Vivekanand Education Society's

College of Arts, Science and Commerce

(Autonomous)

Sindhi Society, Chembur, Mumbai, Maharashtra – 400 071.

Accredited by NAAC "A Grade" in 3rd Cycle - 2017

Best College Award – Urban Area, University of Mumbai (2012-13)

Recipient of FIST Grant (DST) and STAR College Grant (DBT)

Affiliated to the

University of Mumbai

Credit Based System for Holistic Development

Syllabus for

Program: B.Sc. Information Technology (Major)

(Program code: VESUSIT)

As per NEP 2020

with effect from Academic Year 2025 - 2026

T.Y.B.Sc. Information Technology NEP-2020 Course Structure

for Academic Year 2024-25

Semester-V	
Major (Core) Subjects **(Compulsory)**	1. Software Testing 2. Enterprise Java 3. Software Testing and Enterprise Java Practical 4. Internet of things practicals 5. IT Service Management
Vocational Skill Course (VSC) & **Skill Enhancement Courses (SEC)**	(VSC) Web Programming using ASP. NET
ELECTIVES **(any one)**	1. Android programming 2. Android programming practicals OR 1. Artificial Intelligence 2. Artificial Intelligence Practical
Minor Subjects	1. Applied Mathematics 2. Linear Algebra
Field Project (FP)/ **Community Engagement Program (CEP)**	

SEMESTER V

T. Y. B. Sc. (Information Technology) SEMESTER V

Major Course

COURSE TITLE: Software Testing

COURSE CODE: UMMITS5-301[CREDITS - 02]

Course Learning Objective		
The main objective is to help students understand fundamental software testing principles, develop knowledge of test management, and equip them with various testing levels, techniques, and methodologies to ensure software quality across different domains.		
Course Learning Outcomes		
On successful completion of this course, students will be able to LO1: Understand the necessity, principles, and fundamental software testing processes. They will also explore different testing approaches, defect categories, the psychology of testing, and essential skills required for testers. LO2: To develop knowledge of test management, including test policies, strategies, planning, methodologies, testing processes, defect tracking, team efficiency, cost aspects, challenges, and various test levels and types, including maintenance testing. LO3: To be equipped with knowledge of various levels of testing, including unit, integration, system, and specialized tests, along with different testing techniques to ensure software quality across diverse applications and environments.		
Module	**Name of the module**	**[30 L]**
1	**Fundamentals of testing:** Introduction, Necessity of software testing, What is testing? Fundamental test process, The psychology of testing, The historical perspective of testing, Approaches to testing, Testing during the development life cycle, Essentials of Software Testing, Tester's workbench, Important features of the testing process, Misconceptions about testing, Principles of software testing, Salient features of good testing, Process problems faced by testing, Structured approach to testing, Categories of defect, Defect, Error, or Mistake in Software, Attitude towards testing (Common People Issues), Skills required by tester.	**(10 L)**

2	**Test management:**Test policy, Test strategy or Test approach, Test planning, Testing process and number of defects found in testing, Test team efficiency, Mutation testing, Challenges in Testing, test team approach, Cost aspect of testing, Establishing testing policy, Methods, Developing test strategy, Developing testing methodologies (Test Plan), Testing process, Test levels, Test types: the targets of testing, Maintenance testing.	**(10 L)**
3	**Levels of Testing:** Introduction, Proposal testing, Requirement testing, Design testing, Code Review, Unit testing, Module testing, Integration testing, Big-Bang Testing, Sandwich testing, Critical Path First, Sub-System testing, System testing, and Testing stages. **Special Tests:**Introduction, GUI testing, Compatibility testing, Security testing, Performance testing, Volume testing, Stress testing, Recovery testing, Installation testing, Requirement testing, Regression Testing, Error Handling Testing, Manual Support testing, Intersystem testing, Control testing, Smoke Testing, Adhoc testing, Parallel testing, Execution testing, Operations Testing, Compliance testing, Usability testing, Decision table testing, Documentation testing, Training testing, Rapid testing, COTS testing, Client Server testing, Web application testing, Mobile application testing, eBusiness eCommerce testing, Agile Development testing, Data Warehousing testing.	**(10 L)**
	References: 1) Software Testing and Continuous Quality Improvement by William E. Lewis , CRC Press, Third Edition. 2) Software Testing: Principles, Techniques and Tools by M. G. Limaye, TMH 3) Foundations of Software Testing Dorothy Graham, Erik van Veenendaal, Isabel Evans, Rex Black, Cengage Learning 4) Software Testing: A Craftsmans Approach by Paul C. Jorgenson, CRC Press.	

COURSE TITLE: Enterprise Java

COURSE CODE: UMMITS5-302[CREDITS - 02]

Course Learning Objective		
The main objective of this subject is to enable learners to explore Java EE and systematically illustrates its various specifications with plenty of real world examples. Learner are introduces to various web developing tools in java		
Course Learning Outcomes		
On completion of this course, learner should be able to: LO1: Outline the structure of a J2EE application and the environment in which it executes. LO2: Create, deploy, and execute Java servlets in a web application LO3: Use scope and session management techniques LO4: Describe how web applications are secured		
Module	**Name of the module**	**[30 L]**
1	**Understanding Java EE and its architecture**: WhatisanEnterpriseApplication? What Is Java Enterprise Edition? JavaEE Technologies, JavaEE evolution, Glassfish Server, Types of System Architecture, JavaEE Server, JavaEE Containers. **Introduction to Java Servlets**: TheNeedforDynamicContent, JavaServletTechnology, Why Servlets? What can Servlets do? Servlet API and Lifecycle ASimpleWelcomeServlet Using Annotations Instead of Deployment Descriptor. **Working with Databases**: What Is JDBC? JDBC Architecture, Accessing Database, The Servlet GUI and DatabaseExample. **Request Dispatcher**: Requestdispatcher Interface, Methods of Requestdispatcher, Requestdispatcher Application. **COOKIES**: Kinds of Cookies, Where Cookies Are Used? Creating Cookies Using Servlet, Dynamically Changing the Colors of a Page **SESSION**: What Are Sessions? Life cycle of HttpSession, Session Tracking With Servlet API, A Servlet Session Example	**(10 L)**
2	**Working with Files**: Uploading Files, Creating an Upload File Application, Downloading Files, Creating a Download File Application. **Introduction To Java ServerPages**: Why use Java Server Pages? Disadvantages Of JSP, JSP v\s Servlets, Life Cycle of a JSP Page, How does a JSP function? How does JSP execute? Comments, JSP Document, JSP Elements, JSP GUI Example. Action Elements: Including other Files, Forwarding JSP Page to Another Page, Passing	**(10 L)**

	Parameters for other Actions, Loading Java bean. Implicit Objects, Character Quoting Conventions, Unified Expression Language [UnifiedEl], Expression Language. **Java Server Pages Standard Tag Libraries**: What's wrong in using JSP Scriptlet Tags? How JSTL Fixes JSP Scriptlet's Shortcomings? Disadvantages Of JSTL, Tag Libraries. **Introduction To Enterprise Javabeans**: Enterprise Bean Architecture, Benefits of Enterprise Bean, Types of Enterprise Bean, Accessing Enterprise Beans, Enterprise Bean Application, Packaging Enterprise Beans When to use Session Beans? Types of Session Beans, Remote and Local Interfaces, Accessing Interfaces, Life cycle of Enterprise Beans, Packaging Enterprise Beans, Example Of StatefulSessionBean, StatelessSessionBean and SingletonSessionBeans. Life cycle of MessageDriven Bean, Uses of MessageDriven Beans, The MessageDriven Beans Example. **Interceptors**: Request and Interceptor, Defining An Interceptor, AroundInvoke Method, Applying Interceptor, Adding An Interceptor To An Enterprise Bean, Build and Run the Web Application.	
3	**Java Naming and Directory Interface**: What is Naming Service? What is Directory Service? What is Java Naming and Directory interface? Basic Lookup, JNDI Namespace in Java EE, Resources and JNDI, Datasource Resource Definition in Java EE. **Persistence, Object/Relational Mapping And JPA**: What is Persistence? Persistence in Java, Current Persistence Standards in Java, Why another Persistence Standards? Object/RelationalMapping, TheJavaPersistence API, JPA, ORM, Database and Application, Architecture of JAVA, How JPA Works? JPA Specifications. Application Requirement Specifications, Software Requirements, The Application Development Approach, Creating Database and Tables inMysql, creating a Web Application, Adding the RequiredLibraryFiles, creating a Java bean Class, Creating Persistence Unit [Persistence.Xml], Creating JSPS, The JPA Application Structure, Running the JAVA Application. **Introduction to Hibernate:** What is Hibernate? Why Hibernate? Hibernate, Database and Application, Components of Hibernate, Architecture of Hibernate, How Hibernate Works? Application Requirement Specifications, Software Requirements, The Application Development Approach, Creating Database and Tables in Mysql, creating a WebApplication, Adding the Required Library Files, creating a Javabean Class, Creating Hibernate Configuration File, Adding a Mapping Class, Creating JSPS, Running TheHibernateApplication.	**(10 L)**
	References: Java EE 7 For Beginners Sharanam Shah, Vaishali Shah SPD	

	First 2017 Java EE 8 Cookbook: Build reliable applications with the most robust and mature technology for enterprise development Elder Moraes Packt First 2018 Advanced Java Programming Uttam Kumar Roy Oxford Press 2015	

COURSE TITLE: Software Testing and Enterprise Java Practical

COURSE CODE: UMMITS5-303[CREDITS - 02]

Course Learning Objective		
To develop practical skills in manual and automated software testing, including SRS documentation, defect tracking, black-box testing, test automation with Selenium, API testing with Postman, and performance testing with JMeter, using industry-standard tools to ensure software quality.		
Course Learning Outcomes		
On successful completion of this course, students will be able to 1) Develop skills in manual testing, including SRS documentation, defect tracking, test case design, and black-box testing techniques like Equivalence Partitioning, Boundary Value Analysis, and Decision Tables. 2) Automate software testing using tools like Selenium WebDriver for functional testing, Postman for API testing, and JMeter for performance testing to validate software reliability and efficiency. 3) Gain hands-on experience with industry-standard testing tools (Selenium, Postman, JMeter) to ensure software quality, optimize test execution, and enhance defect detection in real-world applications.		
Module	**Name of the module**	**[30 Practicals]**
1	1) Prepare the SRS document of the Payroll system requirement analysis and hospital management system. 2) Take any system (e.g. ATM system) and study its systems specifications, report the various bugs, and prepare the test case. 3) Black Box Testing – Equivalence Partitioning and Boundary value Analysis	

	The program reads an arbitrary number of temperatures (as integer numbers) within the range -60°C … +60°C and prints their mean value. Design test cases for testing the program with the black-box strategy. 4) Black Box Testing: Decision table and Cause Effect Graphing Problem Statement: An insurance agency has the following norms fixed to provide premium for its policyholders: a) If age<=25 and no claim has been made, premium increase will be $50, else $25. b) If age <=25 and number of claims made is one, premium increase will be $100, else $50. c) If age <=25 and number of claims made is 2-4, premium increase will be $400, else $200. d) If one or more claims are made, send a warning letter. If the number of claims made is 5 or more, cancel the policy. Draw the decision table and cause effect graph for Insurance renewal. 5) Test Automation using Selenium IDE. 6) Test Automation using Selenium Webdriver (Python) 7) To perform Black-Box Testing on an open-source web application (OrangeHRM) and document at least five defects using Excel / Google Sheets. 8) To automate the login functionality of OrangeHRM using Selenium WebDriver and verify successful login. 9) Perform API testing using Postman by sending a GET request to retrieve user details and a POST request to create a new user. Validate the response status, headers, and body. Document your findings. 10) Use Apache JMeter to test the performance of a website by simulating multiple users. Run the test and analyze response time and errors.	
2	1. Create a simple calculator application using servlet. 2. Create a servlet for a login page. If the username and password are correct then it says message “Hello ” else a message “login failed” 3. Create a registration servlet in Java using JDBC. Accept the details such as Username, Password, Email, and Country from the user using HTML Form and store the registration details in the database. 4. Using Request Dispatcher Interface create a Servlet which will	**(30 Practicals)**

	validate the password entered by the user, if the user has entered "Servlet" as password, then he will be forwarded to Welcome Servlet else the user will stay on the index.html page and an error message will be displayed. 5. Create a servlet that uses Cookies to store the number of times a user has visited servlet. 6. Create a servlet demonstrating the use of session creation and destruction. Also check whether the user has visited this page first time or has visited earlier also using sessions. Create a Servlet application to upload and download a file 7. Develop a simple JSP application to display values obtained from the use of intrinsic objects of various types. 8. Create an html page with fields, eno, name, age, desg, salary. Now on submit this data to a JSP page which will update the employee table of database with matching eno using JSTL. 9. Create a Currency Converter application using EJB. 10. Develop simple EJB application to demonstrate Servlet Hit count using Singleton Session Beans. 11. Develop simple visitor Statistics application using Message Driven Bean [Stateless Session Bean]. 12. Develop simple Marks Entry Application to demonstrate accessing Database using EJB. 13. Develop a Guestbook Application Using JPA. 14. Develop a JPA Application to demonstrate use of ORM associations. 15. Develop a Hibernate application to store and retrieve employee details in MySQL Database. 16. Develop Hibernate application to enter and retrieve course details with ORM Mapping.	
	References: 1) Introduction to Software Testing, Paul Ammann, Jeff Offutt, Cambridge University Press. 2) Managing the Testing Process: Practical Tools and Techniques for Managing Hardware and Software Testing, Rex Black, Wiley.	

COURSE TITLE: Internet of things practicals

COURSE CODE: UMMITS5-304[CREDITS - 02]

Course Learning Objective		
Course Learning Outcomes		
Module	**Name of the module**	**[60 L]**
1	Starting Raspbian OS, Familiarising with Raspberry Pi Components and interface, Connecting to ethernet, Monitor, USB. 1. Displaying different LED patterns with Raspberry Pi. 2. Displaying Time over 4-Digit 7-Segment Display using Raspberry Pi 3. Raspberry Pi Based Oscilloscope 4. Controlling Raspberry Pi with WhatsApp. 5. Setting up Wireless Access Point using Raspberry Pi 6. Fingerprint Sensor interfacing with Raspberry Pi 7. Raspberry Pi GPS Module Interfacing 8. IoT based Web Controlled Home Automation using Raspberry Pi 9. Visitor Monitoring with Raspberry Pi and Pi Camera 10. Interfacing Raspberry Pi with RFID. Introduction to Arduino Introduction to Arduino circuits and breadboarding, Blinking of LEDs 1. Program using Light Sensitive Sensors 2. Program using temperature sensors 3. Programs using humidity sensors 4. Programs using Line tracking sensors 5. Programs using Ultrasonic Sensors 6. Programs using digital infrared motion sensors 7. Programs using gas sensors 8. Programs using servo motors 9. Programs making Joystick with Arduino	

COURSE TITLE: IT Service Management

COURSE CODE: UMMITS5-305[CREDITS - 02]

Course Learning Objective		
To ensure students acquire the necessary knowledge and skills for a specific area of IT servic management.		
Course Learning Outcomes		
LO1: How IT Service Management works. LO2:Design and operate many applications related to IT Service Management.		
Module	**Name of the module**	**[30 L]**
1	**IT Service Management:** Introduction, What is service management?What are services? Business Process, Principles of Service management: Specialisation and Coordination, The agency principle, Encapsulation, Principles of systems, The service Life Cycle, Functions and processes across the life cycle. **Service Strategy Principles:** Value creation, Service Assets, Service Provider Service Structures, Service Strategy Principles. **Service Strategy:** Define the market, Develop the offerings, Develop Strategic Assets, Prepare for execution. **Service Design:** Fundamentals, **Service Design Principles:** Goals, Balanced Design, Identifying Service requirements, identifying and documenting business requirements and drivers, Design activities **Service Design Processes:** Service Catalogue Management, Service	**(10 L)**
2	**Service Transition:** Fundamentals, **Service Transition Principles:** Principles Supporting Service Transition, Policies for Service Transition **Service Transition Processes:** Transition planning and support,Change Management, Service Asses Configuration Management, Service and Deployment Management, Service Validation and Testing, Evaluation, Knowledge Management. **Service Operation:** Fundamentals, **Service Operation Principles:** Functions, groups, teams, departments and divisions, Achieving balance	**(10 L)**

	in service operations, providing service, Operation staff involvement in service design and service transition, Operational Health, Communication, Documentation **Critical Success factors and risks:** Critical Success factors, Risks	
3	**CSI Process:** The seven step improvement process. **CSI Methods nad Techniques:** Methods and techniques, Assessments, benchmarking, Service Measurement, Metrics, Return on Investment, Service reporting, CSI and other service management processes, **Organising for CSI:** Organizational development, Functions, roles, Customer Engagement, Responsibility model - RACI, Competence and training. **Technology considerations:** Tools to support CSI activities. **Implementing CSI:** Critical Considerations for implementing CSI, The start, Governance, CSI and organizational change, Communication Strategy and Plan	**(10 L)**
	References: 1. ITIL v3 Foundation Complete Certification Kit 2009 2. ITIL v3 Service Strategy OGC/TSO 3. ITIL v3 ServiceTransition OGC/TSO 4. ITIL v3 Service Operation OGC/TSO 5. ITIL Continual Service Improvement TSO 2011	

VEC

COURSE TITLE: Web Programming using ASP. NET

COURSE CODE: UVSITS5-326[CREDITS - 02]

Course Learning Objective		
Learn to create an ASP.NET application that delivers dynamic content to the Web.		
Course Learning Outcomes		
After completion of the course, students will be able to: LO1:To create a simple Active Server Page ASP.NET application that delivers dynamic content to the Web. LO2:To design Web Forms handle events, Web Controls and Input validation, LO3:To develop web application with ASP.Net with database connectivity		
Name of the module		**[60 Practicals]**
1.	Working with Web Forms and Controls	
a	Create a simple web page with various server controls to demonstrate setting and use of their properties. (Example : AutoPostBack)	
b	Demonstrate the use of Calendar control to perform following operations. a) Display messages in a calendar control b) Display vacation in a calendar control c) Selected day in a calendar control using style d) Difference between two calendar dates	
c	Demonstrate the use of Treeview control perform following operations.	

	a) Treeview control and datalist b) Treeview operations	
2.	Working with Form Controls	
a	Create a Registration form to demonstrate use of various Validation controls.	
b	Create Web Form to demonstrate use of Adrotator Control.	
c	Create Web Form to demonstrate use of User Controls.	
3.	Working with Navigation, Beautification and Master page.	
a	Create Web Form to demonstrate use of Website Navigation controls and Site Map.	
b	Create a web application to demonstrate use of Master Page with applying Styles and Themes for page beautification	
c	Create a web application to demonstrate various states of ASP.NET Pages.	
4.	Working with Database	
a	Create a web application bind data in a multiline textbox by querying in another textbox.	
b	Create a web application to display records by using a database.	
c	Demonstrate the use of Datalist link control.	
5	Working with Database	
a	Create a web application to display Data Binding using dropdownlist control.	
b	Create a web application to display the phone no of an author using a database.	
c	Create a web application for inserting and deleting records from a database. (Using Execute-Non Query).	
6.	Working with data controls	
a	Create a web application to demonstrate various uses and properties of SqlDataSource.	
b	Create a web application to demonstrate data binding using	

	DetailsView and FormView Control.	
c	Create a web application to display Using Disconnected Data Access and Databinding using GridView.	
7.	Working with GridView control	
a	Create a web application to demonstrate use of GridView control template and GridView hyperlink.	
b	Create a web application to demonstrate use of GridView button column and GridView events.	
c	Create a web application to demonstrate GridView paging and Creating own table format using GridView.	
8.	Working with AJAX and XML	
a	Create a web application to demonstrate reading and writing operations with XML.	
b	Create a web application to demonstrate Form Security and Windows Security with proper Authentication and Authorization properties.	
9	Create a web application to demonstrate use of various Ajax controls.	
10	Programs to create and use DLL	
	References: Beginning ASP.NET 4.5 in C# by Matthew MacDonald Murach's ASP.NET 4.6 Web Programming in C#2015 by Mary Delamater and Anne Bohem ASP.NET 4.0 programming by J. Kanjilal	

ELECTIVES

COURSE TITLE: Android programming

COURSE CODE: UMEITS5-311[CREDITS - 02]

Course Learning Objective

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

Course Learning Outcomes

After completion of the course, students will be able to:
LO1:Understand the requirements of Mobile programming environment.
LO2:Learn about basic methods, tools and techniques for developing Apps
LO3:Explore and practice App development on Android Platform
LO4:Develop working prototypes of working systems for various uses in daily lives.

Module	Name of the module	[30 L]
1	**Introduction to Kotlin and Android Studio Setup:** **Introduction to Kotlin:**Overview of Kotlin and its benefits over Java in Android development, Setting up the Kotlin environment in Android Studio,Basic Kotlin syntax: variables, data types, and operators,Control structures: if, else, when, and loops,Functions, lambdas, and higher-order functions in Kotlin, Object-Oriented Programming (OOP) concepts in Kotlin: Classes, Objects, Inheritance, Polymorphism. **Getting Started with Android Studio and Kotlin:**Installing and configuring Android Studio with Kotlin plugin,Creating a new Kotlin-based Android project, Android project structure: MainActivity, res directory, manifest file, Understanding Gradle and how it integrates with Kotlin.	**(10 L)**
2	**Android UI Components and Event Handling** **Creating UI with XML:**Understanding activity_main.xml and its role in UI design, Introduction to Views: TextView, EditText, Button, ImageView, LinearLayout, ConstraintLayout, TableLayout, AbsoluteLayout, RelativeLayout, Handling layout designs with ConstraintLayout and the benefits it offers. **View Binding:**Introduction to View Binding and its advantages over findViewById,Setting up and using ViewBinding in Kotlin, Accessing views and managing their properties in Kotlin.	**(10 L)**

	Event Handling in Kotlin: Setting up event listeners for buttons and other interactive elements, Handling button clicks and touch events using Kotlin, Using setOnClickListener, setOnTouchListener, and addTextChangedListener, Working with Toasts, Snackbars, and Dialogs for user interaction.	
3	**<u>Working with Data:</u>** **SQLite Database in Kotlin:**Setting up SQLite Database in Kotlin using SQLiteOpenHelper, Performing CRUD operations (Create, Read, Update, Delete), Querying and displaying data from SQLite Database. **File Storage:**Reading and writing to internal and external storage, Handling file permissions in Kotlin, Working with JSON, XML, and plain text files. **Content Providers:**Understanding content providers and their role, Accessing data from content providers (e.g., contacts, media files).	**(10 L)**
4	**<u>Android Components and Services with Kotlin</u>:** **Intents and Navigation:**Understanding Intents: Explicit and Implicit Intents,Navigating between activities with Intents.Passing data between activities using Intent extras, Working with Android's Navigation Component for managing app navigation. **Broadcast Receivers :**Understanding Broadcast Receivers, Sending and receiving system-wide broadcasts (e.g., connectivity change),Registering and unregistering receivers in Kotlin. **Multithreading :**Introduction to Kotlin Coroutines for managing background threads, Using launch, async, and await in Kotlin for concurrent programming, Updating UI from background threads, Handling background tasks like networking or heavy computations.	
5	**<u>Advanced Features, Networking, and Firebase with Kotlin</u>**	

	Networking and API Integration: Introduction to making network requests using Kotlin, Using HttpURLConnection and Retrofit library for API requests, Working with REST APIs and handling JSON responses using Gson, Using Kotlin's suspend functions for network calls within Coroutines. **Using Third-Party Libraries in Kotlin:I**ntroduction to popular libraries like Retrofit, Picasso, Glide, Gson, etc, Integrating Retrofit for handling API requests and parsing JSON,Image loading and caching using Glide/Picasso. **Firebase Integration with Kotlin:**Introduction to Firebase services (Authentication, Realtime Database, Cloud Firestore, etc.),Setting up Firebase in Kotlin-based Android apps, Storing and retrieving data using Firebase Realtime Database,Implementing Firebase Cloud Messaging for push notifications.	
	References: 1) "Beginning Android 4 Application Development", Wei-Meng Lee, March 2012, WROX. **Additional Reference(s):** 1)https://developers.google.com/training/courses/android-fundamental 2)https://www.gitbook.com/book/google-developer-training/android-developer-fundamentals-c ourse-practicals/details	

COURSE TITLE: Android programming practicals

COURSE CODE: UMEITS5-312[CREDITS - 02]

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

Course Learning Outcomes		
After completion of the course, students will be able to: LO1:Understand the requirements of Mobile programming environment. LO2:Learn about basic methods, tools and techniques for developing Apps LO3:Explore and practice App development on Android Platform 1. Develop working prototypes of working systems for various uses in daily lives.		
Module	**Name of the module**	
1	Introduction to Android, Introduction to Android Studio IDE, Application Fundamentals: Creating a Project, Android Components, Activities, Services, Content Providers, Broadcast Receivers, Interface overview, Creating Android Virtual device, USB debugging mode, Android Application Overview. Simple "Hello World" program.	
2	Programming Resources Android Resources: (Color, Theme, String, Drawable, Dimension, Image),	
3	**Programming Activities and fragments** Activity Life Cycle, Activity methods, Multiple Activities, Life Cycle of fragments and multiple fragments.	
4	**Programs related to different Layouts** Coordinate, Linear, Relative, Table, Absolute, Frame, List View, Grid View.	
5	**Programming UI elements** AppBar, Fragments, UI Components, Programming menus, dialog, dialog fragments	
6	**Programs on Intents, Events, Listeners and Adapters** The Android Intent Class, Using Events and Event Listeners	
7	Programs on Services, notification and broadcast receivers, Programming Security and permissions	
8	Database Programming with SQLite	
9	Programming threads, handles and asynchronized programs	
10	Programming Media API and Telephone API, Programming Network Communications and Services (JSON)	

	References: 1) "Beginning Android 4 Application Development", Wei-Meng Lee, March 2012, WROX. **Additional Reference(s):** 1)https://developers.google.com/training/courses/android-fundamental 2)https://www.gitbook.com/book/google-developer-training/android-developer-fundamentals-course-practicals/details	

COURSE TITLE: Artificial Intelligence

COURSE CODE: UMEITS5-311[CREDITS - 02]

Course Learning Objective		
The primary objective of this course is to introduce the basic principles, techniques, and applications of Artificial Intelligence		
Course Learning Outcomes		
LO1:Use of suitable Intelligent agents for various AI applications LO2: Solve real life problems using AI techniques like searching and game playing.and build smart system using different informed search approaches LO3:Apply the suitable algorithms to solve AI problems		
Module	**Name of the module**	**[30 L]**
1	Introduction: What is Artificial Intelligence? Foundations of AI, history, the state of art AI today. Intelligent Agents: agents and environment, good behavior, nature of environment, the structure of agents.	**(10 L)**
2	Solving Problems by Searching: Problem solving agents, examples problems, searching for solutions, uninformed search, informed search strategies, heuristic functions. Beyond Classical Search: local search algorithms, searching with non-deterministic action, searching with partial observations, online search agents and unknown environments.	**(10 L)**
3	Adversarial Search: Games, optimal decisions in games, alpha-beta pruning, stochastic games, partially observable games, state-of-the-are game programs. Logical Agents: Knowledge base agents, The Wumpus world, logic,	**(10 L)**

	propositional logic, propositional theorem proving, effective propositional model checking, agents based on propositional logic.	
4	First Order Logic: Syntax and semantics, using First Order Logic, Knowledge engineering in First Order Logic. Inference in First Order Logic: propositional vs. First Order, unification and lifting, forward and backward chaining, resolution.	**(10 L)**
5	Planning: Definition of Classical Planning, Algorithms for planning as state space search, planning graphs, other classical planning approaches, analysis of planning approaches, Time, Schedules and resources, hierarchical planning, Planning and Acting in Nondeterministic Domains, multiagent planning, Knowledge Representation: Categories and Objects, events, mental events and objects, reasoning systems for categories, reasoning with default information, Internet shopping world	**(10 L)**
	References: ● Artificial Intelligence: A Modern Approach by Stuart Russel and Peter Norvig ● A First Course in Artificial Intelligence by Deepak Khemani ● Artificial Intelligence by Elaine Rich, Kevin Knight and Shivashankar Nair	

COURSE TITLE: Artificial Intelligence practicals

COURSE CODE: UMEITS5-312[CREDITS - 02]

Course Learning Objective		
Course Learning Outcomes		
Module	**Name of the module**	**[30 Practicals]**

1 a	Write a program to implement depth first search algorithm.	
1 b	Write a program to implement breadth first search algorithm.	
2 a	Write a program to simulate the 4-Queen / N-Queen problem.	
2 b	Design an application to simulate number puzzle problems.	
2 c	Write a program to solve the water jug problem.	
3 a	Write a program to implement alpha beta search.	
3 b	Write a program for a Hill climbing problem.	
3 c	Write a program to implement A* algorithm.	
4 a	Solve the block of World problem.	
4 b	Design the simulation of tic – tac – toe game using min-max algorithm.	
4 c	Write a program to shuffle Deck of cards.	
4 d	Solve traveling salesman problem using artificial intelligence technique.	
5 a	Solve constraint satisfaction problem	
5 b	Write a program which contains three predicates: male, female, parent. Make rules for following family relations: father, mother, grandfather,grandmother, brother, sister, uncle, aunt, nephew and niece, cousin. Question: i. Draw Family Tree. ii. Define: Clauses, Facts, Predicates and Rules with conjunction and disjunction	

MINOR

COURSE TITLE: Applied Mathematics

COURSE CODE: UMNITS5-316[CREDITS - 02]

Course Learning Objective
(1) Give the students a sufficient knowledge of different methods and concepts. (2) Reflecting the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science. (3) To provide students with sound foundation in applied mathematics to solve real life problems in industry.
Course Learning Outcomes
After completion of the course, students will be able to: (1) Formulate real-world problems as first-order ODEs and solve them to analyze and interpret the system's behavior. (2) Understand the concept of linear independence of solutions for linear higher-order ODEs and apply the principle of superposition to find the general solution of linear ODEs. (3) Understand the definition and properties of the Laplace transform and its inverse, as well as how to apply these concepts to solve ODEs and systems of differential equations.

Module	Name of the module	[30 L]
1	**First order Ordinary Differential Equations:** (1) Definition of a differential equation, order, degree, ordinary differential equation, Solution of homogeneous and non-homogeneous differential equations of first order and first degree. (2) General Solution of Exact equations of first order and first degree: Condition for exactness, Non-exact differential equations, Rules for finding integrating factors for non-exact equations. (3) Linear and reducible to linear equations of first order. (4) Applications to orthogonal trajectories, population growth and decay.	**(10 L)**
2	**Higher order Ordinary Differential Equations:** (1) Higher order linear differential equations with constant coefficients, Operator method. (2) Undetermined coefficients, Wronskian, variation of parameters method, Euler-Cauchy equation, power series solution: Example - Legendre and Bessel Differential Equations. (3) Homogeneous system of ODEs of two Variables.	**(10 L)**
3	**Laplace Transform:** Introduction, Definition of the Laplace Transform, Table of Elementary Laplace Transforms, Theorems on	**(10 L)**

	Important Properties of Laplace Transformation, First Shifting Theorem, Second Shifting Theorem, The Convolution Theorem, Laplace Transform of an Integral, Laplace Transform of Derivatives, **Inverse Laplace Transform:** Shifting Theorem, Partial fraction Methods, Use of Convolution Theorem, Solution of Ordinary Linear Differential Equations with Constant Coefficients, Solution of Simultaneous Ordinary Differential Equations, Laplace Transformation of Special Function, Periodic Functions, Heaviside Unit Step Function, Dirac-delta Function(Unit Impulse Function).		
	Reference Books: (1) G. F. Simmons, "Differential equations with applications and historical notes", McGraw-Hill Education, 2nd Edition 2017. (2) The Laplace Transform: Theory and Applications, Joel L. Schiff, Springer **Additional Reference Books:** (1) Erwin Kreyszig: Advanced Engineering Mathematics (2) E.A. Codington: An introduction to ordinary differential equations (3) W. E. Boyce and R. C. DiPrima,"Elementary Differential Equations and Boundary Value Problems", Wiley India, 9th Edition, 2015. (4) S.L. Ross,"Differential Equations", Wiley India, 3rd Edition 2016		

COURSE TITLE: Linear Algebra

COURSE CODE: UMNITS5-317[CREDITS - 02]

Course Learning Objective
1. Give the students a sufficient knowledge of different methods and concepts. 2. Reflecting the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science 3. To provide students with sound foundation in applied mathematics to solve real life problems in industry.
Course Learning Outcomes
After completion of the course, students will be able to: 1. Demonstrate understanding of the fundamental concepts of Linear Algebra and carry out related computational skills. 2. Analyze functions, matrices and equations..

Module	Name of the module	[30 L]
1	**System of Linear Equations and Matrices:** (1) System of homogeneous and non-homogeneous linear equations, the solution of system of m homogeneous linear equations in n unknowns by elimination and their geometrical interpretation for [m, n]=[1, 2], [1,3], [2,2], [2,3], [3,3]. (2) Matrices with real entries, addition, scalar multiplication and multiplication of matrices, Transpose of a matrix, Type of matrices, Invertible matrices. (3) System of linear equations in matrix form, elementary row operations, row echelon matrix, Gaussian elimination method, to deduce that the system of m homogeneous linear equations in n unknowns has a non-trivial solution if m < n.	**(10 L)**
2	**Vector Spaces:** (1) Definition of vector space V over real number, properties and examples, Vector space, Subspace of vector space, (2) Linear combination of vectors, Linear span, Linear independent and dependent vectors. (3) Basis and Dimension of a finitely generated vector space and subspaces.	**(10 L)**
3	**Linear Transformation and Eigenvalues** (1) Linear transformation, Matrix associated with linear transformation, Composition of linear maps, Kernel and Range of a linear map, Rank-Nullity Theorem, Inverse of a linear transformation, Cayley- Hamilton Theorem. (2) Eigenvalues, Eigenvectors, Eigenvalues of symmetric, skew-symmetric, Hermitian and Skew-Hermitian matrices, Diagonalization, Orthogonal Diagonalization of a real symmetric matrix.	**(10 L)**
	Reference Books: (1) G. Strang, ”Introduction to linear algebra”, Wellesley Cambridge Press, 5th Edition 2016. (2) Serge Lang, Introduction to Linear Algebra, Second Edition, Springer. (3) 2. S. Kumaresan, Linear Algebra, A Geometric Approach, Prentice Hall of India, Pvt. Ltd, 2000. **Additional Reference Books:** (1) M. Artin: Algebra, Prentice Hall of India Private Limited, 1991. (2) K. Hoffman and R. Kunze: Linear Algebra, Tata McGraw-Hill, New Delhi, 1971.	

	(3) Gilbert Strang: Linear Algebra and its applications, International Student Edition. (4) L. Smith: Linear Algebra, Springer Verlag. (5) A. Ramachandra Rao and P. Bhima Sankaran: Linear Algebra, Tata McGraw-Hill, New Delhi. (6) T. Banchoff and J. Warmers: Linear Algebra through Geometry, Springer Verlag, New York, 1984. (7) Otto Bretcher: Linear Algebra with Applications, Pearson Education. (8) Gareth Williams: Linear Algebra with Applications.	

Semester-VI	
Major (Core) Subjects **(Compulsory)**	1. Business Intelligence 2. Network Security 3. Business Intelligence and Network Security Practical 4. Geographic Information Systems practicals 5. Software Quality Assurance
ELECTIVES **(any one)**	1. Linux Administration 2. Linux Administration Practicals OR 1. Game Programming 2. Game Programming Practical
Minor Subjects	1. Computer Oriented Statistical Methods 2. Computer Oriented Statistical Methods using R Practicals
On-Job Training (OJT)	

SEMESTER VI

T. Y. B. Sc. (Information Technology) SEMESTER V

Major Course

COURSE TITLE: Business Intelligence

COURSE CODE: UMMITS6-301[CREDITS - 02]

Course Learning Objective
This course aims to provide learners with the concepts, tools, and techniques of Business Intelligence, Decision Support Systems, Data Mining, Knowledge Management, and Artificial Intelligence for effective decision-making. It enables students to apply mathematical models, data-driven approaches, and knowledge systems ethically to solve business problems and improve organizational performance.
Course Learning Outcomes
On successful completion of this course, students will be able to **CO1:** Define and explain the concepts of Business Intelligence, Decision Support Systems and their components. **CO2:** Apply mathematical models and decision-making processes to solve structured and unstructured business problems.

CO3: Analyze the role of BI architectures, data, and knowledge in supporting effective and timely business decisions.

CO4: Evaluate the success factors and ethical considerations in the implementation of BI and DSS.

CO5: Design decision support solutions using BI tools and models for real-world business applications.

Module	Name of the module	[30 L]
I	**Business intelligence**: Definition, Effective and timely decisions, Data, information, knowledge, The role of mathematical models, Business intelligence architectures, Components of business intelligence system, Ethics and business intelligence **Decision support systems (DSS):** Definition of system and its characteristics, Phases of the decision-making process, Different types of decisions, Definition of decision support system, Development of a decision support system, Factors that affect the degree of success of the DSS.	**(10 L)**
II	**Mathematical models for decision making:** Structure of the mathematical model, Phases in the development of mathematical models for decision-making, Classes of models. **Data mining:** Definition of data mining, Applications of data mining, Representation of input data, Data mining process, Analysis methodologies. **Data preparation:** Data validation, Data transformation, Data reduction.	**(10 L)**
III	**Knowledge Management:** Introduction to Knowledge Management, Benefits, Challenges, and Solutions in Knowledge Management, Knowledge Management Process, Organizational Learning and Transformation, Knowledge	**(10 L)**

	Management Activities, Power of Knowledge Management, Approaches to Knowledge Management, Information Technology (IT) in Knowledge Management, Knowledge Management System (KMS) cycle, Knowledge Management Systems Implementation. **Artificial Intelligence and Expert Systems:** Artificial intelligence versus human/natural intelligence, Basic Concepts of Expert Systems, Structure of Expert Systems, Knowledge engineering, and Development of Expert Systems.	
	References: 1) Business Intelligence: Data Mining and Optimization for Decision Making by Carlo Vercellis, Wiley publisher, First edition, 2009. 2) Decision Support and Business Intelligence Systems by Efraim Turban, Ramesh Sharda, Dursun Delen, Pearson publisher, Ninth edition, 2011. 3) Fundamentals of Business Intelligence by W Grossmann, Rinderle-Ma, Springer publisher, First edition, 2015	

COURSE TITLE: Network Security

COURSE CODE: UMMITS6-302 [CREDITS - 02]

Course Learning Objective
Course Objectives ● To learn the fundamentals of cryptography ● To learn the key management techniques and authentication approaches ● To explore the network and transport layer security standards ● To learn real time security practices
Course Learning Outcomes

Course Outcome:
After completing the course, the learner will be able to:
CO1: Identify the security issues in the network and resolve it.
CO2: Evaluate security mechanisms using rigorous approaches by key ciphers and Hash functions
CO3: Demonstrate various network security applications, IPSec, Firewall, IDS, Web Security, Email Security and Malicious software etc.
CO4: Enabling students to understand and implement security controls and defensive measures like encryption, firewalls, and authentication protocols

Module	Name of the module	[30 L]
1.1	**Introduction**: Security goals, attacks, services and mechanism, techniques **Symmetry-key ciphers**: traditional, modern, DES, AES **Asymmetric-key cryptography**: RSA, Message integrity and authentication **Digital Signature**: Process, Services, attacks on digital signature, digital signature schemes	**(10 L)**
1.2	**Authentication and Authorization**: passwords, challenge-response, biometrics **Key Management**: Symmetric-key distribution, Kerberos, Symmetric-Key agreement, Public-Key Distribution **Security at Transport Layer**: SSL and TLS **Security at Network Layer**: IPSec	**(10 L)**
1.3	**Network Defense Tools & Techniques** **Firewalls and VPN**: Overview, The Evolution of Firewalls, Core Firewall Functions, Additional Firewall Capabilities, Firewall Design. **Intrusion Detection and Prevention Systems**: IDS Concepts, IDS Types and Detection Models, IDS Features, IDS Deployment Considerations, Security Information and Event Management (SIEM). **Wireless Network Security**:Data-Link Layer Wireless Security Features, Flaws, and Threats, Wireless Vulnerabilities and Mitigations, Wireless Network Hardening Practices and Recommendations, Wireless Intrusion Detection and Prevention, Wireless Network Positioning and Secure Gateways. Cloud Security	**(10 L)**
	References: 1. Cryptography and Network Security by Behrouz A. Forouzan, McGraw-Hill International Edition 2008	

	2. The Complete Reference: Information Security by Mark Rhodes-Ousley McGraw-Hill Publication 2nd Edition, 2013 3. Essential Cybersecurity Science by Josiah Dykstra, O'Reilly publication 5th edition 2017	

COURSE TITLE: Practical Based on major1 and 2(BI and NS)

COURSE CODE: UMMITS6-303[CREDITS - 02]

Course Learning Objective
The objective of this course is 1) To enable students to apply ETL, data warehousing, OLAP, and data mining techniques using tools like Power BI and Excel to analyze, visualize, and derive business insights for effective decision-making. 2) Develop and implement a java interface for encryption and decryption algorithms i.e., AES, MD5 and RSA algorithms 3) Implementing ACLS, IPS and Firewalls using Cisco Packet tracer
Course Learning Outcomes
After completion of this course learner will be able to: CO1: To equip students with practical skills in ETL, data staging, OLAP cube construction, and MDX queries, along with visualization techniques using Excel and Power BI. CO2: To apply What–If Analysis, reporting, and data mining techniques (classification, clustering, regression, and time series) to uncover patterns, forecast trends, and support business decision-making. CO3: To provide a comprehensive approach to business intelligence and analytics. CO4: Enabling students to understand and implement security controls and defensive measures like encryption, firewalls, and authentication protocols, and conduct penetration testing to protect data and systems

Module	**Name of the module**	**[60 Practicals**

		]
I	**1)** Import the legacy data from different sources, such as Excel, SQL Server, Oracle, etc., and load it into the target system. (You can download a sample database, such as Adventureworks, Northwind, Foodmart, etc.) **2)** **a)** Perform the Extraction, Transformation, and Loading (ETL) process to construct the database in Power BI. **b)** Create the Data staging area for the selected database. **3)** Create the cube with suitable dimensions and fact tables based on ROLAP, MOLAP, and HOLAP models **4)** **a)** Execute the MDX queries to extract the data from the data warehouse **b)** Import the cube in Microsoft Excel and create the Pivot table and Pivot Chart to perform **5)** Import the data warehouse data in Microsoft Excel and create the Pivot table and Pivot Chart. **6)** Apply the what–if Analysis for data visualization. Design and generate necessary reports based on the data warehouse data. **7)** Perform the data classification using a classification algorithm. **8)** Perform the data clustering using a clustering algorithm. **9)** Perform the linear regression on the given data warehouse data **10)** Perform the data analysis using time series analysis	**(30 P)**
	1 Substitution Techniques Write a program to perform substitution ciphers to encrypt the plain text to: a. Caesar cipher and to decrypt it back to plain text. b. Modified Caesar cipher and to decrypt it back to plain text. c c. Monoalphabetic cipher and to decrypt it back to plain text. d. Polyalphabetic cipher and to decrypt it back to plain text **2 Transposition Ciphers:**	**(30 L)**

	Write a program to perform transposition ciphers to encrypt the plain text to cipher and to decrypt it back to plain text using a. Rail fence technique. b. Simple Columnar technique. c. Columnar with multiple rounds. d. Vernam cipher as the transposition technique 3 Write a program to encrypt input string by using SecretKey of the following algorithms, and then decrypt the encrypted string and compare the decrypted string with the input string. Use the following algorithms for encryption and decryption: a. DES b. BlowFish c. IDEA d. Triple DES 4 Write a program to encrypt input string by using SecretKey of the following algorithms, and then decrypt the encrypted string and compare the decrypted string with the input string. Use the following algorithms for encryption and decryption: a. RSA b. AES c. DSA **Using Cisco Packet tracer** 1. Configure Routers a OSPF MD5 authentication. b NTP. c to log messages to the syslog server. d to support SSH connections. 2. Configure AAA Authentication a Configure a local user account on Router and configure authenticate on the console and vty lines using local AAA b Verify local AAA authentication from the Router console and the PC-A client 3. Configuring Extended ACLs a Configure, Apply and Verify an Extended Numbered ACL 4. Configure IP ACLs to Mitigate Attacks a Verify connectivity among devices before firewall configuration. b Use ACLs to ensure remote access to the routers is available only from management station PC-C. c Configure ACLs on to mitigate attacks. 5. Configure a Zone-based Policy firewall 6. Configure IOS Intrusion Prevention System (IPS) using the CLI a. Enable IOS IPS b. Modify an IPS signature	

	References: 1) The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling by Ralph Kimball, 3rd Edition, John Wiley & Sons publisher. 2) Mastering Microsoft Power Bi Paperback by Brett Powell , First Edition Ingram short title. 3) Applied Microsoft Power Bi Bring Your Data to Life! By Teo Lachev, 3rd Edition. 4) OLAP Solutions: Building Multidimensional Information Systems – Erik Thomsen John Wiley & Sons publisher. 5) Cryptography and Network Security by Behrouz A. Forouzan, McGraw-Hill International Edition 2008	

COURSE TITLE: Geographic Information System

COURSE CODE: UMMITS6-304[CREDITS - 02]

Course Learning Objective
Course Objective: ● To understand the principles of Geographical Information System ● To learn Data Management and Processing Systems Hardware and Software Trends ● To understand Spatial Referencing and Positioning ● To understand the Classification of analytical GIS Capabilities ● To understand Data visualization and its strategies
Course Learning Outcomes
Course Outcome: After completing the course, the learner will be able to: CO1: Understanding the importance of Geographical Information System CO2: Comprehending the Data Management and Processing Systems. CO3: Understanding Spatial Referencing and Positioning CO4: Analysing GIS capabilities

CO5: Understanding Data visualization

Module	Name of the module	[60 Practicals]

List of Practicals

1	Familiarizing Quantum GIS: Installation of QGIS, datasets for both Vector and Raster data ,Maps.
2	Creating and Managing Vector Data: Adding vector layers, setting properties, formatting, calculating line lengths and statistics.
3	Exploring and Managing Raster data: Adding raster layers, raster styling and analysis, raster mosaicking and clipping
4	Making a Map, Working with Attributes, Importing Spreadsheets or CSV files Using Plugins, Searching and Downloading OpenStreetMap Data
5	Working with attributes, terrain Data
6	Working with Projections and WMS Data
7	Georeferencing Topo Sheets and Scanned Maps Georeferencing Aerial Imagery Digitizing Map Data
8	Managing Data Tables and Saptial data Sets: Table joins, spatial joins, points in polygon analysis, performing spatial queries
9	Advanced GIS Operations 1: Nearest Neighbor Analysis, Sampling Raster Data using Points or Polygons, Interpolating Point Dat
10	Advance GIS Operations 2: Batch Processing using Processing Framework Automating Complex Workflows using Processing Modeler
11	Automating Map Creation with Print Composer Atlas Validating Map data

References:
1.Principles of Geographic Information Systems- An Introductory Text Book-Editors: Otto Huisman and Rolf A—The International Institute of Geoinformation Science and Earth ObservationFourth 2009
2.Principles of Geographic Information Systems—- P.A Burrough and R.A.McDonnell—-Oxford University Press Third 1999
3.Introduction to Geographic Information Systems—Chang Kang- tsung(Karl), McGrawHill 7th 2013

COURSE TITLE: Software Quality Assurance

COURSE CODE: UMMITS6-305[CREDITS - 02]

Course Learning Objective

This course aims to provide learners with a comprehensive understanding of quality concepts, principles, and practices in both general and software-specific contexts. It emphasizes software quality management, verification, and validation techniques, and the V-Model as a structured approach to ensuring defect-free, reliable software. Students will gain the ability to apply quality frameworks, metrics, and continuous improvement methods to enhance software development and organizational performance.

Course Learning Outcomes

On successful completion of this course, students will be able to

CO1: Explain the historical perspective, core components, and principles of quality and TQM.
CO2: Analyze the relationship between software quality, productivity, and organizational culture.
CO3: Evaluate software quality management systems, frameworks, and critical issues in the software development life cycle.
CO4: Apply verification and validation methods, reviews, and coverage techniques across the testing lifecycle.
CO5: Demonstrate the V-Model by designing appropriate testing activities at each software development stage and assess their effectiveness.

Module	Name of the module	[30 L]
I	**Introduction to Quality:** Historical Perspective of Quality, What is Quality? (Is it a fact or perception?), Definitions of Quality, Core Components of Quality, Quality View, Financial Aspect of Quality, Customers, Suppliers and Processes, Total Quality Management (TQM), Quality Principles of Total Quality Management, Quality Management Through Statistical Process Control, Quality Management Through Cultural Changes, Continual (Continuous) Improvement Cycle, Quality in Different Areas, Benchmarking and Metrics.	**(10 L)**
II	**Software Quality:** Introduction, Constraints of Software Product Quality Assessment, Customer is a King, Quality and Productivity Relationship, Requirements of a Product, Organisation Culture, Characteristics of Software, Software Development Process, Types of Products, Schemes of Criticality Definitions, Problematic Areas of Software Development Life Cycle, Software Quality Management, Why Software Has Defects? Processes Related to Software Quality, Quality Management System Structure, Pillars of Quality Management System, Important Aspects of Quality Management.	**(10 L)**
III	**Verification & Validation:** Introduction, Verification, Verification Workbench, Methods of Verification, Types of reviews based on Stage Phase, Entities involved in verification, Reviews in testing lifecycle, Coverage in Verification, Concerns of Verification, Validation, Validation Workbench, Levels of Validation, Coverage in Validation, Acceptance Testing, Management of Verification and Validation, Software development verification and validation activities. **V-Model:** Introduction, V-model for software, Testing during Proposal stage, Testing during requirement stage, Testing during test planning phase, Testing during design phase, Testing during coding, VV Model, Critical Roles and Responsibilities.	**(10 L)**
	References:	

	1) Software Quality Assurance: From Theory to Implementation, by Galin, Pearson India, First Edition 2) Software Testing and Continuous Quality Improvement by William E. Lewis, CRC Press, Third Edition. 3) Software Engineering. A Practitioner's Approach by Roger Pressman, McGraw-Hill Education, Seventh Edition. 4) Software Product Quality Control by Stefan Wagner, Springer.	

ELECTIVES

COURSE TITLE: Linux Administration

COURSE CODE: UMMITS6-311[CREDITS - 03]

Course Learning Objective
Course Objective: ● To gain a deep understanding of various Linux distributions. ● To be able to install, configure, and optimize for specific server roles. ● To develop expertise in securing Linux servers from unauthorized access, attacks, and vulnerabilities. ● To acquire the skills to monitor server performance, identify bottlenecks, and optimize resource utilization. ● To understand Bash scripting language to automate repetitive tasks and server management processes.
Course Learning Outcomes
Course Outcome:

After completing the course, the learner will be able to:
CO1: Demonstrate a comprehensive understanding of various Linux distributions, packages and proficiency in developing effective access control lists to manage users and group accounts. CO2: Acquire the ability to manage storage and partitions, and develop efficiency in configuring network and infrastructure services.
CO3: Implement different servers with their server configuration roles and parameters.
CO4: Analyze system logs to identify potential problems and security incidents.
CO5: Develop expertise in implementing security measures like firewalls, access controls, password policies, and encryption to protect the system and ability to write scripts to automate tasks.

Module	Name of the module	[45 L]
1	**Getting Started** Starting with Linux , Duties of the System Administrator, Installing Red Hat Enterprise Linux Server **Working with Users, Groups, and Permissions**: Managing Users and Groups, Commands for User Management, Managing Passwords, Modifying and Deleting User Accounts, Configuration Files, Creating Groups, Using Graphical Tools for User, and Group Management, Managing Permissions, the Role of Ownership, Basic Permissions: Read, Write, and Execute, Advanced Permissions, Working with Access Control Lists, Setting Default Permissions with umask, Working with Attributes. **Gaining Privileges, Console Access, Installing and Managing Software YUM:** Checking for and updating Packages, Packages and Package Groups, Configuring Yum and Yum Repositories, Yum Plug-ins, Additional resources **Packagekit:** Updating packages with software update, Using Add/Remove Software, Packagekit Architecture, Additional Resources **Configuring and Managing Storage:** Understanding Partitions and Logical Volumes, Creating Partitions, Creating File Systems, File Systems Overview, Creating File Systems, Changing File System Properties, Checking the File System Integrity, Mounting File Systems Automatically Through fstab, Working with Logical Volumes, Creating Logical Volumes, Resizing Logical Volumes, Working with Snapshots, Replacing Failing Storage Devices, Creating Swap Space, Working with Encrypted Volumes	**(15 L)**

	Networking, Network Manager: The Network Manager Daemon, Interacting with Network Manager, Establishing Connections **Network Interfaces:** Network Configuration Files, Interface Configuration files, Interface Control Scripts, Static routes and the default gateway, Configuring static routes in ifcfg files, Network function files, ETHTool**.** **Infrastructure Services: Services and Daemons**- Configuring the default runlevel, Configuring the Services, Running Services, Additional Resources. **Configuring Authentication**- Configuring System Authentication, Using and Caching credentials with SSSD. **OpenSSH**- The SSH Protocol, Configuring OpenSSH, Using OpenSSH certificate authentication, OpenSSH clients, More than a Secure Shell,Additional Resources **TigerVNC-** VNC servers, sharing an existing Desktop, Using a VNC Viewer, Additional Resources		**(15 L)**
3	**Servers:** **DHCP Servers:** Why Use DHCP? Configuring DHCPv4 server, Configuring DHCPv4 Client**.** **DNS Servers –** Introduction to DNS, BIND **Web Servers –** The Apache HTTP server **Mail Servers –** Email Protocols, Email Program Classification, Mail Transport Agents, Mail Delivery Agents, Mail User Agents, Additional Resources **File Servers –** Samba, FTP **Monitoring and Automation**		**15 L**
	1. Red Hat Enterprise Linux 6 Deployment Guide -Red Hat-Red Hat Content Services-First-2021 2. Linux Bible -Christopher Negus-Wiley-Tenth-2020 3. Red hat Linux Networking and System Administration-Terry Collings and Kurt Wall -Wiley- Third- 2005 4. Red Hat Enterprise Linux6 Administration- Sander van Vugt Sybex- First- 2013 5. Linux Administration: A Beginner's Guide Wale Soyinka -TMH -Eighth- 2020		

COURSE TITLE: Linux Administration Practicals

COURSE CODE: UMMITS6-312[CREDITS - 01]

Course Learning Objective		
Course Learning Outcomes		
Module	**Name of the module**	**[30 practicals]**

0.	**Installation of RHEL6.x**
1.	**Working with Users, Groups, and Permissions**
a.	Creating and Managing Users
b.	Creating and Managing Groups
c.	Using Permissions and Advanced Permissions
2.	**Working with Console, RPM, and Yum**
a.	Managing Console and Gaining Privileges
b.	Working with RPM
c.	Working with Yum
3.	**Working with Storage, Network and Infrastructure services**
a.	Configuring and Managing Storage
b.	Connecting to the Network
c.	Configuring and enabling Infrastructure services

d.	Configuring OpenSSH
4.	**Configuring Server for File Sharing**
a.	Configuring NFS Server and Client
b.	Configuring Samba
c.	Configuring FTP
5.	**Configuring DHCP, DNS, Web and Mail Servers**
a.	Configuring DHCP server
b.	Configuring DNS server
c.	Configuring Web server
d.	Configuring Mail server
6.	**Configuring Monitoring and Automation tools**
a.	Configuring System Monitoring tools
b.	Configuring rsyslog
c.	Configuring cron, anacron, At and Batch Utility

References:

1 . Red Hat Enterprise Linux6 Administration Sander van Vugt Sybex First 2013

2 . Red Hat Enterprise Linux 6 Deployment Guide Red Hat Red Hat Content Services First 2021

3 . Red hat Linux Networking and System Administration Terry Collings and Kurt Wall Wiley Third 2005

4 . Linux Administration: A Beginner's Guide Wale Soyinka TMH Eighth 2020

5 . RedHat Certified System Administrator William Maning Emero Publishing Second 2012

COURSE TITLE: Game Programming

COURSE CODE: UMMITS6-311[CREDITS - 03]

Course Learning Objective		
Objectives: Learner should get the understanding computer Graphics programming using Directx or Opengl. Along with the VR and AR they should also aware of GPU, newer technologies and programming using most important API for windows.		
Course Learning Outcomes		
Module	**Name of the module**	**[45 L]**
UNIT I	**Mathematics for Computer Graphics, DirectX Kickstart:** Cartesian Coordinate system: The Cartesian XY-plane, Function Graphs, Geometric Shapes, Polygonal Shapes, Areas of Shapes, Theorem of Pythagoras in 2D, Coordinates, Theorem of Pythagoras in 3D, 3D Polygons, Euler's Rule **Vectors:** Vector Manipulation, multiplying a Vector by a Scalar, Vector Addition and Subtraction, Position Vectors, Unit Vectors, Cartesian Vectors, Vector Multiplication, Scalar Product, Example of the Dot Product, The Dot Product in Lighting Calculations, The Dot Product in Back-Face Detection, The Vector Product, The Right-Hand Rule, deriving a Unit Normal Vector for a Triangle Areas, Calculating 2D Areas **Transformations:** 2D Transformations, Matrices, Homogeneous Coordinates, 3D Transformations, Change of Axes, Direction Cosines, rotating a Point about an Arbitrary Axis, Transforming Vectors, Determinants, Perspective Projection, Interpolation DirectX: Understanding GPU and GPU architectures. How they are different from CPU Architectures? Understanding how to solve by GPU?	**(15 L)**
UNIT II	**DirectX Pipeline and Programming:** Introduction To DirectX 11: COM, Textures and Resources Formats, The swap chain and Page flipping, Depth Buffering, Texture Resource Views, Multisampling Theory and MS in Direct3D, Feature Levels Direct3D 11 Rendering Pipeline: Overview, Input Assembler Stage (IA), Vertex Shader Stage (VS), The Tessellation Stage (TS),	**(15 L)**

	Geometry Shader Stage (GS), Pixel Shader Stage (PS), Output merger Stage (OM) Understanding Meshes or Objects, Texturing, Lighting, Blending. **Interpolation and Character Animation:** **Trigonometry:** The Trigonometric Ratios, Inverse Trigonometric Ratios, Trigonometric Relationships, The Sine Rule, The Cosine Rule, Compound Angles, Perimeter Relationships **Interpolation:** Linear Interpolant, Non-Linear Interpolation, Trigonometric Interpolation, Cubic Interpolation, Interpolating Vectors, Interpolating Quaternions **Curves:** Circle, Bezier, B-Splines Analytic Geometry: Review of Geometry, 2D Analytic Geometry, Intersection Points, Point in Triangle, and Intersection of circle with straight line.	
UNIT III	**Introduction to Rendering Engines:** Understanding the current market Rendering Engines. Understanding AR, VR and MR.Depth Mappers, Mobile Phones, Smart Glasses, HMD's **Unity Engine:** Multi-platform publishing, VR + AR: Introduction and working in Unity, 2D, Graphics, Physics, Scripting, Animation, Timeline, Multiplayer and Networking, UI, Navigation and Pathfinding, XR, Publishing. **Scripting:** Scripting Overview, Scripting Tools and Event Overview XR: VR, AR, MR, Conceptual Differences. SDK, Devices	**(15 L)**
	References: 1) Mathematics for Computer Graphics, John Vince, Springer-Verlag London, 5th Edition,2017 2) Mathematics for 3D Game Programming and Computer Graphic, Eric Lengyel, Delmar Cengage Learning, Delmar Cengage Learning,2011 3) Introduction To 3D Game Programming With Directx® 11,Frank D Luna, Mercury Learning And Information,2012. 4) https://docs.unity3d.com/Manual/index.html - Free	

COURSE TITLE: Game Programming practical

COURSE CODE: UMMITS6-312[CREDITS - 01]

Course Learning Objective		
Course Learning Outcomes		
Module	**Name of the module**	**[30 Practicals]**

List of practicals:

1	Setup DirectX 11, Window Framework and Initialize Direct3D Device
2	Buffers, Shaders and HLSL (Draw a triangle using Direct3D 11)
3	Texturing (Texture the Triangle using Direct 3D 11)
4	Lightning (Programmable Diffuse Lightning using Direct3D 11)
5	Specular Lightning (Programmable Spot Lightning using Direct3D 11)
6	Loading models into DirectX 11 and rendering.
	Perform following Practical using online content from the Unity Tutorials Web--sites: https://unity3d.com/learn/tutorials/s/interactive-tutorials
7	https://unity3d.com/learn/tutorials/s/roll-ball-tutorial
8	https://unity3d.com/learn/tutorials/s/2d-ufo-tutorial
9	https://unity3d.com/learn/tutorials/s/space-shooter-tutorial
10	https://unity3d.com/learn/tutorials/topics/vr/introduction?playlist=22946

MINOR

COURSE TITLE: Computer Oriented Statistical Methods

COURSE CODE: UMMITS6-[CREDITS - 02]

Course Learning Objective		
To demonstrate understanding of numerical and statistical methods in support of the analysis, design and application for problem solving in the field of information technology.		
Course Learning Outcomes		
On successful completion of this course, students will be able to **CO1:**Remember key concepts: central tendency, dispersion, sampling, hypothesis testing, and R basics. **CO2:**Understand relationships among statistical measures and their applications. **CO3:**Apply statistical formulas, hypothesis tests, and R programming for data analysis. **CO4:**Analyze data distributions, sampling effects, and regression results. **CO5:**Evaluate the suitability and validity of statistical methods and conclusions. **CO6:**Create detailed statistical reports and perform comprehensive data analyses using computational tools.		
Module	**Name of the module**	**[45 L]**
UNIT I	**The Mean, Median, Mode, and Other Measures of Central Tendency:** Averages, or Measures of Central Tendency , Arithmetic	**(15 L)**

	Mean , Weighted Arithmetic Mean ,Properties of the Arithmetic Mean, Arithmetic Mean Computed from Grouped Data ,Median , Mode, Relation Between the Mean, Median, and Mode, Geometric Mean G, Harmonic Mean, Relation Between the Arithmetic, Geometric, and Harmonic Means, Root Mean Square, Quartiles,Deciles, and Percentiles. **Measures of Dispersion**: Dispersion, or Variation, Range, Mean Deviation, Semi- Interquartile Range, Percentile Range, Standard Deviation, Variance, Properties of the Standard Deviation, Relations Between Measures of Dispersion, Absolute and Relative Dispersion; Coefficient of Variation. **Moments, Skewness, and Kurtosis :** Moments , Moments for Grouped Data ,Relations Between Moments , Computation of Moments for Grouped Data, Skewness, Kurtosis, Population Moments, Skewness, and Kurtosis.	
UNIT II	**Elementary Sampling Theory** : Sampling Theory, Random Samples and Random Numbers, Sampling With and Without Replacement, Sampling Distributions, Sampling Distribution of Means, Sampling Distribution of Proportions, Sampling Distributions of Differences and Sums, Standard Errors. **Statistical Estimation Theory:** Estimation of Parameters, Unbiased Estimates, Efficient Estimates, Point Estimates and Interval Estimates; Their Reliability, Confidence-Interval Estimates of Population Parameters, Probable Error. **Statistical Decision Theory:** Statistical Decisions, Statistical Hypotheses, Tests of Hypotheses and Significance, or Decision Rules, Type I and Type II Errors, Level of Significance, Tests Involving Normal Distributions, Two-Tailed and One-Tailed Tests, p-Values for Hypothesis Tests, Control Charts, Tests Involving Sample Differences, Tests Involving Binomial Distributions. **Small Sampling Theory:** Small Samples, Student's t Distribution, Confidence Intervals, Tests of Hypotheses and Significance, The Chi-Square Distribution, Confidence Intervals for Sigma , Degrees of Freedom, The F Distribution.	**(15 L)**

UNIT III	**The Chi-Square Test:** Definition of chisquare, Significance Tests, The Chi-Square Test for Goodness of Fit, Contingency Tables, Yates' Correction for Continuity, Simple Formulas for Computing chisquare, Coefficient of Contingency, Correlation of Attributes, Additive Property of chi-square. **Curve Fitting and the Method of Least Squares:** Relationship Between Variables, Curve Fitting, Equations of Approximating Curves, Freehand Method of Curve Fitting, The Straight Line, The Method of Least Squares, The Least-Squares Line, Nonlinear Relationships, The Least-Squares Parabola, Regression, Applications to Time Series, Problems Involving More Than Two Variables. **Correlation Theory:** Correlation and Regression, Linear Correlation, Measures of Correlation, The Least-Squares Regression Lines, Standard Error of Estimate, Explained and Unexplained Variation, Coefficient of Correlation, Product-Moment Formula for the Linear Correlation Coefficient, Regression Lines and the Linear Correlation Coefficient, Correlation of Time Series, Sampling Theory of Correlation, Sampling Theory of Regression.	**(15 L)**
		(10 L)
	References: 1. Statistics Murray R. Spiegel, Larry J. Stephens. Mcgraw – Hill International Fourth 2. A Practical Approach Using R, R.B. Patil, H.J. Dand And R. Bhavsar, SPD, Edition 1st, 2017 3. Fundamental Of Mathematical Statistics, S.C. Gupta And V.K. Kapoor, Sultan Chand And Sons, Edition Eleventh Revised ,2011 4. Mathematical Statistics, J.N. Kapur And H.C. Saxena, S. Chand , Edition twentieth Revised , 2005	

COURSE TITLE: Computer Oriented Statistical Methods

COURSE CODE: UMMITS6-[CREDITS - 02]

Course Learning Objective
Course Learning Outcomes

	List of Practical (Using R)	[30 L]
1.	Using R execute the basic commands, array, list and frames.	
2.	Create a Matrix using R and Perform the operations addition, inverse, transpose and multiplication operations	
3.	Using R Execute the statistical functions: mean, median, mode, quartiles, range, inter quartile range histogram	
4.	Using R import the data from Excel / .CSV file and Perform the above functions.	
5.	Using R import the data from Excel / .CSV file and Calculate the standard deviation, variance, co-variance.	**(10 L)**
6.	Using R import the data from Excel / .CSV file and draw the skewness.	
7.	Import the data from Excel / .CSV and perform the hypothetical testing.	
8.	Import the data from Excel / .CSV and perform the Chi-squared Test.	
9.	Using R perform the binomial and normal distribution on the data.	
10.	Perform the Linear Regression using R	
	References:	

Modality of Assessment

The performance of the learners for those exams having Semester End Examinations and Internal Assessment shall be evaluated in two parts as per the following ratio:

Semester End Examination: Internal Assessment [60:40]

The learner's performance shall be assessed by conducting the **Semester-end Examination with 60% marks and Continuous Internal Assessment (CIA) with 40% marks.** Practical Examination will consist of Semester-end examination.

Students will have to score 40% of marks INDIVIDUALLY in Internal assessment as well as Semester-end Examination to pass the course.

Internal Assessment: It is defined as the assessment of the learners on the basis of internal

evaluation by way of participation of learners in various academic and correlated activities in the given semester of the programme.

Semester End Assessment: It is defined as the assessment of the learners on the basis of Performance in the Semester-end Theory/ Practical examination

Table-1- Mode of Assessment under NEP 2020

Name of the course	Nature of Evaluation & Mode of Assessment	Credits	Duration	Marks
Major Theory OR	**1. Internal (40%) (Table 2)**	**2-Credit**		**20**
	2. Semester-end Theory Examination (60%) (Table 3)		**75 min**	**30**
Elective	**1. Internal (40%) (Table 2)**	**4 credits**		**30**
	2. Semester-end Theory Examination (60%) (Table 3)		**100 min**	**45**
	Semester-end Practical Examination (Table-4)		**75 min**	**25**
Minor	**1. Internal (40%) (Table 2)**	**2-Credit**		**30**
	2. Semester-end Theory Examination (60%) (Table 3)		**100 min**	**45**
Major (Practical) (2 subjects)	**Semester-end Practical Examination (Table-4)**	**2-Credit**	**2.5 hours**	**50**

OJT	Documentation+presentation+evaluation by employer	**4-Credit**	**-**	

Table - 2
Theory - Mode of assessment-Continuous Internal Assessment [40%]

Evaluation type
1. Assignments. **2.** Project based learning activities (Group Discussion Research/ Case studies/ Reports / Assignments / Presentations / Skit / Poster / etc.). **3.** Class Test (Objective - Multiple Choice Questions/ Subjective). **4.** Active participation in class activities. **5.** Overall conduct as a responsible student with respect to good behaviour, leadership qualities, interpersonal skills etc. For example - Depending on the subject – 10 Marks Test + 10 Marks Assignment/Presentation/Case Study/Quiz/Mini Project**.** OR 15 Marks Test + 15 Marks Assignment/Presentation/Case Study/Quiz,Mini Project**.**

Table-3

Paper Pattern for Semester-End Theory Examination
1. Each unit should have equal weightage 2. Minimum one question per unit 3. No MCQ/True-False type of questions should be asked, only descriptive questions are allowed 4. Each question should have extra sub-questions (max 100% option)

Table-4
Semester End Examination for Practical Assessment --Major/Minor/VSC
[To be conducted at departmental level]

	Minor[25 marks(1 Credit)]		**Major[50 marks (2-Credit)]**	
A	Any one/ more experiment/s	20	Min two experiments per subject	40
B	Journal	5	Viva	5
C			Journal	5
	Total	**25**	**Total**	**50 M**