	To develop students' ability to understand the concepts of traditional networks with its limitations and the need to move to Software Defined Networks.
PEC312.2	To develop the students' ability to understand the fundamentals of SDN, its planar architecture and to understand the flexibility of multilevel pipeline processing.
PEC312.3	To create switches and design networks by manually adding/deleting flow entries inside the table and learning to dissect the packets.
PEC312.4	To create switches and design networks by manually adding/deleting flow entries inside the table and learning to dissect the packets.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PEC312.1	3	1	1	-	-	-	-	1	1	-	-	2	-	1	2
PEC312.2	3	3	2	2	2	-	-	1	1	-	-	2	1	1	2
PEC312.3	3	3	3	2	2	-	-	2	2	-	-	2	2	1	4
PEC312.4	3	3	2	2	2	-	-	2	2	-	-	2	2	2	4

Contents	Duration
Unit 1. Introduction to Traditional networks – Traditional networks, Control Plane, Data Plane and Management Plane, Flow table, Limitations of traditional networks- Need for simplification, Lowering operating costs, Single flow table, Flexibility issues, Proprietary protocols and Destination based forwarding. For CES.	**9 Hrs**
Unit 2. Introduction to SDN – Software defined networks, SDN Planes-Data plane, Control Plane, Application Plane, Open Flow, Open Network Foundation, Protocol-Encryption, Northbound & Southbound-API, Multi-level flow table and pipeline processing, Group table, Meter table-Meter bands, OpenFlow version- 1.0,1.1,1.2,1.3.	**9 Hrs**
Unit 3. SDN Messages – Messages-Controller-Switch, Symmetric & Asynchronous messages Counters, OpenFlow Ports.	**5 Hrs**
Unit 4. Table matching Table matching in SDN, Network Automation and Virtualization.	**5 Hrs**
Unit 5. Mininet Emulator – Introduction to Mininet, Custom topologies of OpenFlow and Legacy Networks, Flow table manipulation-Adding & Deleting Flow entries, Packet Dissection via Wireshark.	**8 Hrs**

Unit 6. SDN Applications and Use Cases SDN Controllers-Ryu, POX, Floodlight, SDN Applications, SDN- Use Cases, SDN in the Data Center and WAN, SDN-Open Source and its Features	**8 Hrs**

List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	Installing and configuring Mininet	O	2
2	Creating and analyzing network topologies in Mininet	O	2
3	Setting up an OpenFlow controller (POX, Ryu, ONOS)	O	2
4	Inspecting and modifying OpenFlow flow tables	O	2
5	Implementing custom packet forwarding rules using wireshark	O	2
6	Load balancing using OpenFlow rules	O	2
7	Writing a basic SDN application (e.g., MAC learning switch)	O	2
8	Implementing network monitoring using SDN APIs	O	2
9	Configuring Access Control Lists (ACL) in SDN	O	2
10	Implementing Quality of Service (QoS) with traffic prioritization	O	2
11	Simulating an SDN-based Data Center Network	O	2
12	Exploring SDN integration with NFV and 5G	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 to 12 experiments from the list.

Text Books:

1	Nadeau, Thomas D., and Ken Gray. SDN: Software Defined Networks: an authoritative review of network programmability technologies. " O'Reilly Media, Inc.", 2013.
2	Chuck Black and Paul Goransson, "Software Defined Networks: A Comprehensive Approach", Morgan Kaufman.

Reference Books:

1	Coker, Oswald, and Siamak Azodolmolky. Software-defined Networking with OpenFlow: Deliver Innovative Business Solutions. Packt Publishing Ltd, 2017

Useful Link /Web Resources:

1. https://www.opennetworking.org/wp-content/uploads/2014/10/openflow-spec-v1.3.0.pdf (OpenFlow version 1.3)
2. http://mininet.org/ (Mininet Network Emulator).
3. Kreutz, D., Ramos, F. M., Verissimo, P. E., Rothenberg, C. E., Azodolmolky, S., & Uhlig, S. (2014). Software-defined networking: A comprehensive survey. Proceedings of the IEEE, 103(1), 14-76.
4. https://www.opennetworking.org/ (Open Network Foundation)

*****

Course Title: Prompt Engineering	
Course Code: 231CSEPECL313	Semester: VI
Teaching Scheme: L-T-P: 3-0-2	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks: 25	ESE Marks: 50

Prerequisite:	Python, Knowledge of language models , Basic understanding of ML concepts

Course Description:

The Prompt Engineering course is a comprehensive and always up-to-date curriculum designed for individuals seeking a deeper understanding of this rapidly growing field. With the recent surge in popularity of AI and Prompt Engineering, many individuals with limited knowledge or experience in the field have positioned themselves as experts. This course was developed from the ground up by seasoned Prompt Engineers and other professionals in the Prompt Engineering field.

Course Objectives:

1	To understand the principles and techniques of prompt engineering, including the designs of effective prompts
2	To explore the capabilities of large language models for text and image generations and to leverage the creation of engaging content
3	To gain practical experience in crafting prompts and generating text and images using AI tools and platforms

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
PEC313.1	Understand the importance and benefits of prompt engineering
PEC313.2	Apply the techniques involved and monitor the prompt for Generative AI
PEC313.3	Compute the functions and feedback for ChatGPT prompt
PEC313.4	Identify the framework to find out the Quality prompt
PEC313.5	Analyze the effective output for the quality prompt
PEC313.6	Evaluate the various advanced prompt engineering techniques

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PEC313.1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	2
PEC313.2	3	3	3	3	-	-	-	-	-	-	-	-	-	2	3
PEC313.3	3	3	3	3	-	-	-	-	-	-	-	3	2	-	2
PEC313.4	3	3	3	3	-	-	-	-	-	-	-	3	2	-	2
PEC313.5	3	3	3	3	-	-	-	-	-	-	3	-	2	-	4
PEC313.6	3	3	3	3	-	-	-	-	-	-	3	-	-	2	5

Contents	Duration
Unit 1: Introduction to Prompt Engineering Prompts, Types of Prompts, works of prompt engineering, Evaluating and validating prompts - Role of prompts in AI models – Importance of effective prompts – Techniques in Prompt engineering - Ethical considerations in prompt engineering– Benefits in prompt engineering.	**8 Hrs**
Unit 2: Prompt Engineering – Generative AI Generative language models- NLP and ML foundations, common NLP task , optimizing prompt-based models, Tuning and optimization techniques , Pre-training and transfer learning – Designing effective prompts – prompt generation strategies – Monitoring prompt effectiveness.	**7 Hrs**
Unit 3: ChatGPT Reinforcement Learning from Human Feedback- The Process of Building a Model- Moving from Instruct GPT to ChatGPT- Instruct GPT- ChatGPT- The Changing API- Chat Completion API- Moving Away from Chat Moving Beyond Chat to Functions- Prompt Engineering as Play Writing.	**7 Hrs**
Unit 4: A Framework for Effective AI Communication The CLEAR Framework - Concise and Logical Prompt Crafting - Explicit Prompt Crafting - Adaptive Prompt Crafting - Reflective Prompt Crafting.	**8 Hrs**

Unit 5: Prompt approach The Relationship Between Prompts and Outputs - Quality Prompts - A Systematic Approach.	**7 Hrs**
Unit 6: Advanced Prompt Engineering Chain-of-Thought (CoT) Prompting, Tree-of-Thoughts (ToT) Prompting, Active prompting, Reason and Act (ReAct), Expert Prompting, Automatic Prompt Engineering (APE).	**8 Hrs**

List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	Understand and practice zero-shot, one-shot, and few-shot prompting.	S	2
2	Develop metrics (accuracy, coherence) to assess prompt performance	O	2
3	Create prompts for summarization, sentiment analysis, classification.	O	2
4	Use pre-trained models and analyze the impact of prompt rephrasing.	O	2
5	Build a simple prompt log for tracking prompt performance over time.	O	2
6	Compare responses from ChatGPT and InstructGPT using the same prompts.	O	2
7	Create a mini application that dynamically generates prompts based on user input.	O	2
8	Craft prompts using the Concise, Logical, Explicit, Adaptive, and Reflective (CLEAR) approach.	O	2
9	Modify one prompt for different use cases and target audiences.	O	2
10	Implement both prompting methods for reasoning tasks (e.g., logic puzzles, math).	O	2
11	Simulate ToT prompting manually for decision-making tasks.	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 experiments from the list.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
KASABA BAWADA, KOLHAPUR
D. Y. PATIL COLLEGE OF ENGG. & TECH.

Text Books:

1	Prompt Engineering for Generative AI, by James Phoenix, Mike Taylor, Published by O'Reilly Media, Inc. in 2024, ISBN: 9781098153434.

Reference Books:

1	The Art of Prompt Engineering with Chatgpt: A Hands-On Guide: 3 (Learn AI Tools the Fun Way!) by Nathan Hunter published in 2023.
2	What Is ChatGPT Doing ... and Why Does It Work? Paperback by Stephen Wolfram in 2023.
3	Prompt Engineering: The Art of Asking Hardcover by Yaswanth Sai Palaghat in 2023.

Useful Link /Web Resources:

1. https://youtu.be/_ZvnD73m40o
2. https://youtu.be/jC4v5AS4RIM
3. https://www.youtube.com/watch?v=QZosTTcg7F8&ab_channel=Simplilearn

*****

Course Title: Big Data Analytics	
Course Code: 231CSEPECL314	Semester: VI
Teaching Scheme: L-T-P: 3-0-2	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks: 25	ESE Marks: 50

Prerequisite:	Database Engineering and Computer Network

Course Description:

This course gives an overview of Big Data Analytics. In addition, it also focuses on the technologies that are available for storage, processing of Big Data such as Hadoop and R. It also helps a student to perform a variety of analytics on different data sets and to arrive at positive conclusions

Course Objectives:

1	To understand the Big Data and its analytics.
2	To provide an overview of Apache Hadoop
3	To apply analytics on Structured and Unstructured Data.
4	To exposure to Data Analytics with R..

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
PEC314.1	Understand Big Data and its Analytics in real world.
PEC314.2	Analyze the Big Data framework to efficiently store and process Big Data to generate analytics.
PEC314.3	Apply tools and techniques to analyse Big Data.
PEC314.4	Develop the Big Data Solutions using Hadoop and R.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PEC314.1	3	-	1	-	-	-	-	-	-	-	-	2	-	-	2
PEC314.2	3	3	1	2	2	-	-	-	-	-	1	2	-	-	4
PEC314.3	3	2	2	3	3	1	-	-	1	-	-	-	2	-	3
PEC314.4	3	2	3	1	1	2	1	-	-	-	2	2	2	-	3

Contents	Duration
Unit 1: Getting an Overview of Big Data What is Big Data?, Evolution of Big Data, Elements of Big Data, Big Data Analytics, Careers in Big Data	**7 Hrs**
Unit 2: Technologies for Handling Big Data Distributed and Parallel Computing for Big Data, Introducing Hadoop, Hadoop Ecosystem, Hadoop Distributed File System, MapReduce, Hadoop YARN, Hbase, Hive, Pig and Pig Latin, Sqoop, Zookeeper, Flume, Oozie	**8 Hrs**
Unit 3: Understanding Hadoop MapReduce and YARN Fundamentals The MapReduce Framework, Techniques to Optimize MapReduce Jobs, Use of MapReduce, Background of YARN, Advantages of YARN, YARN Architecture, Working of YARN, YARN Scheduler	**8 Hrs**
Unit 4: Exploring Hive and Pig Introducing Hive, Hive Services, Data Types in Hive, Built Functions in Hive, Hive DDL, Data Manipulation in Hive, Data Retrieval Queries, 08 Hours Introducing Pig, Running Pig, Getting Started with Pig Latin, Working with Operators in Pig	**7 Hrs**
Unit 5: Understanding Analytics, Analytical Approaches and Tools to Analyze Data Comparing Reporting and Analytics, Type of Analytics, Analytical Approaches, History of Analytical Tools, Introducing Popular Analytical Tools, Comparing Various Analytical Tools	**7 Hrs**
Unit 6: Understanding R Fundamentals Exploring R, reading datasets and exporting data from R, Manipulating and processing data in R.	**8 Hrs**

List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	Installation of Hadoop.	O	2
2	Implementation of HDFS Commands, Hadoop YARN Administration commands and User commands.	O	2
3	Building Hadoop MapReduce application for counting frequency of word/phrase in simple text file.	S	2
4	Handling the Database using Hadoop Hive DDL commands, like create database, Viewing database, Dropping database, Altering database, creating tables, Dropping and altering tables.	O	2
5	Handling the Database using Hadoop Hive DML commands like Insert, delete, update, data retrieval queries and Join-inner and outer.	O	2
6	Working with operators in Apache Pig- FOREACH, ASSERT, FILTER, GROUP, ORDER BY, DISTINCT, JOIN, LIMIT, SAMPE, SPLIT, FLATIEN.	O	2
7	Installation of R Studio and implementation of basic concepts in R.	O	2
8	Working with R with data sets- create, read, write and R Tables- create, read, write.	O	2
9	Manipulating and processing data in R- merging datasets, sorting data, putting data into shape, managing data using matrices managing data using data frames.	O	2
10	Text Mining using R and Hadoop.	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 to 12 experiments from the list.

Text Books:

1	Big Data (Black Book)- DT Editorial Services- Dream tech Press (Units 1 to 6)

Reference Books:

1	Big Data and Analytics- Seema Acharya and Subhashini Chellappan- Wiley Publications. (Units 1 to 6)
2	Big Data Analytics with R and Hadoop- Vignesh Prajapati- Packt Publishing 2013 (Units 1 to 6)
3	Hadoop: The Definitive Guide, Tom White- O'reilly, 2012 (Units 1 to 6)

Useful Link /Web Resources:

1. https://nptel.ac.in/courses/106104189

*****

Course Title: Cyber Security & Digital Forensics	
Course Code: 231CSEPECL315	Semester: VI
Teaching Scheme: L-T-P: 3-0-2	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks: 25	ESE Marks: 50

Prerequisite:	Fundamental knowledge of Data Communication, Networking and Information Security.

Course Description:

The Cyber Security course teaches the students how to identify the computer system vulnerabilities, to recognize digital exploitation and also prevent damage such as loss of data, loss of money through viruses. In the Digital Forensics course, students will learn about legal considerations applicable to computer forensics and how to identify, collect and preserve digital evidence.

Course Objectives:

1	To gain knowledge of cyber security so as to secure digital data and secure computer networks and understand different cybercrimes.
2	To identify the essential and up-to-date concepts, methodology and tools of Computer Forensics
3	To understand key terms and provisions in I.T. act.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
PEC315.1	Understand basic concepts of cyber security, cybercrimes and threats.
PEC315.2	Describe the cyber security vulnerabilities and prevention techniques.
PEC315.3	Explain the concepts of digital forensics.
PEC315.4	Understand concepts in I.T. ACT.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PCE315.1	2	2	-	-	-	-	-	2	-	-	-	-	2	-	2
PCE315.2	2	3	-	-	-	-	-	2	-	-	-	-	-	2	3
PCE315.3	2	3	-	-	-	-	-	2	-	-	-	-	-	-	2
PCE315.4	2	2	-	-	-	-	-	2	-	-	-	-	-	-	4

Contents	Duration
Unit 1: Cyber Space & Security Defining Cyberspace, Architecture of cyberspace, Concept of cyber security, Cyber security increasing threat landscape, Cyber security terminologies- Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker., Non-state actors, Cyber terrorism, Protection of end user machine, Critical IT and National Critical Infrastructure, Cyber warfare.	**6 Hrs**
Unit 2: Cyber Crime Classification of cybercrimes, Common cybercrimes- cybercrime targeting computers and mobiles, cybercrime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Online scams and frauds- email scams, Phishing, Vishing, Smishing, Online job fraud, Online sextortion, Debit/ credit card fraud, Online payment fraud, Cyber bullying, website defacement, Cybersquatting, Pharming, Cyber espionage, Crypto jacking, Dark net- illegal trades, drug trafficking, human trafficking., Social Media Scams & Frauds- impersonation, identity theft, job scams, misinformation, cyber stalking.	**8 Hrs**
Unit 3: Cyber security Management Compliance and Governance Cyber security Plan- cyber security policy, cyber crisis management plan., Business continuity, Risk assessment, Types of security controls and their goals, Cyber security audit and compliance, National cyber security policy and strategy.	**8 Hrs**

Unit 4: Computer Forensics Computer Forensics Definition and Cardinal Rules Types of Computer Forensics Technology – Types of Computer Forensics Systems – Vendor and Computer Forensics Services. Computer forensics evidence and capture: Data Recovery – Evidence Collection and Data Seizure-Duplication and Preservation of Digital Evidence-Computer Image Verification and Authentication.	**7 Hrs**
Unit 5: Forensic Tools and Processing of Electronic Evidence Introduction to Forensic Tools, Usage of Slack space, tools for Disk Imaging, Data Recovery, Vulnerability Assessment Tools, Encase and FTK tools, Anti Forensics and probable counters, retrieving information, process of computer forensics and digital investigations, processing of digital evidence, digital images, damaged SIM and data recovery, multimedia evidence, retrieving deleted data: desktops, laptops and mobiles, retrieving data from slack space, renamed file, ghosting, compressed files.	**8 Hrs**
Unit 6: I.T. act Introduction, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, I.T. Act, Intellectual Property, IP Theft, Copyright, Trademark, Privacy and Censorship.	**4 Hrs**

List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	Using tools like Nmap, Wireshark or any other tool to check the potential vulnerabilities on a network.	S	2
2	Understanding the digital evidence: Collection, preservation, and chain of custody for digital evidence.	S	2
3	Memory Forensics: Extract and analyze volatile data using tools like Volatility.	O	2
4	Email Header Analysis by extracting and analysing email headers to detect phishing and spoofing.	O	2
5	Identify and analyze malicious software behavior using sandbox tools.	S	2

6	Verify integrity of data by using MD5 and SHA hashing.	O	2
7	File System Analysis: Investigate FAT32, NTFS, and EXT file systems.	S	2
8	Using tools for data recovery for the deleted files using tools like Autopsy, Recuva, or TestDisk.	O	2
9	Steganography and Anti-Forensics Techniques to detect hidden data in images, audio or text using tools like StegExpose.	O	2
10	Mobile Forensics: Analyze iOS backups for contacts, messages, and logs for iOS devices.	S	2
11	Mobile Forensics: Extract and analyze mobile data using ADB and open-source tools for Android devices.	O	2
12	Mobile Forensics: To recover deleted messages on social media like WhatsApp.	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 to 12 experiments from the list.

STUDENTS ACTIVITIES THAT CAN BE CONDUCTED:

1. Analyze the behavior of malicious software by installing on the computer in the laboratory.
2. Use of FTK Imager to images of digital devices, including mobile devices.

Text Books:

1	Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.- (Unit 1,2,3)
2	John R. Vacca, "Computer Forensics: Computer Crime Scene Investigation", Cengage Learning, 2nd Edition, 2005 – (Unit 4)
3	C. Altheide& H. Carvey Digital Forensics with Open Source Tools, Syngress, 2011. ISBN: 9781597495868- (Unit 5)
4	CYBER LAW-The Indian Perspective, Pawan Duggal (2009) - (Unit 6)

Reference Books:

1	Computer Security Fundamentals - Chuck Easttom, Pearson, third edition (Unit 1,2,3)
2	Jason Luttgens, Matthew Pepe, Kevin Mandia, Incident Response & Computer Forensics, McGraw-Hill Osborne Media, 3rd edition, 2014. (Unit 4,5)
3	Keith J. Jones, Richard Bejtlich, Curtis W. Rose, Real Digital Forensics: Computer Security and Incident Response, Paperback – Import, 2005. (Unit 5)
4	7 Years of Indian Cyber Laws, Rohas Nagpal (2008) (Unit 6)

Useful Link /Web Resources:

1. https://legalserviceindia.com
2. https://infosecawareness.in/cyber-laws-of-india
3. https://www.netacad.com/

*****

Course Title: Software Testing	
Course Code: 231CSEPECL316	Semester: VI
Teaching Scheme: L-T-P:3-0-2	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks: 25	ESE Marks: 50

Prerequisite:	Software Engineering

Course Description:

This course provides an in-depth understanding of software testing principles, methodologies, and tools. It covers various testing techniques, including functional and structural testing, test case creation, automation, performance testing, and security testing. Students will explore the software testing life cycle (STLC). The course also introduces software testing tools, automation frameworks, and best practices for ensuring software quality and reliability.

Course Objectives:

1	To understand the fundamental concepts of software testing, testing life cycles, and testing methodologies.
2	To learn various testing techniques, including functional, structural, performance, and security testing.
3	To apply the software test automation and its frameworks.
4	To explore emerging trends in software testing, including AI, DevOps, and cloud-based testing.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
PEC316.1	Apply software testing principles and techniques to ensure software reliability and quality.
PEC316.2	Design and implement test cases using functional and structural testing approaches.
PEC316.3	Apply debugging strategies and tools to identify and resolve software defects
PEC316.4	Apply modern testing trends- AI-based testing, continuous testing in DevOps, and cloud testing.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PEC316.1	2	-	-	-	-	-	-	1	-	-	-	1	2	-	3
PEC316.2	3	2	-	-	-	-	-	-	-	-	-	-	2	-	3
PEC316.3	3	2	1	1	-	-	-	-	-	-	-	-	2	-	3
PEC316.4	3	-	-	2	-	-	-	-	-	-	-	1	-	-	3

Contents	Duration
Unit 1: Basics of Software Testing Testing Process, Testing Terminologies, Principles of Testing, Limitations of Testing, The V Shaped Software Life Cycle Model, STLS- Software Testing Life cycle, Types of Testing and Levels of Testing, Verification and Validation.	**4 Hrs**
Unit 2: Functional and Structural Testing Functional Testing- Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, and Cause-Effect Graphing Technique. Structural Testing- Control Flow Testing, Data Flow Testing, Slice Based Testing, and Mutation Testing.	**6Hrs**
Unit 3: Creating Test Cases and Software Testing Tools Roles and Responsibilities of a Software Tester, Test Planning, Generation of Test Cases from Use Cases, Selection of Test Cases, Debugging- Debugging Process, Debugging Approaches and Debugging Tools. Software Testing Tools- Static Software Testing Tools, Dynamic Software Testing Tools and Process Management Tools.	**6 Hrs**
Unit 4: Software Test Automation Test Automation, terms used in Automation, Skills needed for automation, Scope of automation, Design and Architecture for Automation, Generic requirements for Test tools/Framework, Process model for Test Tools, selection of Test Tools, Challenges in Automation.	**4 Hrs**

Unit 5: Selenium Framework What is testing framework, Types of frameworks, Selenium Features, Configuration selenium IDE, selenese commands- actions, accesses, assertions, WebDriver architecture, scripting using web driver, Locators, User Interactions	**5 Hrs**
Unit 6: Emerging Trends in Software Testing AI & Machine Learning in Testing-AI-powered test automation, Predictive analytics in testing, DevOps and Continuous Testing- CI/CD pipelines, Shift-left and Shift-right testing approaches, Cloud-based Testing- Cloud testing benefits, Tools, Mobile App Testing- Native, Web, and Hybrid app testing, Mobile testing tools and Blockchain and IoT Testing- Unique challenges, Testing strategies	**5 Hrs**

List of Experiments

Exp. No.	Name of Experiment	S/O	Hours
1	Understand the basic concepts and terminologies of software testing and apply them to real-world scenarios.	S	2
2	Learn and implement functional testing techniques for boundary value analysis and equivalence class testing.	O	2
3	Practice structural testing methods such as control flow and data flow testing.	O	2
4	Understand how to create, select, and organize test cases based on use cases and test planning.	O	2
5	Apply debugging techniques and tools to identify and fix issues within the software.	O	2
6	Explore the different software testing tools used for static and dynamic testing.	O	2
7	Learn and apply test automation techniques, set environment for automation frameworks, and select appropriate automation tools	O	2
8	Use Selenium IDE to record and execute test cases.	O	2
9	Write a Selenium WebDriver script to automate Google search	O	2
10	Understand and explore the latest trends- AI-powered test automation and CI/CD pipeline in software testing.	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 to 12 experiments from the list.

STUDENTS ACTIVITIES THAT CAN BE CONDUCTED:

1. Case Study
2. Group Discussion

Text Books:

1	Yogesh Singh, "SOFTWARE TESTING", Cambridge University Press (Chapter 1,2,3)
2	Srinivas Desikan, Gopalswamy Ramesh, "Software Testing Principles and Practices", Pearson Publication (Chapter 4)
3	Selenium Web Browser Automation Tutorials point, simply learning (Chapter 5,6)

Reference Books:

1	Paul C. Jorgensen, "Software Testing A Craftsman's Approach", CRC Press Taylor & Francis Group, Fourth Edition, (Chapter 1, 2, and 3)
2	Mauro Pezze, and Michal Young, "Software Testing and Analysis: Process, Principles, and Techniques", WILEY (Chapter 1,2,3,and 4)
3	Glenford J. Myers, Tom Badgett, and Corey Sandler, "The Art of Software Testing", John Wiley & Sons, Inc, Third Edition.

Useful Link /Web Resources:

1. https://onlinecourses.nptel.ac.in/noc25_cs66/preview
2. https://www.udemy.com/course/foundations-of-agile-software-testing-j/
3. https://www.youtube.com/watch?v=mxv_4c4y40I

*****

Course Title: High Performance Computing	
Course Code: 231CSEPECL317	Semester: VI
Teaching Scheme: L-T-P: 3-0-2	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks: 25	ESE Marks: 50

Prerequisite:	Computer architecture, Operating Systems, Basic concepts of algorithms and data structures.

Course Description:

This course provides a theoretical foundation in High-Performance Computing (HPC), covering parallel computing architectures, memory models, and performance evaluation techniques. Students will learn about parallel programming paradigms, interconnection networks, and scalability principles. The course focuses on analyzing HPC models, understanding parallel computing strategies, and evaluating their efficiency for real-world applications.

Course Objectives:

1	To explain the need for High-Performance Computing and the principles of parallel computing.
2	To describe different parallel architectures, interconnection networks, and scalability models.
3	To analyze performance metrics such as speedup, efficiency, and scalability in parallel computing.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
PEC317.1	Understand and explain the fundamentals of parallel computing and the need for high-performance systems.
PEC317.2	Describe different parallel computing architectures, memory models, and interconnection networks.
PEC317.3	Analyze performance evaluation techniques such as Amdahl's Law and scalability metrics.
PEC317.4	Compare and evaluate various parallel computing approaches and their applicability to real-world problems.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PEC317.1	3	3	2	-	2	-	-	-	1	-	-	2	2	1	2
PEC317.2	2	3	3	-	3	-	-	-	2	-	-	2	-	-	2
PEC317.3	2	3	3	-	3	-	-	-	2	-	-	3	-	-	4
PEC317.4	3	3	3	-	3	-	-	-	2	-	-	3	-	-	5

Contents	Duration
Unit 1: Parallel Computing Need of ever-increasing performance, Building parallel systems, Need to write parallel programs, Analyze parallel programs	**6 Hrs**
Unit 2: Parallel Systems The von Neumann architecture, Processes, multitasking, and threads SIMD systems, MIMD systems, Interconnection networks, Performance, Speedup and efficiency, Amdahl's law, Scalability	**7 Hrs**
Unit 3: Shared-Memory Programming with OpenMP Shared memory programming, Parallel for loop, critical section, Writing OpenMP Programs, Compiling and running OpenMP programs, The reduction clause, The parallel for Directive.	**7 Hrs**
Unit 4: Distributed-Memory Programming with MPI Compilation and execution of MPI Programs, MPI Init and MPI Finalize, Communicators, MPI Comm size and MPI Comm rank, SPMD programs, Communication, MPI Send, MPI Recv, Message matching, Tree-structured communication, MPI All-reduce, Broadcast, Scatter, Gather, All-gather	**7 Hrs**
Unit 5: Programming with CUDA GPGPU Architecture of NVIDIA, CUDA Model, Programming in CUDA, Examples	**6 Hrs**

Unit 6: Application Scalability HPC Application Development, Parallel Computing libraries in python, Comparison of Serial and parallel examples.	**6 Hrs**

List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	Study of Processor architecture and networking.	S	2
2	Analytical modeling of sequential algorithm.	O	2
3	Feasibility study of parallel approach.	O	2
4	Problem statements based on Open MP Programming	O	2
5	Problem statements based on MPI Programming	O	2
6	Problem Statements based on CUDA	O	2
7	Study of advanced parallel tools like OpenACC, Digits, CuDNN	O	2
8	Perform vector addition on GPU using CUDA.	O	2
9	Divide matrices among processes and perform parallel matrix multiplication using MPI.	O	2
10	Implement recursive algorithms (e.g., Fibonacci, Quicksort) using OpenMP tasks for load balancing.	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 experiments from the list.

Text Books:

1	Michael J. Quinn, "Parallel Programming in C with MPI and OpenMP", Tata McGraw Hill, 2003
2	Peter S. Pacheco, "An Introduction to Parallel Programming", Morgan Kaufmann, 2011
3	David B. Kirk and Wen-mei W. Hwu, "Programming Massively Parallel Processors", Morgan Kaufmann, 2010

Reference Books:

1	Implement & benchmark parallel programming in C using MPI, OpenMP, and CUDA.
2	Ananth Grama, George Karypis, Vipin Kumar, Anshul Gupta, "Introduction to Parallel Computing", Pearson Education Limited, 2003
3	Shane Cook, CUDA Programming: A Developer Guide to Parallel Computing with GPUs" Elsevier, 2013
4	Shameem Akhter and Jason Roberts , "Multi-core Programming" Intel Press, 2006

Useful Link /Web Resources:

1. Introduction to parallel programming with OpenMP and MPI, By Prof. Yogish Sabharwal, IIT Delhi https://onlinecourses.nptel.ac.in/noc22_cs21/preview
2. GPU Architectures and Programming By Prof. Soumyajit Dey, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc20_cs41/preview
3. Parallel Computing, IIT Delhi, Dr. Subodh Kumar https://nptel.ac.in/courses/106102114

*****

Course Title: Search Engine Optimization	
Course Code: 231CSEPECL318	Semester: VI
Teaching Scheme: L-T-P: 3-0-2	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks: 25	ESE Marks: 50

Prerequisite:	Basic knowledge of web development (HTML, CSS, and JavaScript) and Familiarity with internet technologies and web standards.

Course Description:

This course provides an in-depth understanding of Search Engine Optimization (SEO) techniques and strategies, focusing on how to optimize websites for search engines and improve their visibility on the internet. The course covers both the technical and creative aspects of SEO, emphasizing the role of algorithms, web development, content creation, and analytics. Students will gain hands-on experience with various SEO tools. By the end of the course, students will be able to develop effective SEO strategies for websites and understand the technical foundations that drive search engine rankings.

Course Objectives:

1	To understand the Core Principles of SEO including the functionality of search engines the role of algorithms in indexing and ranking
2	To conduct effective keyword research using modern tools and techniques.
3	To develop Technical SEO Expertise with knowledge and skills to address and implement technical SEO aspects
4	To integrate SEO with Other Digital Marketing Practices to build relationship between SEO and other digital marketing strategies

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
PEC318.1	Understand the basic principles of SEO and how they affect search engine rankings
PEC318.2	Implement On-Page SEO Techniques and apply technical SEO strategies
PEC318.3	Use SEO Tools for Performance Monitoring and Analysis.
PEC318.4	Build Quality Back links and Understand Link Building Strategies
PEC318.5	Implement Local SEO and Mobile Optimization
PEC318.6	Critique the effectiveness of recent SEO strategies in your content and apply Ethical SEO Practices.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
PEC318.1	3	2	2	2	2	-	-	-	-	-	-	-	2	2	2
PEC318.2	3	3	3	3	3	-	-	-	-	-	-	3	3	2	3
PEC318.3	2	2	3	3	3	-	-	-	-	-	-	3	3	2	3
PEC318.4	3	3	2	3	3	3	-	-	-	-	-	3	3	3	6
PEC318.5	3	2	3	3	3	3	-	-	-	-	-	3	3	3	3
PEC318.6	3	2	3	3	3	3	-	-	-	-	-	3	3	3	5

Contents	Duration
Unit 1: Introduction to SEO and Search Engine Basics Definition, Importance, and History, How Search Engines Work: Crawling, Indexing, and Ranking, Components of Search Engine Algorithms (Google, Bing, etc.) Understanding SERPs (Search Engine Result Pages), Factors Affecting Search Engine Rankings, Basic SEO Terminology: Keywords, Meta Tags, and Crawling.	**7 Hrs**

Unit 2: On-Page SEO Techniques and Website Optimization On-Page SEO Basics: Title Tags, Meta Descriptions, Headings, Keyword Research and Optimization, URL Optimization and Internal Linking Strategies, Image Optimization: Alt Text, File Size, and Compression, Mobile-Friendliness and Page Speed Optimization, Content Optimization: Quality, Freshness, and Length.	**7 Hrs**
Unit 3: Technical SEO Strategies Site Architecture and Navigation, Structured Data and Schema Markup, Sitemap Creation and Optimization, Robots.txt File and Crawl Budget Optimization, Website Analytics and Google Search Console Setup,URL Redirects, Canonicalization, and Avoiding Duplicate Content	**7 Hrs**
Unit 4: SEO Tools and Performance Monitoring Introduction to SEO Tools: Google Analytics, SEMrush, Ahrefs, Moz, and more, Keyword Tracking and Competitor Analysis, Backlink Monitoring and Link Analysis, Traffic Analysis and User Behavior with Google Analytics, Understanding SEO Reports and Data Interpretation, Site Audits and SEO Performance Reviews	**8 Hrs**
Unit 5: Link Building Strategies and Local SEO Link Building: Importance and Types of Links (Natural, Manual, and Self-Created), Outreach Strategies: Guest Posting, Influencer Collaboration, Avoiding Black-Hat Techniques: Link Farms, Spam Links, Local SEO: Google My Business, Local Listings, and Local Citations, Mobile Optimization for Local SEO: Mobile-First Indexing	**8 Hrs**
Unit 6: Ethical SEO Practices and Evaluating SEO Strategies Ethical SEO vs. Black-Hat SEO, Techniques to Avoid: Keyword Stuffing, Cloaking, and Clickbait, Evaluating SEO Strategies for Effectiveness and Long-Term Impact, Adapting to Algorithm Changes (e.g., Google's Core Updates),SEO Content Marketing and User Experience, Ethical Responsibilities in Digital Marketing and SEO	**8 Hrs**

List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	Set up SEO tools like Google Analytics, Google Search Console, and SEMrush.	O	2
2	Conduct keyword research using tools like Google Keyword Planner and SEMrush.	O	2
3	Apply on-page SEO techniques to optimize a webpage using tools like Screaming Frog to analyze and identify on-page SEO issues.	S	2
4	Develop a backlink strategy for improving a website's domain authority.	O	2
5	Analyze and improve mobile optimization for a website using Google's Mobile-Friendly Test tool to evaluate a website's mobile performance.	O	2
6	Monitor website SEO performance and generate reports using Google Analytics to track keyword rankings, traffic, and user behavior.	O	2
7	Conduct a full SEO site audit to identify issues and areas for improvement using tools like SEMrush or Screaming Frog.	O	2
8	Implement URL optimization and improve internal linking for better SEO optimizing URL structures for clarity and SEO-friendliness.	O	2
9	Optimize website content to improve its SEO based on keyword research and SEO best practices.	O	2
10	Analyze competitors' SEO strategies and track keyword performance using tools like SEMrush and Ahrefs to conduct competitor analysis.	O	2
11	Learn and implement ethical SEO techniques while avoiding black-hat practices to identify unethical SEO techniques (e.g., keyword stuffing, cloaking)	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 experiments from the list.

STUDENTS ACTIVITIES THAT CAN BE CONDUCTED:

1. Flipped Class room Activity
2. Think-Pair-Share Activity.
3. Case- Study Presentations

Text Books:

1	"SEO 2023: Learn Search Engine Optimization with Smart Internet Marketing Strategies" by Adam Clarke.
2	"The Art of SEO: Mastering Search Engine Optimization" by Eric Enge, Stephan Spencer, and Jessie Stricchiola (3rd Edition)

Reference Books:

1	"SEO For Dummies" by Peter Kent
2	"Search Engine Optimization (SEO) Secrets" by Danny Dover

Useful Link /Web Resources:

1. https://developers.google.com/search
2. https://moz.com/blog
3. https://neilpatel.com/blog
4. https://ahrefs.com/blog
5. https://yoast.com/seo-blog
6. https://analytics.google.com/analytics/academy

*****

Course Title: Mobile Application Development	
Course Code: 231CSEVSECL301	Semester: VI
Teaching Scheme: L-T-P: 1-0-2	Credits: 2
Evaluation Scheme: ISE + MSE Marks: NA INT Marks: 25	ESE POE Marks: 25

Prerequisite:	Basics of the Java language, XML and SQL

Course Description:

This course provides the knowledge about creation of Android Mobile Applications using JAVA and XML. This can be used for developing the different android applications with activities and fragments. The course also includes designing of own applications with the help of XML and databases applied to various domains. This course will help to gain the skills and project-based experience needed for a mobile application and development career.

Course Objectives:

1	To introduce the android basics and tools for developing android applications.
2	To create an android application using the intent and fragments.
3	To design the android applications user interfaces using different input controls.
4	To create the android application using SQLite database.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
VSEC301.1	Understand the android basics and be able to use the tools for developing the android applications.
VSEC301.2	Develop the android applications using the intent and fragments.
VSEC301.3	Design and develop the android application user interfaces using input controls.
VSEC301.4	Develop the android application with SQLite database.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
VSEC301.1	2	-	-	-	2	-	-	-	-	-	-	-	-	-	2
VSEC301.2	2	2	1	-	-	-	-	-	-	-	-	-	2	-	6
VSEC301.3	3	1	1	-	-	-	-	-	1	-	-	-	1	-	3
VSEC301.4	2	1	1	-	-	-	-	-	1	-	-	-	2	-	6

Contents	Duration
Unit 1: Introduction to Android OS Overview of Android, History, Android Versions, Android OS stack, Activity, Activity life cycle, Fragments, Fragment Lifecycle.	**3 Hrs**
Unit 2: Views and Layouts XML introduction, Android View Hierarchies, Linear Layouts, Relative Layout, Table Layout, List View, Frame Layout Sliding, Using Padding and Margins with Layouts.	**3 Hrs**
Unit 3: Intents What Is Intent? Android Intent Messaging via Intent Objects, Types of Intents, Using Intents with Activities.	**2 Hrs**
Unit 4: Input Controls, Input Events, Dialogs: Buttons, Text Fields, Checkboxes, Radio Buttons, Toggle Buttons, Spinners, Event Listeners, Event Handlers, Touch Mode, Handling Focus, Dialogs: Alerts, Rating Bar, Progress bar, Popups, Toasts.	**2 Hrs**
Unit 5: Menus, Notification and Action Bar Menus, Options menu, Context menu, Popup menu, Handling menu click events, creating a Notification, Notification actions, Notification priority, Managing Notifications, Removing notifications.	**3 Hrs**
Unit 6: Android Storage and Android Database Installing SQLite plugin, DBHelper, The Database Schema and Its Creation, Four Major Operations, Cursors, Example.	**2 Hrs**

List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	Study of Android Basics.	S	2
2	Installation and Configuration Android Studio.	S	2
3	Implementation of different view layout.	O	2
4	Implement a program for demonstrating the activities and fragments.	O	2
5	Implementation of a program for Implicit and Explicit Intent	O	2
6	Implement a program to demonstrate Buttons, Text Fields, Checkboxes, Radio Buttons, and Toggle Buttons with their events handler.	O	2
7	Implement a program to demonstrate Rating bar, Progress Bar with their events handler.	O	2
8	Implement a program to demonstrate Menus with their events handler	O	2
9	Implement a program to demonstrate notification	O	2
10	Implement an application that writes data to the internal storage	O	2
11	Implement a program to demonstrate different database operation using SQLite database	O	2
12	Design and develop the mini project for solving the different real time problems using Android Application Development in the group of 4-5 students.	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 to 12 experiments from the list.

Text Books:

1	Wei-Mag Lee, "Beginning Android application development", WROX
2	Marko Gargenta, "Learning Android", 2011, O'Reilly Media
3	Wallace Jackson, "Android Apps for Absolute Beginners", APRESS, second edition
4	Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2nd ed.

Reference Books:

1	Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd
2	James Steele, "The Android Developer's Cook book: Building Applications with the Android SDK", Paperback
3	Reto Meier, "Application Development", Wiley India
4	W.Frank Ableson, RobiSen, Chris King, C. Enrique Ortiz, "Android in Action", Third Edition

Useful Link /Web Resources:

1. https://developer.android.com/studio

*****

Course Title: Liberal Learning- SAP HANA – In-Memory Database and Application Platform	
Course Code: 231CSECCAP302	**Semester: VI**
Teaching Scheme: L-T-P: 2-0-0	**Credits: Audit**
Evaluation Scheme: ISE Marks:50	**ESE Marks: NA**

Prerequisite:	Basic knowledge of Databases, Programming language, familiarity with enterprise software or ERP systems.

Course Description:

This course introduces **SAP HANA**, SAP's high-performance in-memory database. Students will learn the architecture, core functionalities, modeling tools, application development strategies, and administrative features of SAP HANA. The course provides hands-on experience through data modeling, real-time analytics, and application development using tools like SAP HANA Studio, SAP Web IDE, and XS Advanced.

Course Objectives:

1	To understand SAP HANA's architecture and in-memory computing concepts.
2	To apply data modeling techniques using SAP HANA Studio and related tools.
3	To administer and manage SAP HANA systems efficiently.
4	To develop real-time applications and analytical solutions using SAP HANA.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
CCA302.1	Explain the architecture, components, and technical benefits of SAP HANA.
CCA302.2	Design data models using HANA views and perform complex data operations.
CCA302.3	Configure, monitor, and maintain the SAP HANA system securely.
CCA302.4	Build and deploy full-stack applications using SAP HANA XS Advanced and SAPUI5.

Contents	Duration
Unit 1: Introduction to SAP HANA Overview of SAP, ERP, and SAP HANA evolution, Traditional DBMS vs SAP HANA (in-memory), SAP HANA architecture: Index server, name server, preprocessor, etc. Benefits of SAP HANA for real-time analytics and processing	**4 Hrs**
Unit 2: SAP HANA Database Architecture Row vs Column store, Compression, partitioning, and parallel processing, Persistence layer: savepoints, logging, and recovery, Data lifecycle management	**4 Hrs**
Unit 3: SAP HANA Data Modeling SAP HANA Studio and Web IDE, Attribute views, analytic views, and calculation views, Star schema and modeling best practices, SQLScript and table functions, Analytical privileges and security in modeling	**7 Hrs**
Unit 4: Data Provisioning and Integration Data import/export using Flat files and SAP tools, SAP Landscape Transformation (SLT) replication, SAP Data Services, Smart Data Access (SDA), Smart Data Integration (SDI), Integrating non-SAP sources with HANA	**7 Hrs**
Unit 5: SAP HANA Administration Installation and configuration, User and role management, Backup and recovery strategies Monitoring, diagnostics, and performance tuning, HANA Cockpit and HANA Studio tools	**4 Hrs**
Unit 6: Application Development on SAP HANA XS Classic vs XS Advanced, Using SAP HANA XS Advanced and HDI containers, OData services and integration with SAPUI5, Text analytics and predictive analysis in HANA, Security, application deployment, and lifecycle management.	**4 Hrs**

Text Books and References:

1	Bjarne Berg," SAP HANA 2.0 Certification Guide", 2nd Edition
2	Denys van Kempen, "SAP HANA Cookbook", 2nd Edition, Packt Publishing, 2018
3	Thomas Jung, Rich Heilman, "SAP HANA: An Introduction", 1st Edition, SAP Press, 2016

*****

Course Title: Security Incident and Event Management	
Course Code: 231CSEHCL302A	Semester: VI
Teaching Scheme: L-T-P: 3-0-2	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks: 25	ESE Marks: 50

Prerequisite:	Foundational knowledge of computer networks, operating systems, and basic cybersecurity concepts. Familiarity with log analysis, scripting, and security tools like firewalls or IDS/IPS.

Course Description:

This course provides an in-depth understanding of Security Incident and Event Management (SIEM) systems, which are critical in modern cybersecurity infrastructure. Students will explore the architecture, deployment, and configuration of SIEM platforms, as well as methodologies for collecting, correlating, and analyzing logs and events. The course emphasizes practical skills in incident detection, threat intelligence integration, and compliance reporting through hands-on labs and real-world use cases.

Course Objectives:

1	To introduce the architecture, components, and operational principles of SIEM systems.
2	To develop proficiency in log collection, normalization, and correlation for threat detection.
3	To analyze security incidents and implement response strategies using SIEM tools.
4	To integrate SIEM solutions with threat intelligence feeds and ensure regulatory compliance.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
HC302A.1	Explain the functioning and architecture of SIEM systems.
HC302A.2	Collect and correlate logs from diverse data sources for effective incident detection.
HC302A.3	Analyze and respond to real-time security events and breaches using SIEM platforms.
HC302A.4	Integrate SIEM tools with external threat feeds and perform compliance-based reporting.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
HC302A.1	3	2	-	-	-	-	-	-	-	-	-	1	-	-	2
HC302A.2	-	3	-	-	3	-	-	-	-	-	1	-	-	-	2
HC302A.3	-	-	3	2	-	1	-	-	-	-	-	-	2	2	4
HC302A.4	-	-	-	-	-	-	1	-	-	2	-	3	-	2	3

Contents	Duration
Unit 1: Introduction to SIEM and its Role in Cybersecurity Concept and definition of SIEM, Evolution and history of SIEM systems, Importance of SIEM in enterprise security architecture, Role of SIEM in real-time threat monitoring, SIEM vs traditional log management, Introduction to Security Operations Center (SOC), Overview of leading SIEM vendors: Splunk, IBM QRadar, ArcSight, ELK Stack	**6 Hrs**
Unit 2: SIEM Architecture and Components Overview of SIEM architecture, Core components: log collectors, event forwarders, log storage, Parsing engines and correlation engines, Visualization tools: dashboards, alerting, and reporting, Log formats: Syslog, JSON, CEF, LEEF, Log normalization and enrichment, Time synchronization and event sequencing, Log lifecycle and retention policies.	**7 Hrs**
Unit 3: Log Collection, Normalization, and Correlation Log source types: firewalls, IDS/IPS, endpoints, servers, cloud platforms, Methods of log collection (agents, agentless, APIs), Normalization: schema mapping, field standardization, Creating correlation rules and use cases, Detecting attack patterns: brute-force, port scanning, privilege escalation, Use of regular expressions and field extractions, Filtering and tuning events to reduce false positives.	**7 Hrs**

Unit 4: Threat Detection, Analysis, and Incident Response Alert and event analysis techniques, Use of dashboards for attack chain visualization, Threat hunting methodologies, Root cause analysis and incident timeline reconstruction, Response automation with playbooks and workflows, Integration with SOAR platforms, Case studies of real-world attack detection using SIEM.	**8 Hrs**
Unit 5: SIEM Integration with Threat Intelligence and Compliance Reporting Understanding threat intelligence (TI) and its types, Integrating TI feeds via STIX, TAXII, OpenCTI, Correlating TI data with internal alerts, Compliance frameworks: PCI-DSS, HIPAA, GDPR, ISO 27001, Generating compliance reports using SIEM, Detecting non-compliance and policy violations, Audit logging and report automation.	**7 Hrs**
Unit 6: Hands-On Use Cases and Deployment of SIEM Tools Installation and setup of a SIEM instance (e.g., ELK, Splunk), Ingesting and parsing real-time logs from multiple sources, Creating dashboards and custom alert rules, Sample use cases: Insider threat detection, Ransomware behavior alerting, Data exfiltration monitoring Account compromise via failed logins, Tuning and optimizing rule logic, Exporting reports and integrating third-party data sources	**7 Hrs**

List of Experiments

Exp. No.	Name of Experiment	S/O	Hours
1	Installation and Configuration of a SIEM Tool	O	2
2	Configure log forwarding from endpoints to the SIEM platform.	O	2
3	Create parsing rules for raw log data from different devices.	O	2
4	Detect brute-force login attempts using correlation logic.	O	2
5	Monitor and alert on scanning activity using SIEM.	O	2
6	Create visual dashboards for monitoring specific threats.	O	2
7	Connect SIEM with a threat intelligence source.	O	2
8	Automate incident response using scripts or SOAR.	O	2
9	Use SIEM to create compliance-based audit reports.	O	2
10	Use baseline behavior analysis to detect potential account compromise.	O	2

❖ S-STUDY, O-OPERATIONAL

Note: The instructor should take at least 10 experiments from the list.

Text Books:

1	David Miller, Shon Harris, Allen Harper, Stephen VanDyke, and Chris Blask, "Security Information and Event Management (SIEM) Implementation" McGraw-Hill

Reference Books:

1	Arun E Thomas, "SIEM Best Practices Guide for Security Operations Center", BPB Publications, 1st edition
2	Richard Bejtlich, "The Practice of Network Security Monitoring", No Starch Press, 1st edition

Useful Link /Web Resources:

1. https://www.ibm.com/qradar
2. https://www.splunk.com
3. https://www.elastic.co/what-is/elk-stack

*****

Course Title: Back End Development	
Course Code: 231CSEHCL302B	Semester: VI
Teaching Scheme: L-T-P: 3-0-2	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks: 25	ESE Marks: 50

Prerequisite:	Basic knowledge of JavaScript (ES6+ features), Understanding of HTTP protocol & RESTful services, Basic knowledge of databases (SQL or NoSQL)

Course Description:

This course provides an in-depth understanding of Node.js, a powerful, event-driven, non-blocking I/O runtime environment used for building scalable and high-performance web applications. The course covers core Node.js modules, asynchronous programming, RESTful API development, authentication, real-time communication, and deployment techniques.

Course Objectives:

1	To introduce students to server-side JavaScript programming with Node.js.
2	To understand asynchronous and event-driven architecture.
3	To work with file systems, streams, and databases using Node.js.
4	To design and develop RESTful APIs and integrate authentication mechanisms.
5	To explore real-time applications using WebSockets.
6	To learn best practices for performance optimization and deployment.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
HC302B.1	Demonstrate an understanding of Node.js architecture and its execution model.
HC302B.2	Implement asynchronous programming techniques such as callbacks, promises, and async/await.
HC302B.3	Develop RESTful APIs using Express.js and handle database operations using MongoDB or MySQL.
HC302B.4	Implement authentication & authorization in a Node.js application.
HC302B.5	Build real-time applications using WebSockets.
HC302B.6	Deploy and optimize Node.js applications in a cloud environment.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
HC302B.1	3	2	1	-	2	-	-	-	-	–	-	2	-	-	2
HC302B.2	2	3	2	-	3	-	-	-	-	–	-	2	-	-	2
HC302B.3	2	3	3	-	3	-	-	-	-	1	-	2	2	2	3
HC302B.4	2	3	3	-	2	-	-	-	-	1	-	2	-	2	2
HC302B.5	1	2	3	-	3	-	-	-	-	2	-	2	-	-	3
HC302B.6	2	2	3	-	3	-	-	-	-	2	-	3	-	-	3

Contents	Duration
Unit 1: Introduction to Node.js Introduction to backend development, Node.js overview, installation, REPL, Node.js architecture & event loop.	**6 Hrs**
Unit 2: Core Modules & Asynchronous Programming Understanding modules (fs, http, path), npm, callbacks, promises, async/await, event-driven architecture.	**6 Hrs**
Unit 3: Building Web Servers & RESTful APIs Creating an HTTP server, routing, handling requests & responses, Express.js framework, middleware, RESTful API design.	**6 Hrs**
Unit 4: Database Integration Connecting to MongoDB/MySQL, CRUD operations, Mongoose ORM, handling database errors.	**6 Hrs**
Unit 5: Authentication & Security User authentication with JWT & OAuth, bcrypt for password hashing, handling security vulnerabilities (CORS, CSRF, XSS).	**6 Hrs**
Unit 6: Real-time Applications & Deployment WebSockets for real-time communication, working with Socket.io, performance optimization, deploying Node.js apps on cloud platforms (Heroku, AWS, Vercel).	**6 Hrs**

List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	Setting up Node.js and running a simple script.	O	2
2	Working with core modules (fs, path, os).	O	2
3	Creating a basic HTTP server using the http module.	O	2
4	Implementing callbacks, promises, and async/await.	O	2
5	Building a RESTful API with Express.js and handling routes.	O	2
6	Performing CRUD operations using MongoDB/MySQL.	O	2
7	Implementing user authentication with JWT and bcrypt.	O	2
8	Using WebSockets to build a simple real-time chat app.	O	2
9	Optimizing Node.js application performance.	O	2
10	Deploying a Node.js app on Heroku/Vercel.	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 experiments from the list.

Text Books:

1	"Node.js in Action" – Mike Cantelon, Marc Harter, TJ Holowaychuk
2	"Learning Node.js Development" – Andrew Mead
3	"JavaScript: The Good Parts" – Douglas Crockford

Reference Books:

1	"Node.js Design Patterns" – Mario Casciaro & Luciano Mammino
2	"Node.js Web Development" – David Herron
3	"Eloquent JavaScript" – Marijn Haverbeke

Useful Link /Web Resources:

1. **Node.js Official Docs:** https://nodejs.org/en/docs/
2. **MDN JavaScript Guide:** https://developer.mozilla.org/en-US/docs/Web/JavaScript
3. **Node.js Best Practices (GitHub):** https://github.com/goldbergyoni/nodebestpractices

*****

Course Title: Backend with Google Firebase-I	
Course Code: 231CSEHCL302C	Semester: VI
Teaching Scheme: L-T-P: 3-0-2	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20+30=50 INT Marks: 25	ESE Marks: 50

Prerequisite:	Basic knowledge of HTML, CSS, JavaScript, Familiarity with frontend development frameworks (e.g., React or Angular), Understanding of RESTful APIs and asynchronous programming.

Course Description:

This course introduces cloud-based backend development using Google Firebase. Students will explore services such as Firebase Authentication, Realtime Database, Firestore, Cloud Functions, and Hosting. The course emphasizes developing scalable serverless applications with secure data handling, authentication, real-time updates, and deployment on Firebase infrastructure. Ideal for frontend developers transitioning into full-stack development using modern backend-as-a-service (BaaS) technologies.

Course Objectives:

1	To understand the architecture and capabilities of Firebase as a Backend-as-a-Service (BaaS) platform.
2	To apply Firebase Authentication and Realtime Database to build secure and interactive web applications.
3	To implement Firestore, Cloud Functions, and Firebase Hosting for full-stack application development.
4	To deploy and manage cloud-based backend applications using Firebase CLI and Firebase console.

Course Outcomes (COs): After successful completion of the course, students will be able to:

COs	Statements
HC302C.1	Demonstrate understanding of Firebase services &integration into web applications.
HC302C.2	Develop secure authentication flows using Firebase Authentication.
HC302C.3	Create and manage cloud-hosted NoSQL databases using Firestore and Realtime Database.
HC302C.4	Deploy and maintain serverless applications using Firebase Hosting and Cloud Functions.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
HC302C.1	3	2	2	-	3	-	-	-	-	–	-	2	-	-	2
HC302C.2	2	3	3	-	3	-	-	-	-	1	-	2	2	1	2
HC302C.3	2	3	3	-	3	-	-	-	-	1	-	2	2	2	3
HC302C.4	2	2	3	-	3	-	-	-	-	2	-	3	-	-	2

Contents	Duration
Unit 1: Introduction to Firebase and BaaS Introduction to Backend-as-a-Service (BaaS) and serverless architecture, Overview of Firebase features and architecture, Setting up Firebase project and integrating SDK, Firebase Console overview and project management	**6 Hrs**
Unit 2: Firebase Authentication Email/password and third-party provider authentication (Google, GitHub), Custom authentication and anonymous login, Firebase Authentication with frontend frameworks (React, Angular), Secure routing and session management	**6 Hrs**
Unit 3: Firebase Realtime Database Realtime Database vs Firestore: use cases and differences, Reading/writing data in Realtime Database, Real-time syncing and listeners, Security rules and access control	**6 Hrs**
Unit 4: Firebase Firestore (Cloud Firestore) Document-oriented NoSQL data modelling, CRUD operations with Firestore, Structured querying and indexing, Offline data persistence and Firestore rules	**6 Hrs**
Unit 5: Firebase Cloud Functions Introduction to serverless functions, Writing and deploying Cloud Functions using Node.js, Event-driven programming (triggers on Auth, Firestore, HTTP), Integrating Cloud Functions with Firebase Authentication and Firestore	**6 Hrs**
Unit 6: Firebase Hosting and Deployment Firebase CLI setup and initialization, Deploying single-page and full-stack apps, Custom domain and SSL setup, Continuous deployment and version control integration.	**6 Hrs**

List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	Set up a Firebase project and connect it to a web app	O	2
2	Implement email/password authentication using Firebase Authentication	O	2
3	Enable Google login and manage user sessions securely	O	2
4	Create and update user profiles in Realtime Database	O	2
5	Build a live chat app using Firebase Realtime Database	O	2
6	Model Firestore documents and perform CRUD operations	O	2
7	Set security rules for Firestore to restrict access	O	2
8	Develop and deploy a Cloud Function to send welcome emails	O	2
9	Trigger Cloud Functions based on Firestore data changes	O	2
10	Deploy a single-page React app using Firebase Hosting	O	2
11	Integrate Firebase Hosting with custom domain and HTTPS	O	2
12	Build a full-stack app with Authentication, Firestore, Functions, and Hosting	O	2

❖ **S-STUDY, O-OPERATIONAL**

Note: The instructor should take at least 10 experiments from the list.

Text Books:

1	Marko Aleksendric, "Firebase Essentials – Android Edition", First Edition, Payload Media, 2020
2	Laurence Moroney, "The Definitive Guide to Firebase", First Edition, Apress, 2017

Reference Books:

1	Paul Halliday, "Title: Firebase Cookbook", First Edition, Packt Publishing, 2018

Useful Link /Web Resources:

1. https://firebase.google.com/docs

*****

HEAD OF DEPARTMENT
Computer Science & Engineering
D. Y. Patil College of Engg. & Tech.
Kasaba Bawada, Kolhapur 416 006

Dean Academics

PRINCIPAL,
D. Y. Patil College of Engineering & Technology
Kasaba Bawada, Kolhapur.
(An Autonomous Institute)