Re-Accredited B++ 2.86 CGPA by NAAC
VEER NARMAD SOUTH GUJARAT UNIVERSITY
University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી
યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.
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ક્રમાંકઃએસ./સિલેબસ/પરિપત્ર/૧૪૪૭૯ /૨૦૨૩
તા.૧૪/૦૬/૨૦૨૩

પ્રતિ,
વડાશ્રી,
ડિપાર્ટમેન્ટ ઓફ કોમ્પ્યુટર સાયન્સ,
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી,
સુરત.

વિષય :– MCA Semester-3 and 4ના અભ્યાસક્રમ અંગે.

મહાશયશ્રી,

સવિનય જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૩–૨૪થી અમલમાં આવનાર MCA Semester-3 and 4ના અભ્યાસક્રમ અંગે કોમ્પ્યુટર સાયન્સ અભ્યાસસમિતિની તા.૧૩/૦૫/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંકઃ૨ થી કરેલ ભલામણ કોમ્પ્યુટર સાયન્સ એન્ડ આઈ.ટી. વિદ્યાશાખાની તા.૨૭/૦૫/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંકઃ૨ અન્વયે સ્વીકારી નીચે મુજબ કરેલ ભલામણ એકેડેમિક કાઉન્સિલની તા.૦૭/૦૬/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંકઃ ૧૩ થી સ્વીકારી મંજૂર કરેલ છે. જેની આથી જાણ કરવામાં આવે છે.

Computer Science Study Committee Dt. 13-05-2023 Meeting Resolution No. 2

:: It is hereby resolved that. The Curriculum of MCA Semester- 3 & 4, Prepared by the subcommittee appointed by the board, was unanimously approved and recommended to put before the faculty.

કોમ્પ્યુટર સાયન્સ એન્ડ આઈ.ટી. વિદ્યાશાખાની તા.૨૭/૦૫/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંકઃ ૨

:: આથી ઠરાવવામાં આવે છે કે, કોમ્પ્યુટર સાયન્સ અભ્યાસ સમિતિની તા.૧૩/૦૫/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંકઃ૨ અન્વયે કરેલ ભલામણ સ્વીકારી શૈક્ષણિક વર્ષ ૨૦૨૩–૨૪ થી અમલમાં આવનાર M.C.A. સેમે.૩ અને સેમ.૪ ના નવા અભ્યાસક્રમ (Curriculum) અને Framework નો યથાવત સ્વીકારી કરી એકેડેમિક કાઉન્સિલને ભલામણ કરવામાં આવે છે.

એકેડેમિક કાઉન્સિલની તા.૦૭/૦૬/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંકઃ ૧૩

:: આથી ઠરાવવામાં આવે છે કે, કોમ્પ્યુટર સાયન્સ એન્ડ આઈ.ટી. વિદ્યાશાખાની તા.૨૭/૦૫/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંકઃ ૨ અન્વયે કરેલ ભલામણ સ્વીકારી મંજૂર કરવામાં આવે છે.

બિડાણઃ ઉપર મુજબ

કુલસચિવ વતી

પ્રતિ,
૧) અધ્યક્ષશ્રી, કોમ્પ્યુટર સાયન્સ એન્ડ ઈન્ફોર્મેશન ટેકનોલોજી વિદ્યાશાખા.
૨) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.

...તરફ જાણ તેમજ અમલ સારૂ.

Master of Computer Application

Name of Program	**Master of Computer Application**
Abbreviation	**MCA**
Duration	**2 Years**
Eligibility Criteria	Passed BCA/ Bachelor Degree in Computer Science Engineering or equivalent Degree. OR Passed B.Sc./ B.Com./ B.A. with Mathematics at 10+2 Level or at Graduation Level (with additional bridge Courses as per the norms of the concerned University).
Objective of Program	The core objective of the MCA programme is to prepare the students for productive career in software industry and academia by providing an outstanding environment of teaching and research in the core and emerging areas of the discipline.
Program Outcome	**PO1 : Fundamental Knowledge Enrichment** Program trains students with the core computer science and Information Technology (IT) knowledge domains. It also makes students capable of using core concepts in the conceptualization of domain specific application development. **PO2 : Critical Thinking Development** The program develops the skills of critical thinking, problem solving, evaluative learning of various techniques, and understanding the essence of the problem. **PO3 : Advanced Emerging Technology Awareness** The program trains students with the latest technologies that is being used in the industry. The continuous syllabi review adds value to the program for the outgoing students and make them ready to face challenging demands of the industry. **PO4 : Advanced Tools Usage** The program teaches the students to apply the advanced tools to solve real world problems. **PO5 : Nurturing Project Planning and Management Capabilities** The program trains students for designing and conceptualizing the software architecture, planning and managing the product development process of complex and live software projects. It also makes students understand the decision making for selection of an appropriate project management capabilities. **PO6 : Real World Problem / Project Development** Real world project provides the candidates exposure to work in the challenging and demanding environment of the industry. The project development training makes students employable and industry ready. **PO7 : Team Work and Leadership Development** Trains students to work in a team and also to take leadership of the of the project management team.
Program Specific Outcomes	PSO1 : Develop and strengthen the fundamental core concepts that are required to solve complex problems PSO2 : Develop the professional and entrepreneurship skills that needs independent logical and analytical thinking, teamwork and leadership PSO3 : Nurture the students to investigate for the design and development of a workable solution for a real world problem

	PSO4 : Develop students for self-learning and practicing challenging problem solution PSO5 : Train students to apply managerial skills to develop business applications. PSO6 : Train students to use recent computer science and application domain specific knowledge PSO7 : Train students to take-up the real world challenges to develop workable solution to a domain specific problem PSO8 : Inculcate the passion for continuous learning and doing research for making a successful professional career

Mapping between POs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
PO1								
PO2								
PO3								
PO4								
PO5								
PO6								
PO7								

Medium of Instruction: English

Program Structure: Semester 3 (Web Group)

Course Code	Title	Teaching per week		Course Credits	University Examination		Internal Marks	Total Marks
		Theory	Practical		Duration	Marks		
301	Internet of Things Machine Learning	4	0	4	3 Hrs	70	30	100
302	Design Patterns	4	0	4	3 Hrs	70	30	100
303	Advanced Web Technologies Advanced Java Technologies	4	0	4	3 Hrs	70	30	100
304	Full Stack Technology	4	0	4	3 Hrs	70	30	100
305	Open Source Web Based Programming	4	0	4	3 Hrs	70	30	100
306	Programming Skills VIII	0	3	3	2 Hrs	70	30	100
307	Programming Skills IX	0	3	3	2 Hrs	70	30	100
308	Programming Skills X	0	3	3	2 Hrs	70	30	100
309	Programming Skills XI	0	3	3	2 Hrs	70	30	100
	Total	20	12	32	23 Hrs	630	270	900

Program Structure: Semester 3 (Database Group)

Course Code	Title	Teaching per week		Course Credits	University Exam		Internal Exam	Total Marks
		Theory	Practical		Duration	Marks		
501	Internet of Things Machine Learning	4	0	4	3 Hrs	70	30	100
502	Design Patterns	4	0	4	3 Hrs	70	30	100
503	ERP Using SAP NoSQL Databases	4	0	4	3 Hrs	70	30	100
504	Advanced Database Administration	4	0	4	3 Hrs	70	30	100
505	Data Warehousing and Data Mining Big Data	4	0	4	3 Hrs	70	30	100
506	Programming Skills XI	0	2	2	2 Hrs	70	30	100
507	Programming Skills XII	0	3	3	2 Hrs	70	30	100
508	Programming Skills XIII	0	2	2	2 Hrs	70	30	100
509	Programming Skills XIV	0	3	3	2 Hrs	70	30	100

Program Structure		Semester 3 (Network Group)						
Course Code	Title	Teaching per week		Course Credits	University Exam		Internal Exam	Total Marks
		Theory	Practical		Duration	Marks		
501	Internet of Things / Machine Learning	4	0	4	3 Hrs	70	30	100
502	Design Patterns	4	0	4	3 Hrs	70	30	100
503	Network Essential & its Security	4	0	4	3 Hrs	70	30	100
504	Network Administration	4	0	4	3 Hrs	70	30	100
505	Wireless Network & Mobile Computing	4	0	4	3 Hrs	70	30	100
506	Programming Skills XI	0	2	2	2 Hrs	70	30	100
507	Programming Skills XII	0	3	3	2 Hrs	70	30	100
508	Programming Skills XIII	0	2	2	2 Hrs	70	30	100
509	Programming Skills XIV	0	3	3	2 Hrs	70	30	100

Program Structure		Semester 3 (General Group)						
Course Code	Title	Teaching per week		Course Credits	University Exam		Internal Exam	Total Marks
		Theory	Practical		Duration	Marks		
501	Internet of Things / Machine Learning	4	0	4	3 Hrs	70	30	100
502	Design Patterns	4	0	4	3 Hrs	70	30	100
503	Network Essential & its Security	4	0	4	3 Hrs	70	30	100
504	Advanced Database Administration	4	0	4	3 Hrs	70	30	100
505	Open Source Web Based Programming	4	0	4	3 Hrs	70	30	100
506	Programming Skills XI	0	2	2	2 Hrs	70	30	100
507	Programming Skills XII	0	3	3	2 Hrs	70	30	100
508	Programming Skills XIII	0	2	2	2 Hrs	70	30	100
509	Programming Skills XIV	0	3	3	2 Hrs	70	30	100

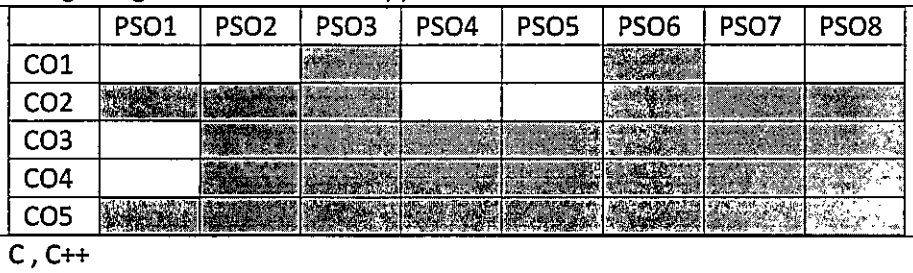
Program Structure		Semester 4			
Course Code	Title	Course Credit	University Exam Marks	Internal Marks	Total Marks
401	Seminar	6	70	30	100
402	Project	24	280	120	400

MCA 3rd Sem.

(Web Group)

Course: 301: **Internet of Things (IoT)**

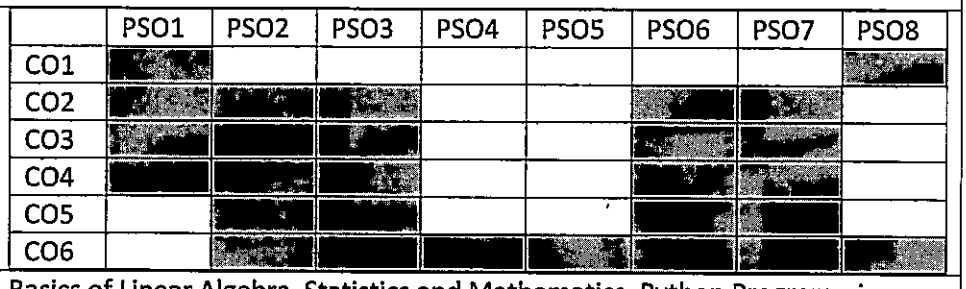
(Elective)

Course Code	301
Course Title	**Internet of Things (IoT)**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Review / Revision	June 2021
Purpose of Course	This course is an introduction for students to IoT. The course also gives students an idea about various components of IoT and explain its working. The course also explains the role of embedded systems in IoT ecosystem.
Course Objective	The objective of the course is - 1. To make student understand IoT 2. To understand the working of Micro-Controller & Micro-Computer 3. To explain various types of sensors 4. To introduce students with Programming in IoT
Course Outcome	CO1: Understand the IoT ecosystem and architecture. Understand IoT standards and protocols. Understand the privacy, security and governance issues in IoT applications. Exposing students with IoT botnet and the risks involved with IoT based applications. CO2: Understand the overview and working of the various sensors used in IoT applications. Introduce and Explain various network communication protocols, standards and IoT data Protocols. Understanding the Wireless Sensor Network and how IoT devices communicate with each other. CO3: Understand Micro-Controller and its architecture. Understand the usage of Micro-Controller in IoT applications. Understand how Arduino and NodeMCU interact with sensors and communicate over the network. CO4: Understand Micro-Computer and its architecture. Understand the difference between a Micro-Controller and Micro-Computer. Understand the usage of Micro-Computer in IoT applications. Understand how Raspberry Pi interact with sensors and communicate over the network. CO5:Expose the students with Server-side development in IoT applications. Understand how to develop and deploy applications in Arduino and NodeMCU. Understand how Arduino and NodeMCU communicate among themselves, sensors and the server. Understand how to build a full IoT app by integrating them with mobile applications.
Mapping between COs with PSOs	
Pre-requisite	C , C++
Course Content	**Unit 1: Introduction to IoT** 1.1 What is IoT 1.2 IoT Applications 1.3 IoT Privacy and Security 1.3.1 Identification in Distributed Environment 1.3.2 Device Authentication 1.4 IoT Botnet **Unit 2: Networking and Communication** 2.1 Basics of Wireless Networking 2.1.1 CSMA/CA

	2.2 IoT Network Protocols 2.2.1 BLE, Zigbee, LoRaWAN, RFID 2.3 IoT Data Protocols 2.3.1 CoAP, MQTT, XMPP, DDS **Unit 3: Sensors** 3.1 Introduction to Sensors 3.2 Types of Sensors & their working 3.3 Wireless Sensor Network 3.3.1 Introduction to WSN 3.3.2 Applications 3.3.3 Characteristics 3.3.4 Challenges 3.3.5 Components 3.4 Wireless Adhoc Network Vs Wireless Sensor Network **Unit 4: Micro-Controller: Arduino, NodeMCU** 4.1 Introduction to Microcontrollers 4.2 Arduino IDE 4.3 Arduino Architecture 4.4 Arduino Pin Diagram 4.5 Introduction to NodeMCU 4.6 NodeMCU Specifications and Applications 4.7 NodeMCU ESP8266 Pinout **Unit 5: IoT App Interaction & Introduction to Raspberry Pi** 5.1 Uploading sensor data to server 5.2 Reading sensor data from server 5.3 Controlling IoT device and components from Mobile or Web 5.4 Introduction to Microcomputers 5.5 Raspberry Pi Architecture 5.6 Raspberry Pi Pinout
Reference Books	1) Getting Started with Internet of Things – By Cuno Pfister, O'Reilly 2) Learning Internet of Things – By Peter Waher , Packt Publication 3) Internet of Things : A Hands-on Approach – By Arshdip Bahga and Vijay Madisetti 4) IoT Governance, Privacy and Security Issues, IERC 5) IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things, Cisco Press 6) Fundamentals of IoT Communication Technologies, Springer 7) Microcontrollers – Architecture, Programming, Interfacing and system design – By Raj Kamal , Pearson 8) Exploring C for Microcontrollers : A hands on approach, Springer 9) Arduino for Dummies, Wiley 10) Make: Getting Started With Arduino - The Open Source Electronics Prototyping Platform, Shroff/Maker Media 11) ESP8266: Get Started With ESP8266 Programming NodeMCU Using Arduino IDE, Createspace Independent Pub 12) Internet of Things Projects with ESP32, Packt Publishing Limited 13) Microprocessor Architecture, Programming and Applications with the 8085 - By Ramesh Gaonkar , Penram International Publishing 14) Raspberry Pi for Dummies , Wiley 15) Raspberry Pi User Guide – By Eben Upton and Garath Halfacree, Wiley
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment is based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 70% assessment is based on semester end University External examination

Course: 301: **Machine Learning**

(Elective)

Course Code	301
Course Title	**Machine Learning (ML)**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Review / Revision	June 2021
Purpose of Course	This course is an introduction for students to ML. The course also gives students an idea about various methods and algorithms of Machine Learning and application development of ML.
Course Objective	The objective of the course is – 1. To make student understand ML 2. To understand the various Machine Learning method 3. To explain various algorithms used in Machine learning 4. To introduce students with Programming in ML
Course Outcome	CO1 : Explain to the students the fundamental know how like the types of machine learning algorithms, applications and various required libraries, model selection etc. required to implement machine learning algorithms. CO2 : Train students with can utilize various data wrangling techniques, data cleaning, data transformation, data reduction, data discretization, feature selection, and data visualization CO3 : Train students who can implement supervised learning algorithms utilizing regression and classification algorithm on the real world dataset. CO4 : Train student to have understanding of Artificial Neural Network and its working. Also, to make them capable of implementing ANN for solving real world problems using it. CO5 : Explain to the students to use clustering and association rules as unsupervised learning method to solve complex problems. CO6 : Train students to use machine learning techniques to solve real life complex problems.
Mapping between COs with PSOs	
Pre-requisite	Basics of Linear Algebra, Statistics and Mathematics, Python Programming
Course Content	**Unit 1 : Introduction** 1.1. Definition of Machine Learning 1.2 Types of Machine Learning : Supervised , Unsupervised and Semi-supervised 1.3 Applications and tools of Machine Learning (Scikit learn library) 1.4 Selecting a model and training a model 1.5 Evaluating a performance of model and improving performance 1.6 Ethic standards while implementing ML model 1.7 MLOps level 0 and level 1 1.8 Characteristics of MLOps level 0 , level 1

	Unit 2 : Data Wrangling 2.1 Definition and goal of Data Wrangling 2.2 Importance of Data Wrangling 2.3 Data Pre-processing and Data Cleaning 2.3.1 Data Cleaning 2.3.2 Data Transformation 2.3.3 Data Reduction 2.3.4 Data Discretization 2.3.5 Feature Selection 2.4 Data Visualization **Unit 3 : Supervised Learning** 3.1 Supervised Learning : Classification and Regression 3.2 Regression 3.2.1 Simple and Multiple Regression 3.2.2 Linear Regression 3.2.3 Gradient Decent 3.2.4 Logistic Regression 3.3 Classification Algorithms : 3.3.1 K-nearest Neighbour 3.3.2 Support Vector Machines 3.3.3 Decision Trees 3.3.4 Naïve Bayes Classifier 3.4 Introduction to Support Vector Machine **Unit 4 : Neural Network** 4.1 Introduction to Neural Network 4.2 Architecture of Neural Network 4.3 Feedforward network and Backpropagation with example 4.4 Applications of Neural Network **Unit 5 : Unsupervised Learning** 5.1 Introduction to Unsupervised learning 5.2 Clustering 5.2.1 Selection of Clusters 5.2.2 Algorithms : 5.2.2.1 K – means clustering 5.2.2.2 Hierarchical Clustering 5.3 Association Rule Learning 5.3.1 Algorithms : 5.3.1.1 FP- Growth 5.3.1.2 Apriori Algorithm
Reference Books	1. "Machine Learning" by Tom M. Mitchell, McGraw Hill 2. "Understanding Machine Learning" by Shai Shalev-Shwartz, Shai Ben-David 3. "Machine Learning" by Anuradha Srinivasaraghavan, Vincy Joseph 4. "Machine Learning using Python" by U Dinesh Kumar Manaranjan Pradhan 5. "Real-World Machine Learning" by Henrik Brink, Joseph Richards, Mark Fetherolf 6. "Python Machine Learning" by Sebastian Raschka and Vahid Mirjalili 7. "Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems" by Aurelien Geron 8. "Machine Learning in Action" by Peter Harrington 9. "Introduction to Machine Learning with Python : A Guide for Data Scientists" by Andreas C. Muller, Sarah Guido

Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment is based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 70% assessment is based on semester end University External examination

Course: 302: **Design Patterns**

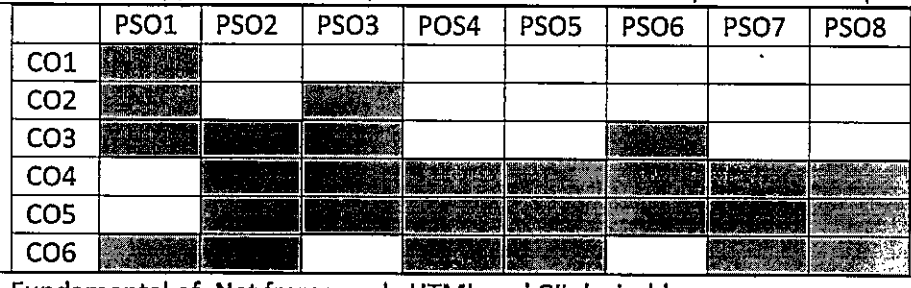
Course Code	302
Course Title	**Design Patterns**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Review / Revision	June 2021
Purpose of Course	The purpose of the course is to make student understand how Patterns can be implemented in various object oriented programming languages to solve real world problems.
Course Objective	The objective of the course is - 1. To study various Design Patterns 2. How these Patterns can be used to design better systems through Object Oriented Programming Languages
Course Outcome	CO1: Explain students about the various design patterns; their categories, and purpose. CO2: Explain the creational design patterns. CO3: Explain the structural design patterns. CO4: Explain the behavioural design patterns. CO5: Explain some more design patterns used in IT industry currently. CO6: Make students understand the applicability of design patterns practiced by IT companies and how effectively combine these patterns for effective software development.
Mapping between COs with PSOs	
Pre-requisite	Object Oriented Programming, Software Engineering
Course Content	**Unit -1 Introduction to Design Patterns** 1.1 What's a Design Pattern 1.2 Benefits of Design Patterns 1.3 Software Design Principles 1.4 SOLID Principles **Unit-2 Creational Patterns** 2.1 Factory Method Pattern 2.2 Abstract Factory Pattern 2.3 Builder Pattern 2.4 Prototype Pattern 2.5 Singleton Pattern **Unit-3 Structural Patterns** 3.1 Adapter Pattern 3.2 Bridge Pattern 3.3 Composite Pattern 3.4 Decorator Pattern 3.5 Overview of other Structural Patterns - Façade Pattern, Flyweight Pattern, Proxy Pattern **Unit-4 Behavioural Pattern** 4.1 Chain of Responsibility Pattern 4.2 Command Pattern 4.3 Iterator Pattern 4.4 Mediator Pattern 4.5 Overview of other Behavioural Patterns - Memento Pattern,

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

	Observer Pattern, State Pattern, Strategy Pattern, Template Method Pattern, Visitor Pattern **Unit-5 Additional Design Patterns and Patterns Applicability** 5.1 Overview of Additional Patterns - Simple Factory Pattern, Null Object Pattern, MVC Pattern 5.2 Security Patterns Repository 5.3 Patterns for Agile Development 5.4 Relation between patterns and pattern combinations
Reference Books	1. Design Patterns: Elements of Reusable Object-Oriented Software, Erich Gamma, Richard Helm, Ralph, John, Addision Wesley 2. Head First Design Patterns, Eric Freeman, O'Reilly 3. Design Patterns in C#, Vaskaran Sarcar, Apress 4. Design Patterns in Modern C++, Reusable Approaches for Object-Oriented Software Design, Dmitri Nesteruk, Apress 5. Modern C++ design: generic Programming and design patterns applied, Alexendrescu, Andrei, Addison-Wesley 6. Java Design Patterns: A Hands-on Experience with Real-World Examples, Vaskaran Sarcar, Apress
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30 % internal assessment and 70% external assessment

Course: 303:**Advanced Web Technologies**

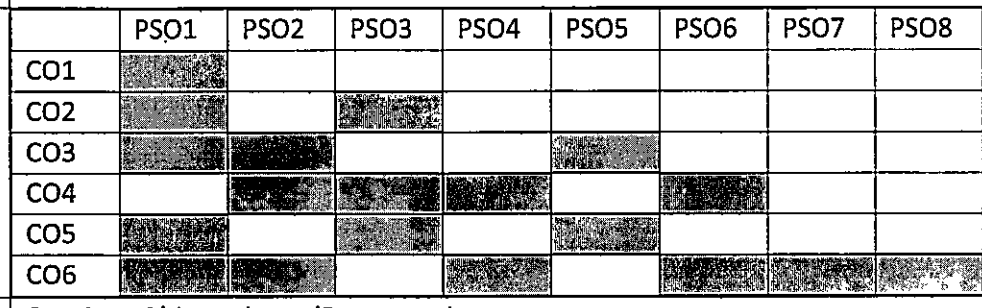
(Elective)

Course Code	303
Course Title	**Advanced Web Technologies**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	June 2021
Purpose of Course	To teach ASP .Net for web application development
Course Objective	To impart knowledge of web application development using ASP .Net
Course Outcome	CO1 : Explain students the fundamental aspects of .NET framework and ASP.NET. CO2 : Train students to use various tools and controls available in ASP.NET in web application development, how to integrate them and to get them work as a part of one single unit. CO3 : Train students to work with database using ADO.NET through design alternatives and through coding as well, also learn the concept of Language Integrated Query. CO4 : Explain and train students to work with MVC architecture to adopt the requirements of modern days application development. Also learn component based development through web services and APIs. CO5 : Expose the students to the new era of .NET Core to understand the upgrades and developments in .NET architecture. CO6 : Explain students to utilize tools & techniques available in ASP.NET for web based application development and server side component development.
Mapping between COs with PSOs	
Pre-requisite	Fundamental of .Net framework, HTML and C# desirable
Course Content	**Unit : 1 : Introduction to ASP.NET** 1.1. Overview of ASP.NET 1.2. Page Class and Page Life Cycle 1.3. Web Configuration files 1.4. Exception Handling 1.5. Error Pages 1.6. ASP.NET State Management 1.7. Introduction to Caching **Unit : 2 : ASP.NET Controls** 2.1 Web Controls 2.1.1 Common Web Server Controls 2.1.2 Specialized Web Server Controls 2.1.3 Table, Image, FileUpload 2.1.4 PostBack / Auto PostBack 2.2 Validation and Rich Controls 2.3 Website Navigation Controls - Sitemap, Treeview, Menu Controls 2.4 ASP.NET AJAX Controls 2.4.1 Introduction 2.4.2 Server Callbacks / Script Manager 2.4.3 ASP.NET AJAX Server Controls 2.4.4 UpdatePanel

	Unit : 3 : ASP .NET Web Application with Database 3.1. ADO.NET Architecture 3.2. Direct Data Access 3.3. Disconnected Data Access 3.4. Data Binding & Data Controls 3.4.1. Single-view, Repeated-Value, Data Source 3.4.2. Grid view ,Detail View, Form View 3.4.3. Data Repeater Control 3.5. LINQ 3.5.1. LINQ Language Features 3.5.2. LINQ to Objects 3.5.3. LINQ to SQL **Unit : 4 : ASP .NET - MVC , WCF Services & API** 4.1. ASP.NET MVC 4.1.1. MVC Architecture 4.1.2. URL Routing Engine 4.1.3. Wiring Controller, Model, and View 4.1.4. Data Access 4.1.5. Introduction to Entity Framework 4.2. WCF Services 4.2.1. Introduction to Web Services 4.2.2. RESTful API 4.2.3. Working with WCF Services 4.3. API 4.3.1. Introduction to JSON 4.3.2. Web API 4.3.3. API Creation and Consumption **Unit : 5 : ASP.NET CORE** 5.1. Overview of C#.NET CORE 5.2. .NET CORE Assemblies and Libraries 5.3. Pattern Matching 5.4. Tuples and Deconstruction 5.5. Local/Nested Functions 5.6. NuGet Package
Reference Book	1. Professional ASP.NET, Wrox Publication 2. ASP.NET – From Novice to Professional, Wrox Publication 3. ASP.NET Bible, By Mridula Parihar 4. Beginning ASP.NET 4.5, Wrox Publication 5. ASP.NET MVC with Entity Framework and CSS, APress 6. Programming Microsoft ASP.NET, Microsoft Press 7. Beginning AJAX with ASP.NET, Wrox Publication 8. Professional ASP.NET MVC 5, Wrox Publication 9. Professional C# 7 and .NET Core 2.0 , Wrox Publication 10. ASP.NET Core 2 Fundamentals, Packt Publication 11. Pro ASP.NET MVC 5, Apress 12. Programming ASP.NET Core, Microsoft Press 13. Pro C# 7 with .NET and .NET Core, Apress 14. Pro ASP.NET Core MVC by Adam Freeman, Springer, 2016
Teaching Methodology	Classroom, seminar and assignment
Evaluation Method	As per University rules

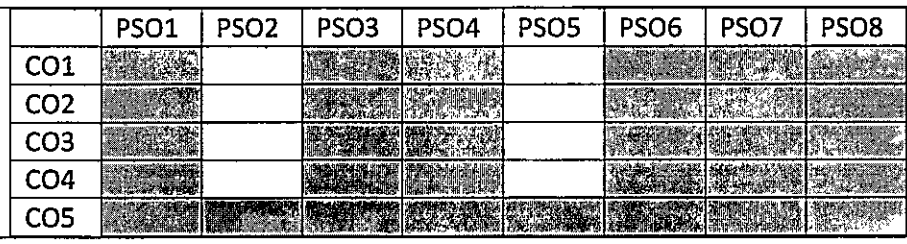
Course: 303: **Advanced Java Programming**

(Elective)

CourseCode	303
CourseTitle	**Advanced Java Programming**
Credit	4
TeachingperWeek	4Hrs.
Minimumweeksper Semester	15(IncludingClasswork,examination,preparation,holidaysetc.)
LastReview/Revision	June 2021
PurposeofCourse	Thiscourseisadvanceleveljavacoursetolearnweb&webenabled applicationdevelopmentusingJavaTechnologies.
CourseObjective	To developwebapplicationskillsusingJavawebtechnology
Course Outcome	CO1 : Explain students the insight of the various aspects the Java web technologies. CO2 : learn to access database through Java programs, using Java Data Base Connectivity (JDBC). CO3 : Create dynamic web pages, using Servlets and JSP, make a reusable software component, using Java Bean. CO4 : Understand the multi-tier architecture of web-based enterprise applications using Enterprise JavaBeans (EJB), develop Session and Entity Beans CO5 : Expose the students with the analysis and development process of the web application development using Java. CO6 : Map Java classes and object associations to relational database tables with JPA
Mapping between COs with PSOs	
Pre-requisite	CoreJava,ObjectorientedProgramming
CourseContent	**Unit1: Advance JDBC (JavaDatabaseConnectivity)** 1.1 Typesof JDBCDrivers 1.2 ConnectingtodatabaseslikeAccess,MySQL,SqlServer,Oracle 1.3 InteractingwithDatabaseusingSQLQueries 1.4 JDBCObjects:Connection,Resultset,Statement,Metadata 1.5 MoreJDBCObjects:DataSource,RowSet,RowSetevents 1.6 CallingStoredProcedures 1.7 ManagingTransactions 1.8 JDBCConnectionPooling 1.9 HandlingErrors/Warning **Unit2:JavaServlets** 2.1 IntroductiontoServlets 2.2 ServletLifecycle 2.3 HandlingHTTP GETandPOSTrequests 2.4 Invokingotherweb resources 2.5 Maintainingclientstate 2.6 ServletAnnotations 2.7 ServletFilter 2.8 File Upload

	Unit3:JavaServerPages(JSP), JSTL(StandardTagLibrary)&EL 3.1 Introductionto JSP,page lifecycle 3.2 JSPElements– directives,scriplet,action 3.3 ImplicitJSPobjects 3.4 UsingJavaBeansinJSP,SessionTracking 3.5 JSTL –UsingJava StandardTagLibrary 3.6 JSTLCore&Databasetags 3.7 IntroductiontoEL(ExpressionLanguage) 3.8 ELimplicitobjects **Unit4:WebServiceswithXML&JSON** 4.1 IntroductiontoWebServices 4.2 BuildingXMLbased webserviceswithJAX-WS 4.3 BuildingRestfulwebservices withJAX-RS 4.4 Reading/WritingXMLfilesinJava(JAXP) 4.5 IntroductiontoAJAX **Unit 5: JPA, EJB &MVCIntroduction** 5.1 Introductionto JavaPersistenceAPI(JPA) 5.2 EntityBeans&SessionBeans 5.3 OverviewofMVCFramework 5.4 SpringArchitecture 5.5 SpringXMLConfiguration 5.6Aspectorientedprogramming
ReferenceBooks	1. JavaEETutorialBasicConceptsbyOracle Corporation 2. Beginning Java™ EEPlatform with GlassFish™ : From Novice toProfessionalby AntonioGoncalves 3. BeginningEJB3ApplicationDevelopmentFromNovicetoProfessionalbyRaghuR.KodaliandJonathanWetherbeewithPeterZadrozny, ApressPublication 4. ProJPA2:MasteringtheJava™Persistence API 5. HeadFirstServletsandJSPBy:BryanBasham,KathySierra,BertBatesPublisher:'ReillyMedia 6. CoreServletsandJavaserverPages:AuthorMartyHall,LarryBrown,SunMicroSystem 7. JavaServlet& JSP Cookbook byBruceW.PerryO;reillyPublication 8. BeginningJSP™,JSF™andTomcat™WebDevelopment:FromNovice toProfessional byGiulio ZambonandMichaelSekler 9. JAVACompleteReference ,TMHPublication 10. ProfessionalJavaDevelopmentwithSpringFramework,WroxPublication
TeachingMethodology	Discussion,IndependentStudy,SeminarsandAssignment
EvaluationMethod	30%Internalassessmentisbasedonclassattendance,participation,classtest,quiz, assignment,seminar, internalexaminationetc. 70%assessmentisbasedonsemesterendUniversityExternalexamination

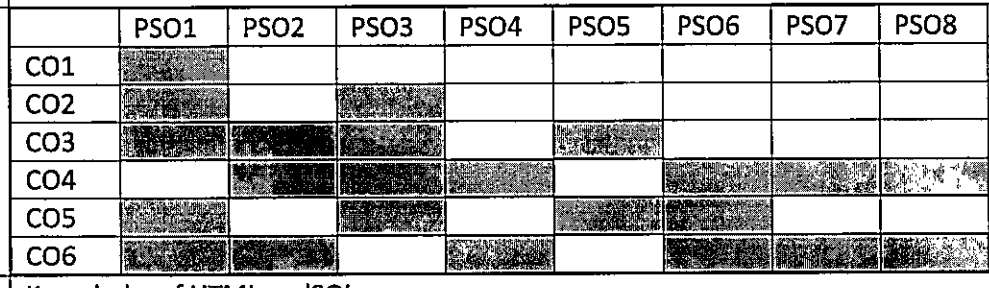
Course:304:**Full Stack Technology**

Course Code	304
Course Title	**Full Stack Technology**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Review / Revision	June 2021
Purpose of Course	The purpose of the course is to make the students capable of developing full stack web applications.
Course Objective	The objective of the course is to make student understand full stack development
Course Outcome	CO1 : Understand the syntax, and semantics of the JavaScript programming language. Manipulate DOM elements with the help of JavaScript. CO2: Understand the design of single-page applications and how React facilitates their development. Understand advantages and disadvantages of using React. Understand functional components, state components, parent & child components, lifecycle, hooks, routing, and state management in React. CO3: Understanding the working of Node environment and Express Framework. Understand Server-side Web Application development and Server-side routing. CO4: Understanding Mongo as a data store. Understanding common use-cases and architectures of Mongo. Performing database operations using Mongo's query and update languages. CO5 : Expose the students with the combined development process of the full stack application. Understand connecting React and Node. Understand Github and CI/CD. Understand the deployment of full stack application using Netlify / Heroku.
Mapping between COs with PSOs	
Pre-requisite	HTML, CSS, Front-end Scripting
Course Content	**Unit 1: Introduction** 1.1 JavaScript 1.1.1 Execution Context and Call Stack 1.1.2 Hoisting in JavaScript 1.1.3 Spread Operator 1.1.4 Scope Chain, Temporal Dead Zone 1.1.5 Block Scope, Shadowing 1.1.6 Closures 1.2 Full Stack Technology **Unit 2: React.js** 2.1 React Introduction 2.1.1 What is React 2.1.2 What is a Component 2.1.3 JSX Overview 2.2 create-react-app 2.2.1 Understanding basics of react app 2.3 Understanding virtual DOM, SPA 2.4 Components 2.4.1 Class Components 2.4.2 Functional Components 2.4.3 Parent, Child Components

	2.4.4 Conditional Rendering 2.4.5 State, setState Method 2.4.6 Props 2.5 Event Handling in React 2.5.1 Event Handling in Class Components 2.5.2 Event Handling in Functional Components 2.6 Lifecycle 2.6.1 Class Component Life Cycle Methods 2.7 React Hooks 2.7.1 What is a React Hook 2.7.2 useState Hook 2.7.3 useEffect Hook 2.8 Building forms in React 2.9 React Router 2.10 Controlled vs Uncontrolled Components 2.11 State Management 2.11.1 Single Source of Truth 2.11.2 Lifting State Up 2.11.3 Prop Drilling 2.11.4 useContext 2.11.5 Redux 2.12 HTTP Methods 2.12.1 Fetch 2.12.2 Axios **Unit 3: Node.js & Express.js** 3.1 Introduction to Node.js 3.2 Creating a Simple Server 3.3 Response types - HTML, JSON 3.4 Modules 3.5 NPM 3.6 Introduction to Express.js 3.7 Express Params and Query String 3.8 Express Router **Unit 4: Mongo DB** 4.1 SQL/NoSQL landscape 4.2 Document Vs. Other types of Storage 4.3 MongoDB feature set 4.4 Introduction to BSON and JSON 4.5 Simple Queries 4.6 Connecting with Node JS 4.6.1 Inserts and Retrievals 4.6.2 Updates and Deletes **Unit 5: MERN & Deployment** 5.1 Connecting React and Node 5.2 Building an application in MERN 5.3 Github and CI/CD 5.4 Deploy using Netlify / Heroku
Reference Books	1. Eloquent JavaScript: A Modern Introduction to Programming, No Starch Press 2. You Don't Know JS, Shroff/O'Reilly 3. The Road to Learn React: Your Journey to Master Plain Yet Pragmatic React.js, Zaccheus Entertainment 4. React Explained: Your Step-by-Step Guide to React, OS Training, LLC 5. Beginning React, Greg Lim

	6. Learning React: Functional Web Development with React and Redux, Shroff/O'Reilly 7. Learn React Hooks: Build and refactor modern React.js applications using Hooks, Packt Publishing Limited 8. Pro React, Apress 9. Web Development with Node and Express: Leveraging the JavaScript Stack, O'Reilly Media 10. Express in Action: Writing, building, and testing Node.js applications, Manning Publications 11. Beginning Node.js, Express & MongoDB Development, Greg Lim 12. MongoDB: The Definitive Guide - Powerful and Scalable Data Storage, Shroff/O'Reilly; Third edition 13. Full-Stack React Projects: Learn MERN stack development by building modern web apps using MongoDB, Express, React, and Node.js, Packt Publishing Limited 14. Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Apress
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment is based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 70% assessment is based on semester end University External examination

Course:305:**OpenSourceWebBasedProgramming**

CourseCode	305
CourseTitle	**Open Source Web Based Programming**
Credit	4
TeachingperWeek	4Hrs.
Minimumweeks/ Semester	15(IncludingClasswork,examination,preparation,holidaysetc.)
Review/ Revision	June 2021
PurposeofCourse	This course helps students to understand fundamentals of Open Source web basedProgramming. The course also imparts students learning about Open source webbasedscriptinglanguagePHP andMysqldatabase.Italso includesMVCorThreetierarchitectureofwebbasedprogramming.
CourseObjective	Student will learnfundamentals andadvancetopicsofOpensourceWebtechnology
Course Outcome	CO1 : Explain students the fundamental as well as Advanced aspects of the Open Source Web based Technology. CO2 : Train students about react JS and difference between React JS and React Native. CO3 : Train students to understand MVC structure and it's benefits. CO4 : Explain and train students to deal with possible problem while developing websites and it's solution. CO5 : Expose the students with the analysis and development process of Websites. CO6 : After studying the course, students will be able to understand how Open source web technology works. They will also be able to create database driven Professional Websites.
Mapping between COs with PSOs	
Pre-requisite	Knowledgeof HTML andSQL
CourseContent	**Unit1:IntroductiontoOpensourceWebbasedProgramming** 1.1 IntroductiontoPHP&MySql 1.2 InstallationofPHP andMySql 1.3 LanguageCharacteristics&Features 1.4 OperatorsandVariables,ControlStructures,LoopingandErrorhandling 1.5 PHPfunctions 1.5.1 StringFunctions 1.5.2 ArrayFunctions 1.5.3 MathematicalFunctions 1.5.4 GraphicsLibrary(GDSupport) 1.5.6 DateandTime Functions 1.5.7 Misc.Function 1.6 StatemanagementTechniques 1.7 ObjectOrientedFeaturesofPHP 1.7.1 ClassesandObjects 1.7.2 Useofconstructors 1.7.3 Serialization 1.7.4 Inheritance **Unit2:MySQLdatabaseserver** 2.1 ConfiguringtheMySQLServer

	2.2 MySQL Tables, Displaying MySQL Database ,Addingandremovinguseraccess 2.3 Databaseconnectionanddataprocessingfunctions **Unit3:AdvancePHP** 3.1 AjaxBasics 3.1.1 HTTPRequestandResponseFundamentals 3.1.2 TheXMLHttpRequestObjectXMLHttpRequestMethods 3.1.3 XMLHttpRequestProperties 3.1.4 Cross-BrowserUsageSendingaRequestto theServer 3.1.5 PHPandAjaxClient-DrivenCommunication 3.1.6 Server-SideProcessingExpandingandContractingContent 3.1.7 FormValidation 3.1.8 Ajax-Based DatabaseQuerying 3.2 XML 3.3 Webservices **Unit4: MVC** 4.1 IntroductiontoMVC 4.2 Introduction to Laravel, Architecture Concepts 4.3 Routing 4.4 Middleware 4.5 Controllers 4.6 Request & Response 4.7 View 4.8 URL generation 4.9 Validation 4.10 Session & Cookie 4.11 Form & File uploading 4.12 ErrorHandling 4.13 Security 4.14 Database **Unit5:Advance Concepts of MVC** 5.1 Blade Templates 5.2 Mail 5.3 Authentication 5.4 Authorization 5.5 Encryption
ReferenceBooks	1. Beginning PHP, Apache, MySQL Web Development - Elizabeth Naramore, JasonGerner, Yann Le Scouarnec, Jeremy Stolz, Michael K. Glass, Gary Mailer – WroxPublication 2. ProfessionalPHPProgramming -JesusCastagnetto ,WroxPressLtd 3. Beginning PHP and MySQL: From Novice to Professional - W. Jason Gilmore,Apress 4. Php: The Complete Reference - Steven Holzner, Tata Mcgraw Hill EducationPrivateLimited 5. AJAX and PHP: Building Responsive Web Applications - Bogdan Brinzarea, CristianDarie packtpub 6. Phpmanual–www.Php.com 7. Beginning Laravel Build Websites with Laravel 5.8 - Sanjib Sinha · 2019 - Apress 8. Laravel The Ultimate Beginner's Guide to Learn Laravel Step by Step, 2nd Edition - Mem Lnc, Rufus Stewart
TeachingMethodology	Classwork,Discussion,Self-Study,Seminarsand/orAssignment
EvaluationMethod	30%Internalassessmentisbasedonclassattendance,participation,classtest,quiz,assignment,seminar, internal examinationetc. 70%assessmentisbasedonsemesterendUniversityExternalexamination

Course: 306: **Programming Skills VIII**

Course Code	306
Course Title	**Programming Skills VIII**
Credit	3
Teaching per Week	2 Hrs.
Minimum weeks/ Semester	15 (Including Lab. work, examination, preparation, holidays etc.)
Review / Revision	June 2021
Purpose of Course	Learn practically IoT / ML
Course Objective	Learn IoT practically, understand the working of Micro-Controller & Micro-Computer and using various types of sensors and its Programming. OR Implement various algorithms used in Machine learning and introduce students with Programming in ML.
Pre-requisite	C/C++ for IoT OR Python Programming for ML
Course Outcome	After successful completion, students will be able to work with different types of Micro-Controllers, Micro-Computers and sensors for their IoT based application development. OR After successful completion, students will be able to work with different types of ML algorithms and ML based application development.
Course Content	Practical based on paper no 301. (IoT/ML) Separate journal to be prepared for this subject 301.
Reference Books	-----
Teaching Methodology	Lab work, Practical Programming Exercises (to be documented in a separate journal), Self-study, and/or Assignment
Evaluation Method	30% Internal assessment is based on Lab attendance, practical test, practical internal examination etc. 70% assessment is based on semester end University External practical examination

Course: 307: **Programming Skills IX**

Course Code	307
Course Title	**Programming Skills IX**
Credit	3
Teaching per Week	2 Hrs.
Minimum weeks/ Semester	15 (Including Lab. work, examination, preparation, holidays etc.)
Review / Revision	June 2021
Purpose of Course	This course helps students to implement the advanced concepts of .NET/Java practically.
Course Objective	Learning to implement the advanced topics of .NET/Java practically.
Pre-requisite	Practical programming in basic .NET/Java.
Course Outcome	After studying the course, students will be able to practically work on advanced technology platforms of .NET/Java.
Course Content	Practical based on paper no 303. Separate journal to be prepared for this subject 303.
Reference Books	-----
Teaching Methodology	Lab work, Practical Programming Exercises (to be documented in a separate journal), Self-study, and/or Assignment
Evaluation Method	30% Internal assessment is based on Lab attendance, practical test, practical internal examination etc. 70% assessment is based on semester end University External practical examination

Course: 308: **Programming Skills X**

Course Code	308
Course Title	**Programming Skills X**
Credit	3
Teaching per Week	2 Hrs.
Minimum weeks/ Semester	15 (Including Lab. work, examination, preparation, holidays etc.)
Review / Revision	June 2021
Purpose of Course	Learn practically, developing full stack web applications.
Course Objective	Practically learn full stack development
Pre-requisite	HTML, CSS, Front-end Scripting
Course Outcome	After completion of this course, the students will be able to design and develop Full Stack web applications
Course Content	Practical based on paper no 304. (Full Stack Technology). Separate journal to be prepared for this subject 304.
Reference Books	-----
Teaching Methodology	Lab work, Practical Programming Exercises (to be documented in a separate journal), Self-study, and/or Assignment
Evaluation Method	30% Internal assessment is based on Lab attendance, practical test, practical internal examination etc. 70% assessment is based on semester end University External practical examination

Course: 309: **Programming Skills XI**

Course Code	309
Course Title	**Programming Skills XI**
Credit	3
Teaching per Week	2 Hrs.
Minimum weeks/ Semester	15 (Including Lab. work, examination, preparation, holidays etc.)
Review / Revision	June 2021
Purpose of Course	This course helps students to implement the basic and advanced concepts of PHP/MySql practically.
Course Objective	Learning to develop and deploy websites using PHP/MySql practically.
Pre-requisite	Basic scripting, programming, html.
Course Outcome	After studying the course, students will be able to practically develop dynamic websites using PHP/MySql.
Course Content	Practical based on paper no 305. Separate journal to be prepared for this subject 305.
Reference Books	-----
Teaching Methodology	Lab work, Practical Programming Exercises (to be documented in a separate journal), Self-study, and/or Assignment
Evaluation Method	30% Internal assessment is based on Lab attendance, practical test, practical internal examination etc. 70% assessment is based on semester end University External practical examination

MCA 3rd Sem

(Database Group)

Course: 301: **Internet of Things (IoT)**

(Elective)

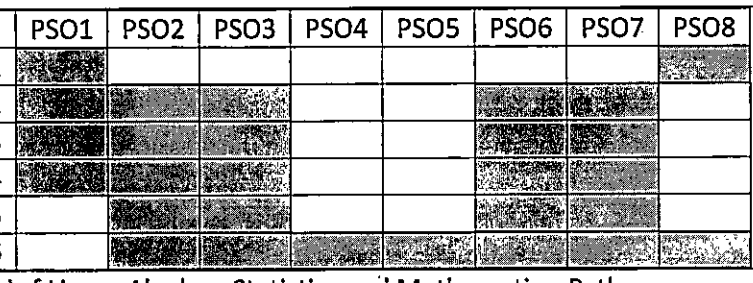
Course Code	301
Course Title	**Internet of Things (IoT)**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Review / Revision	June 2021
Purpose of Course	This course is an introduction for students to IoT. The course also gives students an idea about various components of IoT and explain its working. The course also explains the role of embedded systems in IoT ecosystem.
Course Objective	The objective of the course is - 5. To make student understand IoT 6. To understand the working of Micro-Controller & Micro-Computer 7. To explain various types of sensors 8. To introduce students with Programming in IoT
Course Outcome	CO1: Understand the IoT ecosystem and architecture. Understand IoT standards and protocols. Understand the privacy, security and governance issues in IoT applications. Exposing students with IoT botnet and the risks involved with IoT based applications. CO2: Understand the overview and working of the various sensors used in IoT applications. Introduce and Explain various network communication protocols, standards and IoT data Protocols. Understanding the Wireless Sensor Network and how IoT devices communicate with each other. CO3: Understand Micro-Controller and its architecture. Understand the usage of Micro-Controller in IoT applications. Understand how Arduino and NodeMCU interact with sensors and communicate over the network. CO4: Understand Micro-Computer and its architecture. Understand the difference between a Micro-Controller and Micro-Computer. Understand the usage of Micro-Computer in IoT applications. Understand how Raspberry Pi interact with sensors and communicate over the network. CO5:Expose the students with Server-side development in IoT applications. Understand how to develop and deploy applications in Arduino and NodeMCU. Understand how Arduino and NodeMCU communicate among themselves, sensors and the server. Understand how to build a full IoT app by integrating them with mobile applications.
Mapping between COs with PSOs	
Pre-requisite	C , C++
Course Content	**Unit 1: Introduction to IoT** 1.1 What is IoT 1.2 IoT Applications 1.3 IoT Privacy and Security 1.3.1 Identification in Distributed Environment 1.3.2 Device Authentication 1.4 IoT Botnet

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								

	Unit 2: Networking and Communication 2.1 Basics of Wireless Networking 2.1.1 CSMA/CA 2.2 IoT Network Protocols 2.2.1 BLE, Zigbee, LoRaWAN, RFID 2.3 IoT Data Protocols 2.3.1 CoAP, MQTT, XMPP, DDS **Unit 3: Sensors** 3.1 Introduction to Sensors 3.2 Types of Sensors & their working 3.3 Wireless Sensor Network 3.3.1 Introduction to WSN 3.3.2 Applications 3.3.3 Characteristics 3.3.4 Challenges 3.3.5 Components 3.4 Wireless Adhoc Network Vs Wireless Sensor Network **Unit 4: Micro-Controller: Arduino, NodeMCU** 4.1 Introduction to Microcontrollers 4.2 Arduino IDE 4.3 Arduino Architecture 4.4 Arduino Pin Diagram 4.5 Introduction to NodeMCU 4.6 NodeMCU Specifications and Applications 4.7 NodeMCU ESP8266 Pinout **Unit 5: IoT App Interaction & Introduction to Raspberry Pi** 5.1 Uploading sensor data to server 5.2 Reading sensor data from server 5.3 Controlling IoT device and components from Mobile or Web 5.4 Introduction to Microcomputers 5.5 Raspberry Pi Architecture 5.6 Raspberry Pi Pinout
Reference Books	1) Getting Started with Internet of Things – By Cuno Pfister, O'Reilly 2) Learning Internet of Things – By Peter Waher , Packt Publication 3) Internet of Things : A Hands-on Approach – By Arshdip Bahga and Vijay Madisetti 4) IoT Governance, Privacy and Security Issues, IERC 5) IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things, Cisco Press 6) Fundamentals of IoT Communication Technologies, Springer 7) Microcontrollers – Architecture, Programming, Interfacing and system design – By Raj Kamal , Pearson 8) Exploring C for Microcontrollers : A hands on approach, Springer 9) Arduino for Dummies, Wiley 10) Make: Getting Started With Arduino - The Open Source Electronics Prototyping Platform, Shroff/Maker Media 11) ESP8266: Get Started With ESP8266 Programming NodeMCU Using Arduino IDE, Createspace Independent Pub 12) Internet of Things Projects with ESP32, Packt Publishing Limited 13) Microprocessor Architecture, Programming and Applications with the 8085 - By Ramesh Gaonkar , Penram International Publishing

	14) Raspberry Pi for Dummies , Wiley 15) Raspberry Pi User Guide – By Eben Upton and Garath Halfacree, Wiley
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment is based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 70% assessment is based on semester end University External examination

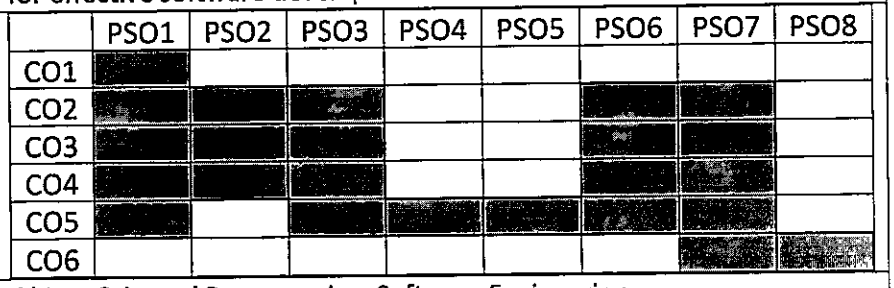
Course: 301: **Machine Learning**
(Elective)

Course Code	301
Course Title	**Machine Learning (ML)**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Review / Revision	June 2021
Purpose of Course	This course is an introduction for students to ML. The course also gives students an idea about various methods and algorithms of Machine Learning and application development of ML.
Course Objective	The objective of the course is – 1. To make student understand ML 2. To understand the various Machine Learning method 3. To explain various algorithms used in Machine learning 4. To introduce students with Programming in ML
Course Outcome	CO1 : Explain to the students the fundamental know how like the types of machine learning algorithms, applications and various required libraries, model selection etc. required to implement machine learning algorithms. CO2 : Train students with can utilize various data wrangling techniques, data cleaning, data transformation, data reduction, data discretization, feature selection, and data visualization CO3 : Train students who can implement supervised learning algorithms utilizing regression and classification algorithm on the real world dataset. CO4 : Train student to have understanding of Artificial Neural Network and its working. Also, to make them capable of implementing ANN for solving real world problems using it. CO5 : Explain to the students to use clustering and association rules as unsupervised learning method to solve complex problems. CO6 : Train students to use machine learning techniques to solve real life complex problems.
Mapping between COs with PSOs	
Pre-requisite	Basics of Linear Algebra, Statistics and Mathematics, Python Programming
Course Content	**Unit 1 : Introduction** 1.1. Definition of Machine Learning 1.2 Types of Machine Learning : Supervised , Unsupervised and Semi-supervised 1.3 Applications and tools of Machine Learning (Scikit learn library)

	1.4 Selecting a model and training a model 1.5 Evaluating a performance of model and improving performance 1.6 Ethic standards while implementing ML model 1.7 MLOps level 0 and level 1 1.8 Characteristics of MLOps level 0 , level 1 **Unit 2 : Data Wrangling** 2.1 Definition and goal of Data Wrangling 2.2 Importance of Data Wrangling 2.3 Data Pre-processing and Data Cleaning 2.3.1 Data Cleaning 2.3.2 Data Transformation 2.3.3 Data Reduction 2.3.4 Data Discretization 2.3.5 Feature Selection 2.4 Data Visualization **Unit 3 : Supervised Learning** 3.1 Supervised Learning : Classification and Regression 3.2 Regression 3.2.1 Simple and Multiple Regression 3.2.2 Linear Regression 3.2.3 Gradient Decent 3.2.4 Logistic Regression 3.3 Classification Algorithms : 3.3.1 K-nearest Neighbour 3.3.2 Support Vector Machines 3.3.3 Decision Trees 3.3.4 Naïve Bayes Classifier 3.4 Introduction to Support Vector Machine **Unit 4 : Neural Network** 4.1 Introduction to Neural Network 4.2 Architecture of Neural Network 4.3 Feedforward network and Backpropagation with example 4.4 Applications of Neural Network **Unit 5 : Unsupervised Learning** 5.1 Introduction to Unsupervised learning 5.2 Clustering 5.2.1 Selection of Clusters 5.2.2 Algorithms : 5.2.2.1 K – means clustering 5.2.2.2 Hierarchical Clustering 5.3 Association Rule Learning 5.3.1 Algorithms : 5.3.1.1 FP- Growth 5.3.1.2 Apriori Algorithm
Reference Books	1. "Machine Learning" by Tom M. Mitchell, McGraw Hill. 2. "Understanding Machine Learning" by Shai Shalev-Shwartz, Shai

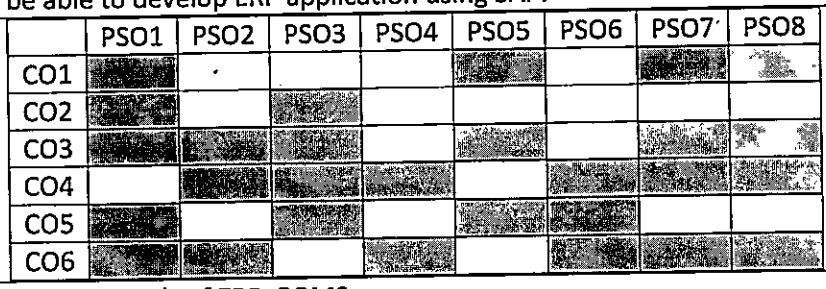
	Ben-David 3. "Machine Learning" by Anuradha Srinivasaraghavan, Vincy Joseph 4. "Machine Learning using Python" by U Dinesh Kumar Manaranjan Pradhan 5. "Real-World Machine Learning" by Henrik Brink, Joseph Richards, Mark Fetherolf 6. "Python Machine Learning" by Sebastian Raschka and Vahid Mirjalili 7. "Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems" by Aurelien Geron 8. "Machine Learning in Action" by Peter Harrington 9. "Introduction to Machine Learning with Python : A Guide for Data Scientists" by Andreas C. Muller, Sarah Guido
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment is based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 70% assessment is based on semester end University External examination

Course: 302: **Design Patterns**

Course Code	302
Course Title	**Design Patterns**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Review / Revision	June 2021
Purpose of Course	The purpose of the course is to make student understand how Patterns can be implemented in various object oriented programming languages to solve real world problems.
Course Objective	The objective of the course is - 3. To study various Design Patterns 4. How these Patterns can be used to design better systems through Object Oriented Programming Languages
Course Outcome	CO1: Explain students about the various design patterns; their categories, and purpose. CO2: Explain the creational design patterns. CO3: Explain the structural design patterns. CO4: Explain the behavioural design patterns. CO5: Explain some more design patterns used in IT industry currently. CO6: Make students understand the applicability of design patterns practiced by IT companies and how effectively combine these patterns for effective software development.
Mapping between COs with PSOs	
Pre-requisite	Object Oriented Programming, Software Engineering
Course Content	**Unit -1 Introduction to Design Patterns** 1.1 What's a Design Pattern 1.2 Benefits of Design Patterns 1.3 Software Design Principles 1.4 SOLID Principles **Unit-2 Creational Patterns** 2.1 Factory Method Pattern 2.2 Abstract Factory Pattern 2.3 Builder Pattern 2.4 Prototype Pattern 2.5 Singleton Pattern **Unit-3 Structural Patterns** 3.1 Adapter Pattern 3.2 Bridge Pattern 3.3 Composite Pattern 3.4 Decorator Pattern 3.5 Overview of other Structural Patterns - Façade Pattern, Flyweight Pattern, Proxy Pattern **Unit-4 Behavioural Pattern** 4.1 Chain of Responsibility Pattern 4.2 Command Pattern 4.3 Iterator Pattern 4.4 Mediator Pattern

	4.5 Overview of other Behavioural Patterns - Memento Pattern, Observer Pattern, State Pattern, Strategy Pattern, Template Method Pattern, Visitor Pattern **Unit-5 Additional Design Patterns and Patterns Applicability** 5.1 Overview of Additional Patterns - Simple Factory Pattern, Null Object Pattern, MVC Pattern 5.2 Security Patterns Repository 5.3 Patterns for Agile Development 5.4 Relation between patterns and pattern combinations
Reference Books	7. Design Patterns: Elements of Reusable Object-Oriented Software, Erich Gamma, Richard Helm, Ralph, John, Addision Wesley 8. Head First Design Patterns, Eric Freeman, O'Reilly 9. Design Patterns in C#, Vaskaran Sarcar, Apress 10. Design Patterns in Modern C++, Reusable Approaches for Object-Oriented Software Design, Dmitri Nesteruk, Apress 11. Modern C++ design: generic Programming and design patterns applied, Alexendrescu, Andrei, Addison-Wesley 12. Java Design Patterns: A Hands-on Experience with Real-World Examples, Vaskaran Sarcar, Apress
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30 % internal assessment and 70% external assessment

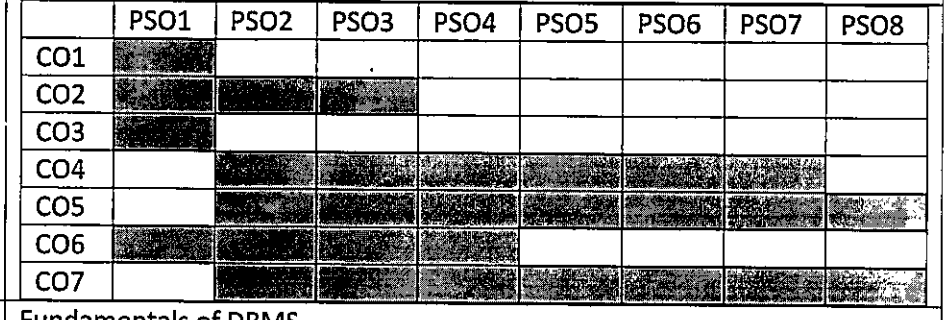
Course: 503: **ERP Using SAP**

Course Code	503
Course Title	**ERP Using SAP**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	June 2020
Purpose of Course	This course imparts fundamental as well as detailed Enterprise Resource Planning using SAP technology platform.
Course Objective	Learn ERP applications and its programming
Course Outcome	CO1 : Explain students the insight of the fundamental aspects of the ERP and SAP. CO2 : Train students to represent declarative knowledge of Sap Application Server and 3-Tier Architecture. CO3 : Train students to understand concepts of Data Dictionary and data structure in ABAP. CO4 : Explain and train students to understand basic concepts of Modularization Technique, Module pool programing, BDC & LSMW and Selection-Screen programming. CO5 : The course emphasizes on teaching SAP implementation as the whole process of transforming ERP business procedures to organization wide requirements. CO6 : After studying this students will be able to understand how to work with ERP modules. After successful completion, students will be able to develop ERP application using SAP.
Mapping between COs with PSOs	
Pre-requisite	Fundamentals of ERP, DBMS
Course Content	**Unit 1: Introduction** 1.1 Introduction to ERP 1.2 Introduction to SAP 1.3 Example: How SAP works in an Organization **Unit 2: Architecture of SAP Application Server** 2.1 3-Tier Architecture 2.2 Application Servers 2.3 Work processes and its Type **Unit 3: Data Dictionary & Data Structures in ABAP** 3.1 Introduction to Data dictionary 3.2 Different Types of Data structures 3.3 Internal Tables and its operation **Unit 4: Modularization Techniques** 4.1 Include Programs 4.2 Subroutines 4.3 Function Module.

	4.4 Types of Function Module(Simple, RFC enabled, BAPI) **Unit 5: List Report, ALV Report** 5.1 Simple List Report 5.2 Interactive List Report 5.3 Events in List Reports 5.4 Field catalog generation in ALV 5.5 Operation on ALV(Sorting, Filtering, Totals, Subtotals, Download, Hide Columns) **Unit 6: Module pool programming / Screen Programming** 6.1 Screen Elements(Simple & Complex) 6.2 Screen Events(PBO/PAI) 6.3 Transactions **Unit 7: Selection-Screen programming** 7.1 Defining Selection Screen. 7.2 User Actions on Selection Screen. 7.3 Events of Selection Screen **Unit 8: Smartform/Sapscript** 8.1 Form printing with smartform 8.2 Form printing with Sapscript **Unit 9: BDC & LSMW** 9.1 Data upload through BDC 9.2 Data upload through LSMW **Unit 10: Enhancement(Exits & BADI)** 10.1 What is Enhancement 10.2 User-Exits 10.3 BADI(Business Add-in)
Reference Books	1. ABAP Cookbook by James Wood 2. BC - ABAP Programming from SAP-AG 3. Teach Yourself ABAP/4 in 21 Days by Ken Greenwood, SAMS 4. SAP Smart Forms by Christoph Wachter, Werner Hertleif 5. SAPscript by Michaelson Buchanan 6. Developing Sap's R/3 Application with Abap/4 7. Data Migration Made Easy - R/3 Simplications Group, SAP Labs 8. ABAP Development for SAP NetWeaver BW: Exits, BAdIs, and Enhancements by Dirk Herzog 9. Next Generation ABAP Development (2nd Edition) by Rich Heilman and Thomas Jung
Teaching Methodology	Discussion, Independent Study, Seminars and Assignment
Evaluation Method	30% Internal assessment is based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 70% assessment is based on semester end University External examination

Course: 503: **NoSQL Databases**

Course Code	503
Course Title	**NoSQL Databases**
Credit	4
Teaching per Week	4
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	June 2020
Purpose of Course	To teach the emerging trends in NoSQL databases
Course Objective	To impart knowledge of NoSQL Databases
Course Outcome	CO1 : Explain students about history, concept , characteristics and types of NoSQL databases CO2: Explain students about the differences between relational databases and NoSQL databases, Advantages and disadvantages of NoSQL databases and application of NoSQL databases CO3: Explain students about fundamentals of MongoDB, MongoDB feature set and Architecture CO4: Train student to create document, collection and databases in MongoDB, use of simple and complex queries to insert, update and view data. CO5: Explain and train student to use MongoDB restful API and applying security CO6: Explain students about Cassandra Architecture, Data modelling in Cassandra and integration of Cassandra with Hadoop CO7: Train student to create and use keyspaces and databases in Cassandra, Also explain and train student about Cassandra administration
Mapping between COs with PSOs	
Pre-requisite	Fundamentals of DBMS
Course Content	**Unit 1: Introduction** 1.1 History 1.2 Concepts and Characteristics of NoSQL databases 1.3 Primary benefits of NoSQL databases **Unit 2: MongoDB** 2.1 SQL/NoSQL landscape 2.2 Document Vs. Other types of Storage 2.3 MongoDB feature set 2.4 Introduction to BSON and JSON 2.5 MongoDB Architecture 2.6 Documents and Collections 2.6.1 Creating Documents 2.6.2 Managing Documents in collections



	2.6.3 Iterating over Documents 2.7 Queries 2.7.1 Simple Queries 2.7.2 Complex Queries 2.7.2.1 Existential field values 2.7.2.2 Aggregations and groups 2.7.2.3 Aggregations and groups in hierarchical data 2.8 Updates and Deletes 2.9 Updates and Arrays 2.10 Indexing 2.11 MongoDB RESTful API 2.12 MongoDB Security 2.13 MongoDB Replication and Sharing 2.14 Introduction to MapReduce **Unit 3: Cassandra** 3.1 Cassandra Architecture 3.1.1 Cassandra P2P Architecture 3.1.2 Clustering Structures- Nodes 3.1.3 Rings 3.1.4 Virtual Nodes 3.1.5 Consistency & Hashing 3.1.6 Gossip Protocol 3.1.7 Data Replication 3.1.8 Replication Factors & Indexes 3.1.9 Tunable Consistency 3.1.10 High & Rapid Scalability Memtables, SStables & Commitlogs 3.1.11 Repairs 3.1.12 Tombstones 3.1.13 Repairs 3.1.14 Replication Factors 3.1.15 Compaction and Anti-Entropy 3.1.16 Bloom Filters 3.2 Data Modelling in Cassandra 3.3 Cassandra Administration 3.4 CQL3 3.5 Integration with Hadoop
Reference Books	1. Chodorow, K. (2013). MongoDB: The Definitive Guide (2nd ed.). Upper Saddle River, NJ: Pearson Education, Inc. ISBN-13: 978-1449344689 ISBN-10: 1449344682. 2. Shashank Tiwari, Professional NoSQL, Sierra Nevada Books, ISBN-13: 978-0470942246 3. Amol Nayak, Instant MongoDB, Packt Publishing Limited, 2013, ISBN-13: 978-1782169703 4. Kristina Chodorow, MongoDB Definitive Guide 2e, O'Reilly, 2013, ISBN-13: 978-1449344689 5. Eben Hewitt, Cassandra Definitive Guide, O'Reilly, 2010, ISBN:ISBN 10:1-4493-9041-2

Teaching Methodology	Classroom, seminar and assignment
Evaluation Method	30% Internal assessment is based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 70% assessment is based on semester end University External examination

Course: 504: **Advanced Database Administration**

Course Code	504
Course Title	**Advanced Database Administration**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks/ Semester	15 (Including Class work, examination, preparation, holidays etc.)
Review / Revision	June 2020
Purpose of Course	Understanding advanced database administration
Course Objective	To learn advanced database administration, database tuning and maintenance
Course Outcome	CO1 : To provide strong foundation in Advanced Database Administration concepts from an industry perspective. CO2 : To have thorough understanding of Oracle Database Management System internal architecture. CO3 : To understand the security aspects and user management. CO4 : To apply and learn various Oracle utilities CO5 : To learn how to practically tune the database to optimize the overall performance. CO6 : To learn and implement Backup and Recovery.
Mapping between COs with PSOs	
Pre-requisite	RDBMS
Course Content	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

Unit 1. Oracle10g Instance creation and management

- 1.1 Oracle Instance
- 1.2 Installing Oracle
- 1.3 Oracle Optimal Flexible Architecture (OFA)
- 1.4. Locating initialization, listener.ora & sqlnet.ora files
- 1.5 Finding the alert log
- 1.6 Common environment variables
- 1.7 Structures in an Oracle Instance
- 1.8 Oracle Memory Structures, SGA and PGA
- 1.9 Oracle Processes and their purposes
- 1.10 Startup, nomount, mount and open database commands

Unit 2. Oracle10g Database Architecture

- 2.1 Oraclde10g management framework
- 2.1 Using the Database Creation Assistant (DBA)
- 2.3 Creating and dropping a database.
- 2.4 Tablespaces
- 2.5 Tables and Indexes
- 2.6 Clusters
- 2.7 Partitioning of Tables and Indexes
- 2.8 Gathering and applying patches

Unit 3. Concurrency Management

- 3.1 Transactions, serialization, locks and latches
- 3.2 Lock modes
- 3.3 Detecting and resolving lock conflicts

3.4 Managing deadlocks

Unit 4. Interfacing with Oracle

4.1 Oracle transaction management
4.2 Using SQL*Plus and iSQL*Plus
4.3 Using embedded Oracle with Pro*C & Java
4.4 PL/SQL & Triggers
4.5 Pining PL/SQL packages & compiling PL/SQL
4.6 System-level triggers – startup trigger, logon trigger, PL/SQL error trigger

Unit 5. Oracle*Net

5.1 Basic Network structure
5.2 Oracle*Net Files
5.3 Multi-threaded server
5.4 Create additional listeners
5.5 Create Oracle Net service aliases
5.6 Configure connect time failover
5.7 Oracle*Net names resolution

Unit 6. Tablespace Management Overview

6.1 Dictionary Managed Tablespaces
6.2 Locally Managed Tablespaces
6.3 Automatic Segment Space Management
6.4 Moving tablespaces online and offline

Unit 7. UNDO Tablespace Management

7.1 Use of undo segments
7.2 Creating an undo tablespace
7.3 User managed undo tablespaces
7.4 Automatic undo management
7.5 Monitor & Configure undo retention
7.6 Use the Undo Advisor
7.7 Size the undo tablespace

Unit 8. Oracle Utilities

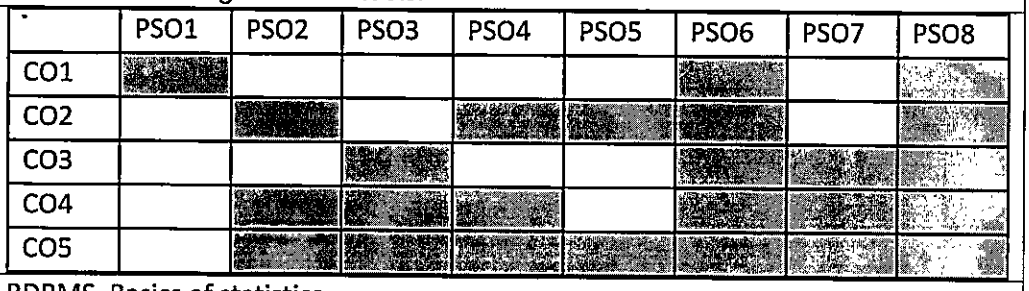
8.1 Datapump - Import/export
8.2 SQL*Loader
8.3 Oracle Streams
8.4 Automatic Database Diagnostic Monitor
8.5 Automatic Tuning Optimizer
8.6 Automatic Shared Memory Tuning

Unit 9. Oracle Performance Tuning

9.1 Locate invalid and unusable objects
9.2 Gather SQL optimizer statistics with dbms_stats
9.3 Basic Oracle performance metrics
9.4 Use OEM and dbms_alert to set warning and critical alert thresholds
9.5 The SQL Tuning Advisor
9.6 The SQL Access Advisor
9.6 Interpreting server generated alerts
9.7 Oracle advisory utilities vdb_cache_advice, vshared pool_advice, v$pga_aggregate_target_advice
9.8 Using OEM performance screens

	9.9 Fixing performance issues **Unit 10. User Management** 10.1 Creating Users 10.2 Altering users 10.3 User Profiles 10.4 User resource groups 10.5 Granting privileges & roles 10.6 Auditing user activity with dbms_audit **Unit 11. Oracle Security** 11.1 Password use in Oracle, Password encryption and password aging, External authentication, Using Single sign-on (SSO) 11.2 Object security 11.3 Virtual Private Databases (VPD) in Oracle 11.4 Oracle "grant execute" security 11.5 Use of Roles in Oracle 11.6 Register for security updates **Unit 12. Backup & Recovery** 12.1 Oracle backup & recovery planning 12.2 Parallel instance recovery 12.3 Basics of checkpoints, redo log files, and archived log files 12.4 Using ARCHIVELOG mode 12.5 Creating consistent Oracle backups 12.6 Online hot backups 12.7 Incremental Oracle backups 12.8 Automating database backups with dbms_scheduler 12.9 Monitor the flash recovery area 12.10 Recovering from loss of a Control file 12.11 Recovering from loss of a Redo log file 12.12 Recovering from loss of a system-critical data file 12.13 Recovering from loss of a non system-critical data file
Reference Books	1. Essentials : Oracle Database 10g by Rick Greenwald, Robert Stackowiak, Jonathan Stern, O'Reilly 2. Oracle High Performance Tuning for 9i and 10g by Gavin Powell, Digital Press 3. Oracle Database 10g, DBA Handbook by Loney, Kevin, Bryla, Bob, Oracle Press 4. Oracle Database 10g - The Complete Reference by Loney, Kevin, Oracle Press 5. Oracle Database 10g: A Beginner's Guide by Micheal Abbey, Ian Abramson Osborne, Oracle Press Series
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment is based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 70% assessment is based on semester end University External examination

Course: 505: **Data Warehousing& Data Mining**

Course Code	505
Course Title	**Data Warehousing & Data Mining**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks/ Semester	15 (Including Class work, examination, preparation, holidays etc.)
Review / Revision	June 2020
Purpose of Course	Understanding Data Warehousing and Data Mining
Course Objective	To understand data warehousing and data mining - concepts and methods, and apply them in practice
Course Outcome	CO1. Explores Differences between Online Transaction Processing and Online Analytical processing System & describe Multidimensional schemas suitable for data warehousing CO2. Explains Data warehousing architectures and tools for organizing able to voluminous data of online processing systematically in Data warehouse/Data Mart and use those data for making strategic decisions CO3. Explains various data pre-processing methods via data reduction, data cleaning, data integration, data transformation etc... CO4. Trains students to extract knowledge using data mining techniques & to discover interesting patterns from large amounts of data for predictions and classification CO5. Trains students to develop a data mining application for data analysis using various algorithms & tools.
Mapping between COs with PSOs	
Pre-requisite	RDBMS, Basics of statistics
Course Content	**Unit 1: Data warehouse: Introduction** 1.1 Data Warehouse characteristics 1.2 Data Marts 1.3 OLTP and OLAP systems 1.4 Star, Snowflakes, and Fact Constellations Schemas for Multi-dimensional Databases 1.5 OLAP Operations in the Multidimensional data model 1.6 Type of OLAP servers **Unit 2: Developing Data Warehouse** 2.1 Building a Data Warehouse 2.2 Three-Tier Data Warehouse Architecture 2.3 Metadata Repository **Unit 3: Data Pre-processing** 3.1 Descriptive Data Summarization: central tendency, disperation of data 3.2 Data Cleaning : missing values, noisy data 3.3 Data Integration & Transformation 3.4 Data Reduction: Attribute selection 3.5 Data Discretization & Concept Hierarchy Generation

	Unit 4: Data Mining: Introduction 4.1 Knowledge discovery and Data Mining. 4.2 Basic Introduction to Data Mining Functionalities: 4.2.1 Concept/Class Description Characterization & Discrimination 4.2.2 Mining Frequent Patterns, Associations, and Correlations 4.2.3 Classification & Prediction 4.3.4 Cluster Analysis 4.2.5 Outlier Analysis 4.2.6 Evolution analysis **Unit 5: Mining Frequent Patterns, Associations, and Correlations** 5.1 Basic concepts: Frequent Itemsets & Closed Itemsets, Association Rules 5.2 The Apriory algorithm: Finding Frequent Itemsets Using Candidate Generation 5.3 FP-growth: Finding Frequent Itemsets without Candidate Generation 5.4 Generating Association Rules from Frequent Itemsets 5.5 Introduction to multilevel and multidimensional Association rules **Unit 6: Classification & Prediction** 6.1 Introduction to Classification & Prediction? 6.2 Prediction: Linear Regression, Nonlinear Regression 6.3 Decision Tree Algorithm 6.3.1 Decision Tree Induction 6.3.2 Attribute Selection Measures- Information Gain and Gain Ratio 6.3.3 Tree Pruning 6.4 Bayesian Classification 6.4.1 Bayes' Theorem 6.4.2 Naïve Bayesian Classification 6.5 Accuracy and Error Measures for classification **Unit 7: Cluster Analysis** 7.1 Classification vs. clustering 7.2 What is Partitioning & Hierarchical Clustering Methods 7.3 Classical Partitioning Methods: k-Means **Unit 8: Application and Trends in Data Mining**
Reference Books	1. Data Mining: Concepts & Techniques by Han & Kamber , Morgan Kaufmann Publishers 2. Introduction to Data Mining with Case Studies by G. K. Gupta, PHI 3. Data Mining Introductory and Advanced Topics by Dunha, Pearson 4. Data Warehouse Toolkit by R. Kinball, John Wiley & Sons 5. Data Warehouses and OLAP: Concepts, Architectures, and Solutions by Robert Wrembel, Christian Koncilia l, GI 6. Data Mining Techniques: For Marketing, Sales, and Customer Relationship Management by Gordon S. Linoff, Michael J. A. Berry, Wiley 7. Data Preparation for Data Mining by Dorian Pyle, Morgan Kaufmann Publishers 8. Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals by Paulraj Ponniah, Wiley 9. Data Warehousing: Concepts, Techniques, Products and Applications by C.S.R. Prabhu, PHI Learning 10. Advanced Data Mining Techniques by David Louis Olson, Dursun Delen, Springer

Teaching Methodology	Class work, Discussion, Self-study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment is based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 70% assessment is based on semester end University External examination

Course: 505: **Big Data**

Course Code	505
Course Title	**Big Data**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks/ Semester	15 (Including Class work, examination, preparation, holidays etc.)
Review / Revision	June 2020
Purpose of Course	Understanding distributed computing, Big Data and Hadoop
Course Objective	To learn Big Bata and Hadoop
Course Outcome	CO1 : Student should be able to understand concept and the building blocks of Big Data CO2 : Student should be able to articulate the programming aspects of cloud computing (map Reduce etc.) CO3 : Access and Process Data on Distributed File System, and to understand big data with the help of different big data applications CO4 : Student must be able to represent the analytical aspects of Big Data CO5 : Students will have understanding of distributed computing and will have hands-on experience on Hadoop CO6 : Student shall know the recent trends related to Hadoop File System, MapReduce etc.
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

Pre-requisite	RDBMS
Course Content	**Unit 1: Introduction** 1.1 Evolution of Big Data 1.2 Structuring Big Data 1.3 Elements of Big Data(V's) 1.4 Big Data Analytics 1.5 Commercial use of Big Data **Unit 2: Big Data Technology** 2.1 Distributed and Parallel Computing 2.2 Introducing Hadoop 2.3 HDFS and MapReduce 2.4 Cloud Computing and Big Data 2.5 In-Memory Computing **Unit 3: Hadoop** 3.1 HDFS Architecture 3.2 Blocks 3.3 Name Nodes and Data Nodes 3.4 Using HDFS Files 3.5 Hadoop Specific File System Types 3.6 HDFS Commands 3.7 org.apache.hadoop.io package 3.8 MapReduce Architecture 3.9 Hadoop YARN

	3.10 HBase 3.11 Combining HBase 3.12 Hive 3.13 Pig and Pig Latin 3.14 Sqoop **Unit 4: Technology Foundations** 4.1 Big Data Stack 4.2 Virtualization and Big Data **Unit 5: Storing Data in Databases and Processing of Data** 5.1 RDBMS and Big Data 5.1.1 CAP Theorem 5.3 NoSQL Databases 5.4 Polygot Persistence 5.5 Integrating Big Data with traditional Data Warehouses 5.6 Big Data Analytics 5.7 Processing Data with MapReduce 5.8 Customizing MapReduce Execution and implementing MapReduce Program 5.9 Testing and Debugging MapReduce Applications 5.10 Analytical Approaches and Tools to Analyze Data
Reference Books	1. D T Editorial services, Big Data Black book, Dreamtech Press, ISBN 978-93-5119-931 2. Alex Holmes, Hadoop in Practice, Manning Publication company, 2014, ISBN 1617292222, 9781617292224 3. Kuan-Ching, Li Hai Jiang, Laurence T. Yang Alfredo Cuzzocrea, Big Data : Algorithms, Analytics and Applications. CRC Press 4. Hu, Wen Chen, Big Data Management, Technologies and Applications, IGI Global 5. Tom White, Hadoop The Definitive Guide, o'Reilly
Teaching Methodology	Class work, Discussion, Self Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment is based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 70% assessment is based on semester end University External examination

Course: 506: **Programming Skills XI**

Course Code	506
Course Title	**Programming Skills XI**
Credit	2
Teaching per Week	3 Hrs.
Minimum weeks/ Semester	15 (Including Lab. work, examination, preparation, holidays etc.)
Review / Revision	June 2020
Purpose of Course	This course helps students to implement the Unix Internals with shell programming/IOT practically.
Course Objective	Learning to implement fundamentals and advanced topics of Unix Internals with Shell Scripting/IOT practically
Pre-requisite	Practical programming in desktop environment / Embedded Technology
Course Outcome	After studying the course, students will be able to practically work on advanced technology platforms of Unix Internals with Shell Scripting /IOT.
Course Content	Practical based on paper no 501. Separate journal to be prepared for this subject based on 501.
Reference Books	-----
Teaching Methodology	Lab work, Practical Programming Exercises (to be documented in a separate journal), Self-study, and/or Assignment
Evaluation Method	30% Internal assessment is based on Lab attendance, practical test, practical internal examination etc. 70% assessment is based on semester end University External practical examination

Course: 507: **Programming Skills XII**

Course Code	507
Course Title	**Programming Skills XII**
Credit	3
Teaching per Week	3 Hrs.
Minimum weeks/ Semester	15 (Including Lab. work, examination, preparation, holidays etc.)
Review / Revision	June 2020
Purpose of Course	This course helps students to implement the concepts of SAP/NoSQL practically
Course Objective	Learning to implement the ERP using SAP/NoSQL databases practically
Pre-requisite	DBMS
Course Outcome	After studying the course, students will be able to practically work on SAP/NoSQL Databases
Course Content	Practical based on paper no 503. Separate journal to be prepared for this subject 503.
Reference Books	-----
Teaching Methodology	Lab work, Practical Programming Exercises (to be documented in a separate journal), Self-study, and/or Assignment
Evaluation Method	30% Internal assessment is based on Lab attendance, practical test, practical internal examination etc. 70% assessment is based on semester end University External practical examination

Course: 508: **Programming Skills XIII**

Course Code	508
Course Title	**Programming Skills XIII**
Credit	2
Teaching per Week	3 Hrs.
Minimum weeks/ Semester	15 (Including Lab. work, examination, preparation, holidays etc.)
Review / Revision	June 2020
Purpose of Course	This course helps students to handle advanced database administration activities
Course Objective	Advanced database administration
Pre-requisite	Practically learning advanced database administration
Course Outcome	After studying the course, students will be able to handle database administration, tuning and maintenance in various fields
Course Content	Practical based on paper no 504. Separate journal to be prepared for this subject 504.
Reference Books	-----
Teaching Methodology	Lab work, Practical Programming Exercises (to be documented in a separate journal), Self-study, and/or Assignment
Evaluation Method	30% Internal assessment is based on Lab attendance, practical test, practical internal examination etc. 70% assessment is based on semester end University External practical examination

Course: 509: **Programming Skills XIV**

Course Code	509
Course Title	**Programming Skills XIV**
Credit	3
Teaching per Week	3 Hrs.
Minimum weeks/ Semester	15 (Including Lab. work, examination, preparation, holidays etc.)
Review / Revision	June 2020
Purpose of Course	This course helps students to implement Data warehousing & data mining / Big Data practically.
Course Objective	Learn to use Data warehousing and data mining techniques in various practical environments / use Big data practically.
Pre-requisite	Databases, SQL, Advanced SQL
Course Outcome	After studying the course, students will be able to understand Data warehousing and data mining/Big Data practically
Course Content	Practical based on paper no 505. Separate journal to be prepared for this subject 505.
Reference Books	-----
Teaching Methodology	Lab work, Practical Programming Exercises (to be documented in a separate journal), Self-study, and/or Assignment
Evaluation Method	30% Internal assessment is based on Lab attendance, practical test, practical internal examination etc. 70% assessment is based on semester end University External practical examination

MCA 3rd Sem

(Network Group)

Course: 301: **Internet of Things (IoT)**

(Elective)

Course Code	301
Course Title	**Internet of Things (IoT)**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Review / Revision	June 2021
Purpose of Course	This course is an introduction for students to IoT. The course also gives students an idea about various components of IoT and explain its working. The course also explains the role of embedded systems in IoT ecosystem.
Course Objective	The objective of the course is - 9. To make student understand IoT 10. To understand the working of Micro-Controller & Micro-Computer 11. To explain various types of sensors 12. To introduce students with Programming in IoT
Course Outcome	CO1: Understand the IoT ecosystem and architecture. Understand IoT standards and protocols. Understand the privacy, security and governance issues in IoT applications. Exposing students with IoT botnet and the risks involved with IoT based applications. CO2: Understand the overview and working of the various sensors used in IoT applications. Introduce and Explain various network communication protocols, standards and IoT data Protocols. Understanding the Wireless Sensor Network and how IoT devices communicate with each other. CO3: Understand Micro-Controller and its architecture. Understand the usage of Micro-Controller in IoT applications. Understand how Arduino and NodeMCU interact with sensors and communicate over the network. CO4: Understand Micro-Computer and its architecture. Understand the difference between a Micro-Controller and Micro-Computer. Understand the usage of Micro-Computer in IoT applications. Understand how Raspberry Pi interact with sensors and communicate over the network. CO5:Expose the students with Server-side development in IoT applications. Understand how to develop and deploy applications in Arduino and NodeMCU. Understand how Arduino and NodeMCU communicate among themselves, sensors and the server. Understand how to build a full IoT app by integrating them with mobile applications.
Mapping between COs with PSOs	
Pre-requisite	C , C++
Course Content	**Unit 1: Introduction to IoT** 1.1 What is IoT 1.2 IoT Applications 1.3 IoT Privacy and Security 1.3.1 Identification in Distributed Environment 1.3.2 Device Authentication 1.4 IoT Botnet

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								

	Unit 2: Networking and Communication 2.1 Basics of Wireless Networking 2.1.1 CSMA/CA 2.2 IoT Network Protocols 2.2.1 BLE, Zigbee, LoRaWAN, RFID 2.3 IoT Data Protocols 2.3.1 CoAP, MQTT, XMPP, DDS **Unit 3: Sensors** 3.1 Introduction to Sensors 3.2 Types of Sensors & their working 3.3 Wireless Sensor Network 3.3.1 Introduction to WSN 3.3.2 Applications 3.3.3 Characteristics 3.3.4 Challenges 3.3.5 Components 3.4 Wireless Adhoc Network Vs Wireless Sensor Network **Unit 4: Micro-Controller: Arduino, NodeMCU** 4.1 Introduction to Microcontrollers 4.2 Arduino IDE 4.3 Arduino Architecture 4.4 Arduino Pin Diagram 4.5 Introduction to NodeMCU 4.6 NodeMCU Specifications and Applications 4.7 NodeMCU ESP8266 Pinout **Unit 5: IoT App Interaction & Introduction to Raspberry Pi** 5.1 Uploading sensor data to server 5.2 Reading sensor data from server 5.3 Controlling IoT device and components from Mobile or Web 5.4 Introduction to Microcomputers 5.5 Raspberry Pi Architecture 5.6 Raspberry Pi Pinout
Reference Books	1) Getting Started with Internet of Things – By Cuno Pfister, O'Reilly 2) Learning Internet of Things – By Peter Waher , Packt Publication 3) Internet of Things : A Hands-on Approach – By Arshdip Bahga and Vijay Madisetti 4) IoT Governance, Privacy and Security Issues, IERC 5) IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things, Cisco Press 6) Fundamentals of IoT Communication Technologies, Springer 7) Microcontrollers – Architecture, Programming, Interfacing and system design – By Raj Kamal , Pearson 8) Exploring C for Microcontrollers : A hands on approach, Springer 9) Arduino for Dummies, Wiley 10) Make: Getting Started With Arduino - The Open Source Electronics Prototyping Platform, Shroff/Maker Media 11) ESP8266: Get Started With ESP8266 Programming NodeMCU Using Arduino IDE, Createspace Independent Pub 12) Internet of Things Projects with ESP32, Packt Publishing Limited

	13) Microprocessor Architecture, Programming and Applications with the 8085 - By Ramesh Gaonkar , Penram International Publishing 14) Raspberry Pi for Dummies , Wiley 15) Raspberry Pi User Guide – By Eben Upton and Garath Halfacree, Wiley
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment is based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 70% assessment is based on semester end University External examination

Course: 301: **Machine Learning**

(Elective)

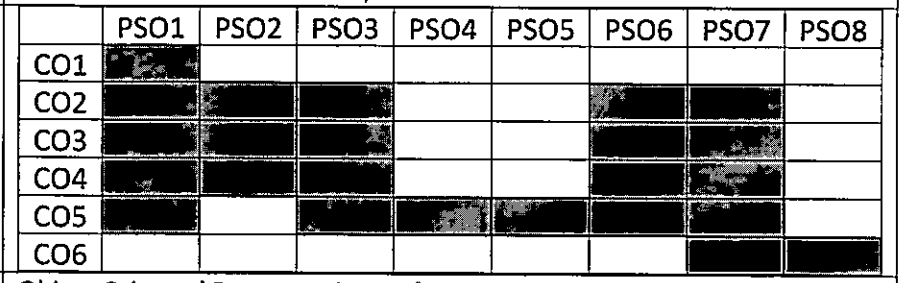
Course Code	301
Course Title	**Machine Learning (ML)**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Review / Revision	June 2021
Purpose of Course	This course is an introduction for students to ML. The course also gives students an idea about various methods and algorithms of Machine Learning and application development of ML.
Course Objective	The objective of the course is – 1. To make student understand ML 2. To understand the various Machine Learning method 3. To explain various algorithms used in Machine learning 4. To introduce students with Programming in ML
Course Outcome	CO1 : Explain to the students the fundamental know how like the types of machine learning algorithms, applications and various required libraries, model selection etc. required to implement machine learning algorithms. CO2 : Train students with can utilize various data wrangling techniques, data cleaning, data transformation, data reduction, data discretization, feature selection, and data visualization CO3 : Train students who can implement supervised learning algorithms utilizing regression and classification algorithm on the real world dataset. CO4 : Train student to have understanding of Artificial Neural Network and its working. Also, to make them capable of implementing ANN for solving real world problems using it. CO5 : Explain to the students to use clustering and association rules as unsupervised learning method to solve complex problems. CO6 : Train students to use machine learning techniques to solve real life complex problems.
Mapping between COs with PSOs	
Pre-requisite	Basics of Linear Algebra, Statistics and Mathematics, Python Programming
Course Content	**Unit 1 : Introduction** 1.1. Definition of Machine Learning 1.2 Types of Machine Learning : Supervised , Unsupervised and Semi-supervised 1.3 Applications and tools of Machine Learning (Scikit learn library)

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

	1.4 Selecting a model and training a model 1.5 Evaluating a performance of model and improving performance 1.6 Ethic standards while implementing ML model 1.7 MLOps level 0 and level 1 1.8 Characteristics of MLOps level 0 , level 1 **Unit 2 : Data Wrangling** 2.1 Definition and goal of Data Wrangling 2.2 Importance of Data Wrangling 2.3 Data Pre-processing and Data Cleaning 2.3.1 Data Cleaning 2.3.2 Data Transformation 2.3.3 Data Reduction 2.3.4 Data Discretization 2.3.5 Feature Selection 2.4 Data Visualization **Unit 3 : Supervised Learning** 3.1 Supervised Learning : Classification and Regression 3.2 Regression 3.2.1 Simple and Multiple Regression 3.2.2 Linear Regression 3.2.3 Gradient Decent 3.2.4 Logistic Regression 3.3 Classification Algorithms : 3.3.1 K-nearest Neighbour 3.3.2 Support Vector Machines 3.3.3 Decision Trees 3.3.4 Naïve Bayes Classifier 3.4 Introduction to Support Vector Machine **Unit 4 : Neural Network** 4.1 Introduction to Neural Network 4.2 Architecture of Neural Network 4.3 Feedforward network and Backpropagation with example 4.4 Applications of Neural Network **Unit 5 : Unsupervised Learning** 5.1 Introduction to Unsupervised learning 5.2 Clustering 5.2.1 Selection of Clusters 5.2.2 Algorithms : 5.2.2.1 K – means clustering 5.2.2.2 Hierarchical Clustering 5.3 Association Rule Learning 5.3.1 Algorithms : 5.3.1.1 FP- Growth 5.3.1.2 Apriori Algorithm
Reference Books	1. "Machine Learning" by Tom M. Mitchell, McGraw Hill 2. "Understanding Machine Learning" by Shai Shalev-Shwartz, Shai

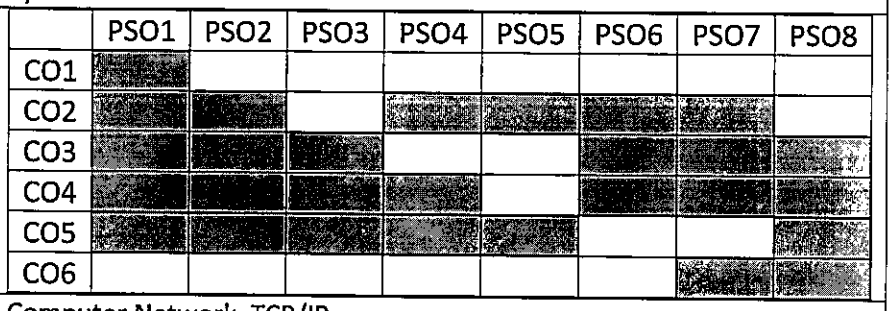
	Ben-David 3. "Machine Learning" by Anuradha Srinivasaraghavan, Vincy Joseph 4. "Machine Learning using Python" by U Dinesh Kumar Manaranjan Pradhan 5. "Real-World Machine Learning" by Henrik Brink, Joseph Richards, Mark Fetherolf 6. "Python Machine Learning" by Sebastian Raschka and Vahid Mirjalili 7. "Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems" by Aurelien Geron 8. "Machine Learning in Action" by Peter Harrington 9. "Introduction to Machine Learning with Python : A Guide for Data Scientists" by Andreas C. Muller, Sarah Guido
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment is based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 70% assessment is based on semester end University External examination

Course: 302: **Design Patterns**

Course Code	302
Course Title	**Design Patterns**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Review / Revision	June 2021
Purpose of Course	The purpose of the course is to make student understand how Patterns can be implemented in various object oriented programming languages to solve real world problems.
Course Objective	The objective of the course is - 5. To study various Design Patterns 6. How these Patterns can be used to design better systems through Object Oriented Programming Languages
Course Outcome	CO1: Explain students about the various design patterns; their categories, and purpose. CO2: Explain the creational design patterns. CO3: Explain the structural design patterns. CO4: Explain the behavioural design patterns. CO5: Explain some more design patterns used in IT industry currently. CO6: Make students understand the applicability of design patterns practiced by IT companies and how effectively combine these patterns for effective software development.
Mapping between COs with PSOs	
Pre-requisite	Object Oriented Programming, Software Engineering
Course Content	**Unit -1 Introduction to Design Patterns** 1.1 What's a Design Pattern 1.2 Benefits of Design Patterns 1.3 Software Design Principles 1.4 SOLID Principles **Unit-2 Creational Patterns** 2.1 Factory Method Pattern 2.2 Abstract Factory Pattern ' 2.3 Builder Pattern 2.4 Prototype Pattern 2.5 Singleton Pattern **Unit-3 Structural Patterns** 3.1 Adapter Pattern 3.2 Bridge Pattern 3.3 Composite Pattern 3.4 Decorator Pattern 3.5 Overview of other Structural Patterns - Façade Pattern, Flyweight Pattern, Proxy Pattern **Unit-4 Behavioural Pattern** 4.1 Chain of Responsibility Pattern 4.2 Command Pattern 4.3 Iterator Pattern

	4.4 Mediator Pattern 4.5 Overview of other Behavioural Patterns - Memento Pattern, Observer Pattern, State Pattern, Strategy Pattern, Template Method Pattern, Visitor Pattern **Unit-5 Additional Design Patterns and Patterns Applicability** 5.1 Overview of Additional Patterns - Simple Factory Pattern, Null Object Pattern, MVC Pattern 5.2 Security Patterns Repository 5.3 Patterns for Agile Development 5.4 Relation between patterns and pattern combinations
Reference Books	13. Design Patterns: Elements of Reusable Object-Oriented Software, Erich Gamma, Richard Helm, Ralph, John, Addision Wesley 14. Head First Design Patterns, Eric Freeman, O'Reilly 15. Design Patterns in C#, Vaskaran Sarcar, Apress 16. Design Patterns in Modern C++, Reusable Approaches for Object-Oriented Software Design, Dmitri Nesteruk, Apress 17. Modern C++ design: generic Programming and design patterns applied, Alexendrescu, Andrei, Addison-Wesley 18. Java Design Patterns: A Hands-on Experience with Real-World Examples, Vaskaran Sarcar, Apress
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30 % internal assessment and 70% external assessment

Course: 503: **Network Essentials and its Security**

Course Code	503
Course Title	**Network Essentials and its Security**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Review / Revision	June 2020
Purpose of Course	To make students learn Network essentials and various security measures for the challenges to which the IT industry is exposed
Course Objective	To understand Network Management and its security
Course Outcomes	CO1: Explain students familiar about network essentials. Make them familiar with various network devices like repeaters, bridge router, and gateway. CO2: Explain how to administer computer network. Make them understand various wide area network techniques, and explain network security. CO3: To understand cryptography, PKI, and digital signatures. CO4: Familiarize with various security services, and how certification and key management is handled in PKI. CO5: To make students understand various network security applications; covering internet protocol security, web security, email security, network management and its security. CO6: Make students understand access control, authentication schemes, firewalls, and virtual private network. Also to learn intrusion detection, virus and mobile and e-commerce security systems.
Mapping between COs with PSOs	
Pre-requisite	Computer Network, TCP/IP
Course Content	**Unit 1: Network Essentials** 1.1 Repeaters & Bridges 1.1.1 LAN Expansion 1.1.2 Repeaters 1.1.3 Bridges 1.1.4 How Bridges Work 1.1.5 Creating the routing table 1.1.6 Segmenting Network Traffic 1.1.7 Remote Bridges 1.1.8 Differentiating between bridges and repeaters 1.2 Routers & Gateways 1.2.1 Routers 1.2.2 How routers work 1.2.3 Routing benefits 1.2.4 Routing protocols 1.2.5 Routing V/S Bridging 1.2.6 B Routers 1.2.7 Gateways

1.2.8 How Gateways work

1.3 Network Administration

1.3.1 Bottlenecks

1.3.2 Simple Network Management Protocol

1.3.3 Data Protection

1.3.4 Backup Methods

1.3.5 Testing and Storage

1.3.6 Implementing a Backup System

1.3.7 Uninterruptible Power Suppliers

1.3.8 How Gateways work

1.3.9 Implementing Fault Tolerant Systems

1.3.10 RAID

1.3.11 Sector Sparing

1.4 Advance WAN Transmission

1.4.1 Overview

1.4.2 Multiplexing, Packet and Circuit Switching Networks

1.4.3 X.25

1.4.4 Asynchronous Transfer Mode (ATM)

1.4.5 ISDN

1.4.6 SONET

1.4.7 SMDS

Unit 2: Introduction to Network Security

Unit 3: Cryptography Techniques

3.1 Classical Cryptography

3.2 Conventional Cryptography

3.2.1 DES

3.3 Public – key Cryptography

3.3.1 RSA

3.4 Digital Signatures

3.4.1 DSA

Unit 4: Security Services

12.1 Message Integrity

12.2 Confidentiality and Authentication

12.3 Certification and Key Management

4.3.1 PKI

Unit 5: Network Security Applications

5.1 IP Security

5.1.1 IPsec

5.2 Web Security

5.2.1 SSL, TLS, SET

5.3 Electronic Mail Security

5.3.1 PGP, S/MIME

5.4 SNMP Security

Unit 6: Access Control in Computer Networks

6.1 Authentication Protocols and Services

6.1.1 Kerberos and X.509

6.2 Firewalls

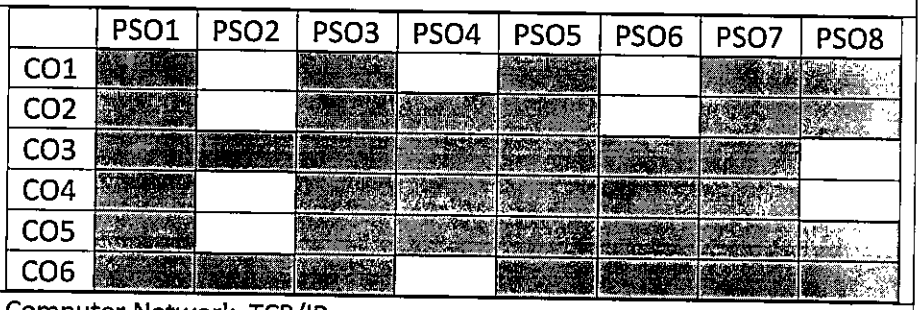
6.3 Virtual Private Networks (VPNs)

Unit 7: System Security

7.1 Intrusion detection

	7.2 Viruses **Unit 8: Mobile System & E-Commerce Securities** 8.1 3G Security 8.2 E-Payment Systems 8.3 Fair Data Exchange
Reference Books	1) Cryptography and Network Security, 2/e, ISBN: 0-13-869017-0 - W. Stallings - Pearson Education, 1999 2) Network Security Essentials: Applications and Standards, 1/e, ISBN: 0-13-016093-8 - W. Stallings - Pearson Education, 2000 3) SSL and TLS: designing and building secure systems, ISBN: 0-201-61598-3 - E. Rescorla - Addison-Wesley, 2001 4) Implementing Secure Intranets and Extranets, ISBN: 0-89006-447-4 - K M Phaltankar - Artech House Publishers, 2000 5) Secure Electronic Commerce: Building the Infrastructure for Digital Signature and Encryption, ISBN: 0-13-027276-0 - W. Ford, and M. Baum - Prentice Hall, 2001 6) Security in Computing, ISBN: 0-13-185794-0, 2/e - C. P. Pfleeger - Prentice Hall, 1997 7) Building Internet Firewalls, 2/e, ISBN: 1-56592-871-7 - E. D. Zwicky, et al - O'Reilly, 2000 8) CDMA Cellular Mobile Communications & Network Security, ISBN: 0-13-598418-1 - M. Y. Rhee, - Prentice Hall, 1998 9) Journal of Computer Security 10) ACM Transactions on Information and System Security 11) ACM Conference on Computer and Communications Security 12) IEEE Symposium on Security and Privacy 13) Internet documents - RFCs (Request for Comments) 14) Guide to Networking Essentials, Fourth Edition - Greg Tomsho, et al 15) Computer Networking Essentials - Debra Littlejohn Shinder 16) Networking Essentials: Hands-On, Self-Paced Training for Supporting Local and Wide Area Networks - Microsoft Corporation (Corporate Author) 17) Computer Network - A. S. Tanenbaum
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment is based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 70% assessment is based on semester end University External examination

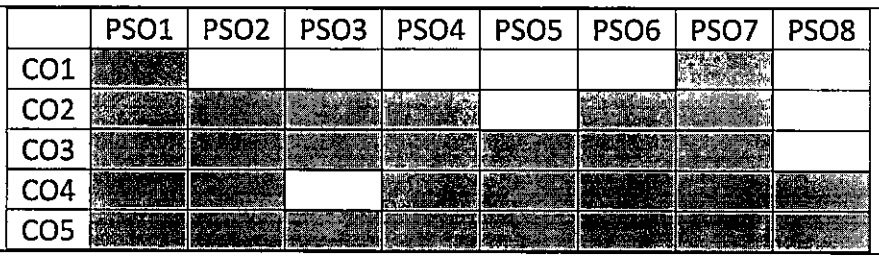
Course: 504: **Network Administration**

Course Code	504
Course Title	**Network Administration**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Review / Revision	June 2020
Purpose of Course	Understanding advanced network administration
Course Objective	To learn advanced network administration, its configuration and maintenance
Course Outcomes	CO1: Understand networking fundamentals and networking using tcp/ip protocol. CO2: Learn network management using dhcp, dns, and nfs. CO3: Learn network management using Linux os; and also remote administration. CO4: Understand administration services, task automation and cron daemon on Linux. CO5: Understand samba service and its configuration CO6: Learn to configure and use system wide logging and network information service
Mapping between COs with PSOs	
Pre-requisite	Computer Network, TCP/IP
Course Content	**Unit 1: Networking and TCP/IP on Linux** a. Fundamentals of Linux Networking b. Fundamentals of TCP/IP on the Linux Operating System c. Advanced Linux TCP/IP Concepts d. Introduction to Dial-up Technologies **Unit 2: Dynamic Host Configuration Protocol** 2.1 Introduction to BOOTP and DHCP 2.2 Installing and Examining a Linux DHCP server 2.3 Examining Additional DHCP Options and Configurations **Unit 3: Domain Name System** 3.1 Introduction to the Domain Name System 3.2 Installing and Configuring DNS **Unit 4: The Network File System** 4.1 Introduction to the Network File System 4.2 Configuring NFS **Unit 5: Linux Remote Administration** 5.1 Introduction to Remote Administration 5.2 The Telnet Protocol 5.3 The open secure Shell protocol

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

	Unit 6: The Cron Daemon 6.1 Introduction to Automation 6.2 Configuring the Cron Daemon **Unit 7: Samba** 7.1 Introduction to Samba 7.2 Cross-Platform Connectivity 7.3 Installing and Configuring Samba **Unit 8: Linux System-Wide Logging** 8.1 Introduction to System-wide Logging 8.2 Configuring System-Logging **Unit 9: The Network Information Service** 9.1 Introduction to NIS 9.2 Setting Up and Configuring an NIS server
Reference Books	1) TCP/IP Network Administration - Craig Hunt - O'Reilly & Associates 2) Managing NFS and NIS - Hal Stern - O'Reilly & Associates 3) DNS and BIND - Albitz/Liu - O'Reilly & Associates 4) Sendmail - Bryan Costales/Eric , Allman/Neil Rickert - O'Reilly & Associates 5) UNIX System Administration Handbook - Second Edition - Nemeth/Snyder/Seebass - Prentice Hall 6) Red Hat Linux Networking and System Administration – Terry Collings, Kurt Wall 7) Red Hat Linux 9 Bible - Christopher Negus 8) Official Red Hat Linux User's Guide - Red Hat Inc. 9) Official Red Hat Linux Administrator's Guide - Red Hat Inc. 10) Red Hat Linux Security and Optimization - Mohammad J. Kabir
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment is based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 70% assessment is based on semester end University External examination

Course: 505: **Wireless Network and Mobile Computing**

Course Code	505
Course Title	**Wireless Network and Mobile Computing**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Review / Revision	June 2020
Purpose of Course	Understanding Wireless Network and Mobile Computing
Course Objective	To understand various aspects related to Wireless Network technologies, mobile networks and its computing
Course Outcomes	CO1: Make students learn fundamentals of wireless technologies. CO2: Make students learn W-LAN technologies, and explain its implementation. CO3: To understand hardware, its implementation and protocols for wireless network. CO4: Explain MANET, its applications, protocols associated, and routing algorithms. CO5: Learn mobile computing and its architecture. Also learn GSM, GPRS and WAP.
Mapping between COs with PSOs	
Pre-requisite	Computer Network
Course Content	**Unit 1: Introduction to Wireless Network Technologies** 1.1 Introduction 1.2 Standards 1.3 Emerging Technologies 1.4 OSI Basics 1.5 LAN Basics 1.6 LAN & WAN Protocols 1.7 Internet Protocol **Unit 2: Wireless LAN Technologies, Implementation and Layers** 2.1 Frequency Hopping Spread Spectrum 2.2 Direct Sequence Spread Spectrum (DSSS) 2.3 Interference 2.4 RF Math 2.5 Service Sets 2.6 Mobile IP 2.7 Appropriate use and design of wireless NetworkingMultipath 2.8 Co-location 2.9 Power-over-Ethernet (PoE) 2.10 Modulation and Bit Coding 2.11 Fragmentation 2.12 SIFS / PIFS / DIFS / EIFS **Unit 3: Hardware Configuration, Implementation and Protocols** 3.1 Access Points

	3.2 Bridges 3.3 Workgroup bridges 3.4 Wireless Residential Gateways 3.5 Host Connectivity 3.6 Antennas, Cables, & Connectors 3.7 MAC and Routing Protocols for IEEE 802.11 3.8 Wireless Mesh Networks **Unit 4: MANET** 4.1. Various applications of MANET 4.2. Destination- Sequenced Distance Vector protocol 4.3. Dynamic Source Routing protocol 4.4. Ad Hoc On-Demand Distance-Vector protocol 4.5. Link Reversal Routing a. Gafni-Bertsekas algorithm b. Lightweight mobile routing algorithm. 4.6. Temporally ordered routing algorithm **Unit 5: Introduction to Mobile Computing, GSM, GPRS & WAP** 5.1 Mobility, Nomadic, Mobile and Ubiquitous computing 5.2 Mobile Computing Architecture 5.3 Mobile Computing Technologies (Hardware, Software, Communication) 5.4 Introduction to GSM 5.5 GSM Architecture, Mobility Management, Network Signaling 5.6 GPRS Architecture 5.7 Network Nodes 5.8 Mobile Internet Standards, WAP Gateway and Protocols 5.9 WML
Reference Books	1) Wireless Local Area Network Fundamentals - Pejman Roshan, Jonathan Leary 2) Wireless Networks First Step (First-step series) - Jim Geier 3) 802.11 wireless network site surveying and installation - Bruce Alexander 4) Introduction to Wireless and Mobile Systems by Cengage Learning (Thompson) 5) J. Schiller, Mobile Communications, Addison –Wesley, 2003 6) Wi-Fi Security - Stewart Miller 7) Wireless and Mobile Network - Architecture Yi-Bing Lin & Imrich Chlamtac - John Wiley & Sons, 2001 8) Mobile and Wireless Design Essentials by Martyn Mallick, John Wiley & Sons 9) Guide to Designing and Implementing wireless LANs - Mark Ciampa - Thomson learning , Vikas Publishing House, 2001 10) Wireless Web Development - Ray Rischapter - Springer publishing, 2000
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment is based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 70% assessment is based on semester end University External examination

Course: 506: **Programming Skills XI**

Course Code	506
Course Title	**Programming Skills XI**
Credit	2
Teaching per Week	3 Hrs.
Minimum weeks/ Semester	15 (Including Lab. work, examination, preparation, holidays etc.)
Review / Revision	June 2020
Purpose of Course	This course helps students to implement the Unix Internals with shell programming/IOT practically.
Course Objective	Learning to implement fundamentals and advanced topics of Unix Internals with Shell Scripting/IOT practically
Pre-requisite	Practical programming in desktop environment / Embedded Technology
Course Outcome	After studying the course, students will be able to practically work on advanced technology platforms of Unix Internals with Shell Scripting /IOT.
Course Content	Practical based on paper no 501. Separate journal to be prepared for this subject based on 501.
Reference Books	-----
Teaching Methodology	Lab work, Practical Programming Exercises (to be documented in a separate journal), Self-study, and/or Assignment
Evaluation Method	30% Internal assessment is based on Lab attendance, practical test, practical internal examination etc. 70% assessment is based on semester end University External practical examination

Course: 507: **Programming Skills XII**

Course Code	507
Course Title	**Programming Skills XII**
Credit	3
Teaching per Week	3 Hrs.
Minimum weeks/ Semester	15 (Including Lab. work, examination, preparation, holidays etc.)
Review / Revision	June 2020
Purpose of Course	This course helps students to understand the Networking and its security practically
Course Objective	Learning to implement Network and its security practically.
Pre-requisite	Network fundamentals
Course Outcome	After studying the course, students will be able to practically implement network and its security
Course Content	Practical based on paper no 503. Separate journal to be prepared for this subject 503.
Reference Books	-----
Teaching Methodology	Lab work, Practical Exercises (to be documented in a separate journal), Self-study, and/or Assignment
Evaluation Method	30% Internal assessment is based on Lab attendance, practical test, practical internal examination etc. 70% assessment is based on semester end University External practical examination

Course: 508: **Programming Skills XIII**

Course Code	508
Course Title	**Programming Skills XIII**
Credit	2
Teaching per Week	3 Hrs.
Minimum weeks/ Semester	15 (Including Lab. work, examination, preparation, holidays etc.)
Review / Revision	June 2020
Purpose of Course	This course helps students to learn network administration
Course Objective	Students will learn administration of network practically
Pre-requisite	Networking fundamentals
Course Outcome	After studying the course, students will be able to practically perform administrative tasks of networks practically
Course Content	Practical based on paper no 504. Separate journal to be prepared for this subject 504.
Reference Books	-----
Teaching Methodology	Lab work, Practical Exercises (to be documented in a separate journal), Self-study, and/or Assignment
Evaluation Method	30% Internal assessment is based on Lab attendance, practical test, practical internal examination etc. 70% assessment is based on semester end University External practical examination

Course: 509: **Programming Skills XIV**

Course Code	509
Course Title	**Programming Skills XIV**
Credit	3
Teaching per Week	3 Hrs.
Minimum weeks/ Semester	15 (Including Lab. work, examination, preparation, holidays etc.)
Review / Revision	June 2020
Purpose of Course	This course helps students to implement the basic and advanced concepts of wireless network and mobile computing
Course Objective	Learning wireless protocols and its implementation practically
Pre-requisite	Computer Network, C/C++ programming
Course Outcome	After studying the course, students will be able to practically develop/enhance wireless protocols and find better solutions application to the various industries dependent upon them
Course Content	Practical based on paper no 505. Separate journal to be prepared for this subject 505.
Reference Books	-----
Teaching Methodology	Lab work, Practical Exercises (to be documented in a separate journal), Self-study, and/or Assignment
Evaluation Method	30% Internal assessment is based on Lab attendance, practical test, practical internal examination etc. 70% assessment is based on semester end University External practical examination

MCA 3rd Sem. (General Group)

Course: 301: **Internet of Things (IoT)**

(Elective)

Course Code	301
Course Title	**Internet of Things (IoT)**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Review / Revision	June 2021
Purpose of Course	This course is an introduction for students to IoT. The course also gives students an idea about various components of IoT and explain its working. The course also explains the role of embedded systems in IoT ecosystem.
Course Objective	The objective of the course is - 13. To make student understand IoT 14. To understand the working of Micro-Controller & Micro-Computer 15. To explain various types of sensors 16. To introduce students with Programming in IoT
Course Outcome	CO1: Understand the IoT ecosystem and architecture. Understand IoT standards and protocols. Understand the privacy, security and governance issues in IoT applications. Exposing students with IoT botnet and the risks involved with IoT based applications. CO2: Understand the overview and working of the various sensors used in IoT applications. Introduce and Explain various network communication protocols, standards and IoT data Protocols. Understanding the Wireless Sensor Network and how IoT devices communicate with each other. CO3: Understand Micro-Controller and its architecture. Understand the usage of Micro-Controller in IoT applications. Understand how Arduino and NodeMCU interact with sensors and communicate over the network. CO4: Understand Micro-Computer and its architecture. Understand the difference between a Micro-Controller and Micro-Computer. Understand the usage of Micro-Computer in IoT applications. Understand how Raspberry Pi interact with sensors and communicate over the network. CO5:Expose the students with Server-side development in IoT applications. Understand how to develop and deploy applications in Arduino and NodeMCU. Understand how Arduino and NodeMCU communicate among themselves, sensors and the server. Understand how to build a full IoT app by integrating them with mobile applications.
Mapping between COs with PSOs	
Pre-requisite	C , C++
Course Content	**Unit 1: Introduction to IoT** 1.1 What is IoT 1.2 IoT Applications 1.3 IoT Privacy and Security 1.3.1 Identification in Distributed Environment 1.3.2 Device Authentication 1.4 IoT Botnet

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								

	Unit 2: Networking and Communication 2.1 Basics of Wireless Networking 2.1.1 CSMA/CA 2.2 IoT Network Protocols 2.2.1 BLE, Zigbee, LoRaWAN, RFID 2.3 IoT Data Protocols 2.3.1 CoAP, MQTT, XMPP, DDS **Unit 3: Sensors** 3.1 Introduction to Sensors 3.2 Types of Sensors & their working 3.3 Wireless Sensor Network 3.3.1 Introduction to WSN 3.3.2 Applications 3.3.3 Characteristics 3.3.4 Challenges 3.3.5 Components 3.4 Wireless Adhoc Network Vs Wireless Sensor Network **Unit 4: Micro-Controller: Arduino, NodeMCU** 4.1 Introduction to Microcontrollers 4.2 Arduino IDE 4.3 Arduino Architecture 4.4 Arduino Pin Diagram 4.5 Introduction to NodeMCU 4.6 NodeMCU Specifications and Applications 4.7 NodeMCU ESP8266 Pinout **Unit 5: IoT App Interaction & Introduction to Raspberry Pi** 5.1 Uploading sensor data to server 5.2 Reading sensor data from server 5.3 Controlling IoT device and components from Mobile or Web 5.4 Introduction to Microcomputers 5.5 Raspberry Pi Architecture 5.6 Raspberry Pi Pinout
Reference Books	1) Getting Started with Internet of Things – By Cuno Pfister, O'Reilly 2) Learning Internet of Things – By Peter Waher , Packt Publication 3) Internet of Things : A Hands-on Approach – By Arshdip Bahga and Vijay Madisetti 4) IoT Governance, Privacy and Security Issues, IERC 5) IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things, Cisco Press 6) Fundamentals of IoT Communication Technologies, Springer 7) Microcontrollers – Architecture, Programming, Interfacing and system design – By Raj Kamal , Pearson 8) Exploring C for Microcontrollers : A hands on approach, Springer 9) Arduino for Dummies, Wiley 10) Make: Getting Started With Arduino - The Open Source Electronics Prototyping Platform, Shroff/Maker Media 11) ESP8266: Get Started With ESP8266 Programming NodeMCU Using Arduino IDE, Createspace Independent Pub 12) Internet of Things Projects with ESP32, Packt Publishing Limited

	13) Microprocessor Architecture, Programming and Applications with the 8085 - By Ramesh Gaonkar , Penram International Publishing 14) Raspberry Pi for Dummies , Wiley 15) Raspberry Pi User Guide – By Eben Upton and Garath Halfacree, Wiley
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment is based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 70% assessment is based on semester end University External examination

Course: 301: **Machine Learning**

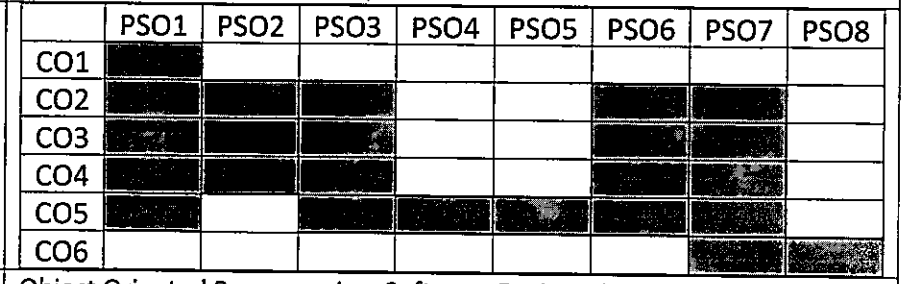
(Elective)

<table>
<tr><td>Course Code</td><td>301</td></tr>
<tr><td>Course Title</td><td>Machine Learning (ML)</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per Week</td><td>4 Hrs.</td></tr>
<tr><td>Minimum weeks per Semester</td><td>15 (Including Class work, examination, preparation, holidays etc.)</td></tr>
<tr><td>Review / Revision</td><td>June 2021</td></tr>
<tr><td>Purpose of Course</td><td>This course is an introduction for students to ML. The course also gives students an idea about various methods and algorithms of Machine Learning and application development of ML.</td></tr>
<tr><td>Course Objective</td><td>The objective of the course is –
1. To make student understand ML
2. To understand the various Machine Learning method
3. To explain various algorithms used in Machine learning
4. To introduce students with Programming in ML</td></tr>
<tr><td>Course Outcome</td><td>CO1 : Explain to the students the fundamental know how like the types of machine learning algorithms, applications and various required libraries, model selection etc. required to implement machine learning algorithms.
CO2 : Train students with can utilize various data wrangling techniques, data cleaning, data transformation, data reduction, data discretization, feature selection, and data visualization
CO3 : Train students who can implement supervised learning algorithms utilizing regression and classification algorithm on the real world dataset.
CO4 : Train student to have understanding of Artificial Neural Network and its working. Also, to make them capable of implementing ANN for solving real world problems using it.
CO5 : Explain to the students to use clustering and association rules as unsupervised learning method to solve complex problems.
CO6 : Train students to use machine learning techniques to solve real life complex problems.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th><th>PSO7</th><th>PSO8</th></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Pre-requisite</td><td>Basics of Linear Algebra, Statistics and Mathematics, Python Programming</td></tr>
<tr><td>Course Content</td><td>Unit 1 : Introduction
1.1. Definition of Machine Learning
1.2 Types of Machine Learning : Supervised , Unsupervised and Semi-supervised
1.3 Applications and tools of Machine Learning (Scikit learn library)</td></tr>
</table>

	1.4 Selecting a model and training a model 1.5 Evaluating a performance of model and improving performance 1.6 Ethic standards while implementing ML model 1.7 MLOps level 0 and level 1 1.8 Characteristics of MLOps level 0 , level 1 **Unit 2 : Data Wrangling** 2.1 Definition and goal of Data Wrangling 2.2 Importance of Data Wrangling 2.3 Data Pre-processing and Data Cleaning 2.3.1 Data Cleaning 2.3.2 Data Transformation 2.3.3 Data Reduction 2.3.4 Data Discretization 2.3.5 Feature Selection 2.4 Data Visualization **Unit 3 : Supervised Learning** 3.1 Supervised Learning : Classification and Regression 3.2 Regression 3.2.1 Simple and Multiple Regression 3.2.2 Linear Regression 3.2.3 Gradient Decent 3.2.4 Logistic Regression 3.3 Classification Algorithms : 3.3.1 K-nearest Neighbour 3.3.2 Support Vector Machines 3.3.3 Decision Trees 3.3.4 Naïve Bayes Classifier 3.4 Introduction to Support Vector Machine **Unit 4 : Neural Network** 4.1 Introduction to Neural Network 4.2 Architecture of Neural Network 4.3 Feedforward network and Backpropagation with example 4.4 Applications of Neural Network **Unit 5 : Unsupervised Learning** 5.1 Introduction to Unsupervised learning 5.2 Clustering 5.2.1 Selection of Clusters 5.2.2 Algorithms : 5.2.2.1 K – means clustering 5.2.2.2 Hierarchical Clustering 5.3 Association Rule Learning 5.3.1 Algorithms : 5.3.1.1 FP- Growth 5.3.1.2 Apriori Algorithm
Reference Books	1. "Machine Learning" by Tom M. Mitchell, McGraw Hill 2. "Understanding Machine Learning" by Shai Shalev-Shwartz, Shai

	Ben-David 3. "Machine Learning" by Anuradha Srinivasaraghavan, Vincy Joseph 4. "Machine Learning using Python" by U Dinesh Kumar Manaranjan Pradhan 5. "Real-World Machine Learning" by Henrik Brink, Joseph Richards, Mark Fetherolf 6. "Python Machine Learning" by Sebastian Raschka and Vahid Mirjalili 7. "Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems" by Aurelien Geron 8. "Machine Learning in Action" by Peter Harrington 9. "Introduction to Machine Learning with Python : A Guide for Data Scientists" by Andreas C. Muller, Sarah Guido
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment is based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 70% assessment is based on semester end University External examination

Course: 302: **Design Patterns**

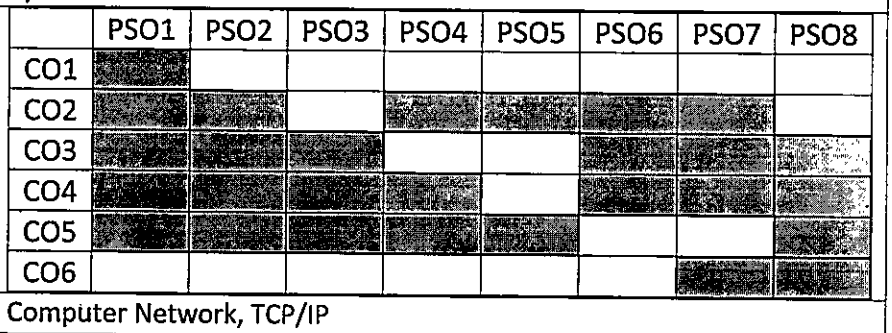
Course Code	302
Course Title	**Design Patterns**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Review / Revision	June 2021
Purpose of Course	The purpose of the course is to make student understand how Patterns can be implemented in various object oriented programming languages to solve real world problems.
Course Objective	The objective of the course is - 7. To study various Design Patterns 8. How these Patterns can be used to design better systems through Object Oriented Programming Languages
Course Outcome	CO1: Explain students about the various design patterns; their categories, and purpose. CO2: Explain the creational design patterns. CO3: Explain the structural design patterns. CO4: Explain the behavioural design patterns. CO5: Explain some more design patterns used in IT industry currently. CO6: Make students understand the applicability of design patterns practiced by IT companies and how effectively combine these patterns for effective software development.
Mapping between COs with PSOs	
Pre-requisite	Object Oriented Programming, Software Engineering
Course Content	**Unit -1 Introduction to Design Patterns** 1.1 What's a Design Pattern 1.2 Benefits of Design Patterns 1.3 Software Design Principles 1.4 SOLID Principles **Unit-2 Creational Patterns** 2.1 Factory Method Pattern 2.2 Abstract Factory Pattern 2.3 Builder Pattern 2.4 Prototype Pattern 2.5 Singleton Pattern **Unit-3 Structural Patterns** 3.1 Adapter Pattern 3.2 Bridge Pattern 3.3 Composite Pattern 3.4 Decorator Pattern 3.5 Overview of other Structural Patterns - Façade Pattern, Flyweight Pattern, Proxy Pattern **Unit-4 Behavioural Pattern** 4.1 Chain of Responsibility Pattern 4.2 Command Pattern 4.3 Iterator Pattern

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

	4.4 Mediator Pattern 4.5 Overview of other Behavioural Patterns - Memento Pattern, Observer Pattern, State Pattern, Strategy Pattern, Template Method Pattern, Visitor Pattern **Unit-5 Additional Design Patterns and Patterns Applicability** 5.1 Overview of Additional Patterns - Simple Factory Pattern, Null Object Pattern, MVC Pattern 5.2 Security Patterns Repository 5.3 Patterns for Agile Development 5.4 Relation between patterns and pattern combinations
Reference Books	19. Design Patterns: Elements of Reusable Object-Oriented Software, Erich Gamma, Richard Helm, Ralph, John, Addision Wesley 20. Head First Design Patterns, Eric Freeman, O'Reilly 21. Design Patterns in C#, Vaskaran Sarcar, Apress 22. Design Patterns in Modern C++, Reusable Approaches for Object-Oriented Software Design, Dmitri Nesteruk, Apress 23. Modern C++ design: generic Programming and design patterns applied, Alexendrescu, Andrei, Addison-Wesley 24. Java Design Patterns: A Hands-on Experience with Real-World Examples, Vaskaran Sarcar, Apress
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30 % internal assessment and 70% external assessment

Course: 503: **Network Essentials and its Security**

Course Code	503

Course Title	**Network Essentials and its Security**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Review / Revision	June 2020
Purpose of Course	To make students learn Network essentials and various security measures for the challenges to which the IT industry is exposed
Course Objective	To understand Network Management and its security
Course Outcome	CO1: Explain students familiar about network essentials. Make them familiar with various network devices like repeaters, bridge router, and gateway. CO2: Explain how to administer computer network. Make them understand various wide area network techniques, and explain network security. CO3: To understand cryptography, PKI, and digital signatures. CO4: Familiarize with various security services, and how certification and key management is handled in PKI. CO5: To make students understand various network security applications; covering internet protocol security, web security, email security, network management and its security. CO6: Make students understand access control, authentication schemes, firewalls, and virtual private network. Also to learn intrusion detection, virus and mobile and e-commerce security systems.
Mapping between COs with PSOs	
Pre-requisite	Computer Network, TCP/IP
Course Content	**Unit 1: Network Essentials** 1.1 Repeaters & Bridges 1.1.1 LAN Expansion 1.1.2 Repeaters 1.1.3 Bridges 1.1.4 How Bridges Work 1.1.5 Creating the routing table 1.1.6 Segmenting Network Traffic 1.1.7 Remote Bridges 1.1.8 Differentiating between bridges and repeaters 1.2 Routers & Gateways 1.2.1 Routers 1.2.2 How routers work 1.2.3 Routing benefits 1.2.4 Routing protocols 1.2.5 Routing V/S Bridging 1.2.6 B Routers 1.2.7 Gateways 1.2.8 How Gateways work

	1.3 Network Administration 1.3.1 Bottlenecks 1.3.2 Simple Network Management Protocol 1.3.3 Data Protection . 1.3.4 Backup Methods 1.3.5 Testing and Storage 1.3.6 Implementing a Backup System 1.3.7 Uninterruptible Power Suppliers 1.3.8 How Gateways work 1.3.9 Implementing Fault Tolerant Systems 1.3.10 RAID 1.3.11 Sector Sparing 1.4 Advance WAN Transmission 1.4.1 Overview 1.4.2 Multiplexing, Packet and Circuit Switching Networks 1.4.3 X.25 1.4.4 Asynchronous Transfer Mode (ATM) 1.4.5 ISDN 1.4.6 SONET 1.4.7 SMDS **Unit 2: Introduction to Network Security** **Unit 3: Cryptography Techniques** 3.1 Classical Cryptography 3.2 Conventional Cryptography 3.2.1 DES 3.3 Public – key Cryptography 3.3.1 RSA 3.4 Digital Signatures 3.4.1 DSA **Unit 4: Security Services** 16.1 Message Integrity 16.2 Confidentiality and Authentication 16.3 Certification and Key Management 4.3.1 PKI **Unit 5: Network Security Applications** 5.1 IP Security 5.1.1 IPsec 5.2 Web Security 5.2.1 SSL, TLS, SET 5.3 Electronic Mail Security 5.3.1 PGP, S/MIME 5.4 SNMP Security **Unit 6: Access Control in Computer Networks** 6.1 Authentication Protocols and Services 6.1.1 Kerberos and X.509 6.2 Firewalls 6.3 Virtual Private Networks (VPNs) **Unit 7: System Security** 7.1 Intrusion detection 7.2 Viruses

	Unit 8: Mobile System & E-Commerce Securities 8.1 3G Security 8.2 E-Payment Systems 8.3 Fair Data Exchange
Reference Books	1. Cryptography and Network Security, 2/e, ISBN: 0-13-869017-0 - W. Stallings - Pearson Education, 1999 2. Network Security Essentials: Applications and Standards, 1/e, ISBN: 0-13-016093-8 - W. Stallings - Pearson Education, 2000 3. SSL and TLS: designing and building secure systems, ISBN: 0-201-61598-3 - E. Rescorla - Addison-Wesley, 2001 4. Implementing Secure Intranets and Extranets, ISBN: 0-89006-447-4 - K M Phaltankar - Artech House Publishers, 2000 5. Secure Electronic Commerce: Building the Infrastructure for Digital Signature and Encryption, ISBN: 0-13-027276-0 - W. Ford, and M. Baum - Prentice Hall, 2001 6. Security in Computing, ISBN: 0-13-185794-0, 2/e - C. P. Pfleeger - Prentice Hall, 1997 7. Building Internet Firewalls, 2/e, ISBN: 1-56592-871-7 - E. D. Zwicky, et al - O'Reilly, 2000 8. CDMA Cellular Mobile Communications & Network Security, ISBN: 0-13-598418-1 - M. Y. Rhee, - Prentice Hall, 1998 9. Journal of Computer Security 10. ACM Transactions on Information and System Security 11. ACM Conference on Computer and Communications Security 12. IEEE Symposium on Security and Privacy 13. Internet documents - RFCs (Request for Comments) 14. Guide to Networking Essentials, Fourth Edition - Greg Tomsho, et al 15. Computer Networking Essentials - Debra Littlejohn Shinder 16. Networking Essentials: Hands-On, Self-Paced Training for Supporting Local and Wide Area Networks - Microsoft Corporation (Corporate Author) 17. Computer Network - A. S. Tanenbaum
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment is based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 70% assessment is based on semester end University External examination

Course: 504: **Advanced Database Administration**

Course Code	504
Course Title	**Advanced Database Administration**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks/ Semester	15 (Including Class work, examination, preparation, holidays etc.)
Review / Revision	June 2020
Purpose of Course	Understanding advanced database administration
Course Objective	To learn advanced database administration, database tuning and maintenance
Course Outcome	CO1 : To provide strong foundation in Advanced Database Administration concepts from an industry perspective. CO2 : To have thorough understanding of Oracle Database Management System internal architecture. CO3 : To understand the security aspects and user management. CO4 : To apply and learn various Oracle utilities CO5 : To learn how to practically tune the database to optimize the overall performance. CO6 : To learn and implement Backup and Recovery.
Mapping between COs with PSOs	

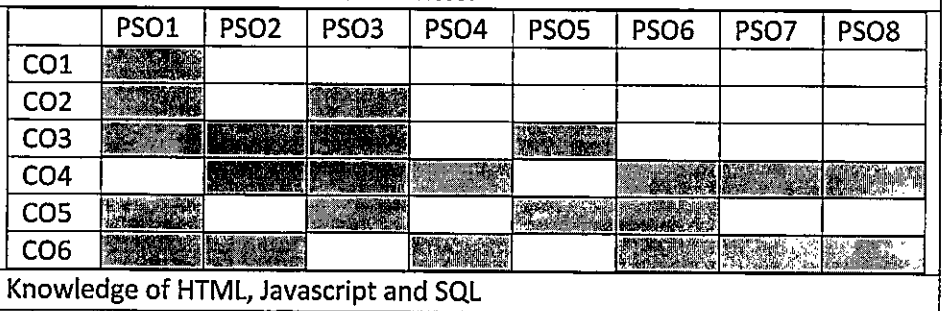
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

Pre-requisite	RDBMS
Course Content	**Unit 1. Oracle10g Instance creation and management** 1.1 Oracle Instance 1.2 Installing Oracle 1.3 Oracle Optimal Flexible Architecture (OFA) 1.4 Locating initialization, listener.ora & sqlnet.ora files 1.5 Finding the alert log 1.6 Common environment variables 1.7 Structures in an Oracle Instance 1.8 Oracle Memory Structures, SGA and PGA 1.9 Oracle Processes and their purposes 1.10 Startup, nomount, mount and open database commands **Unit 2. Oracle10g Database Architecture** 2.1 Oraclde10g management framework 2.1 Using the Database Creation Assistant (DBA) 2.3 Creating and dropping a database 2.4 Tablespaces 2.5 Tables and Indexes 2.6 Clusters 2.7 Partitioning of Tables and Indexes 2.8 Gathering and applying patches **Unit 3. Concurrency Management** 3.1 Transactions, serialization, locks and latches 3.2 Lock modes 3.3 Detecting and resolving lock conflicts

	3.4 Managing deadlocks **Unit 4. Interfacing with Oracle** 4.1 Oracle transaction management 4.2 Using SQL*Plus and iSQL*Plus 4.3 Using embedded Oracle with Pro*C & Java 4.4 PL/SQL & Triggers 4.5 Pining PL/SQL packages & compiling PL/SQL 4.6 System-level triggers – startup trigger, logon trigger, PL/SQL error trigger **Unit 5. Oracle*Net** 5.1 Basic Network structure 5.2 Oracle*Net Files 5.3 Multi-threaded server 5.4 Create additional listeners 5.5 Create Oracle Net service aliases 5.6 Configure connect time failover 5.7 Oracle*Net names resolution **Unit 6. Tablespace Management Overview** 6.1 Dictionary Managed Tablespaces 6.2 Locally Managed Tablespaces 6.3 Automatic Segment Space Management 6.4 Moving tablespaces online and offline **Unit 7. UNDO Tablespace Management** 7.1 Use of undo segments 7.2 Creating an undo tablespace 7.3 User managed undo tablespaces 7.4 Automatic undo management 7.5 Monitor & Configure undo retention 7.6 Use the Undo Advisor 7.7 Size the undo tablespace **Unit 8. Oracle Utilities** 8.1 Datapump - Import/export 8.2 SQL*Loader 8.3 Oracle Streams 8.4 Automatic Database Diagnostic Monitor 8.5 Automatic Tuning Optimizer 8.6 Automatic Shared Memory Tuning **Unit 9. Oracle Performance Tuning** 9.1 Locate invalid and unusable objects 9.2 Gather SQL optimizer statistics with dbms_stats 9.3 Basic Oracle performance metrics 9.4 Use OEM and dbms_alert to set warning and critical alert thresholds 9.5 The SQL Tuning Advisor 9.6 The SQL Access Advisor 9.6 Interpreting server generated alerts 9.7 Oracle advisory utilities vdb_cache_advice, vshared pool_advice, v$pga_aggregate_target_advice 9.8 Using OEM performance screens

	9.9 Fixing performance issues **Unit 10. User Management** 10.1 Creating Users 10.2 Altering users 10.3 User Profiles 10.4 User resource groups 10.5 Granting privileges & roles 10.6 Auditing user activity with dbms_audit **Unit 11. Oracle Security** 11.1 Password use in Oracle, Password encryption and password aging, External authentication, Using Single sign-on (SSO) 11.2 Object security 11.3 Virtual Private Databases (VPD) in Oracle 11.4 Oracle "grant execute" security 11.5 Use of Roles in Oracle 11.6 Register for security updates **Unit 12. Backup & Recovery** 12.1 Oracle backup & recovery planning 12.2 Parallel instance recovery 12.3 Basics of checkpoints, redo log files, and archived log files 12.4 Using ARCHIVELOG mode 12.5 Creating consistent Oracle backups 12.6 Online hot backups 12.7 Incremental Oracle backups 12.8 Automating database backups with dbms_scheduler 12.9 Monitor the flash recovery area 12.10 Recovering from loss of a Control file 12.11 Recovering from loss of a Redo log file 12.12 Recovering from loss of a system-critical data file 12.13 Recovering from loss of a non system-critical data file
Reference Books	1. Essentials : Oracle Database 10g by Rick Greenwald, Robert Stackowiak, Jonathan Stern, O'Reilly 2. Oracle High Performance Tuning for 9i and 10g by Gavin Powell, Digital Press 3. Oracle Database 10g, DBA Handbook by Loney, Kevin, Bryla, Bob, Oracle Press 4. Oracle Database 10g - The Complete Reference by Loney, Kevin, Oracle Press 5. Oracle Database 10g: A Beginner's Guide by Micheal Abbey, Ian Abramson Osborne, Oracle Press Series
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment is based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 70% assessment is based on semester end University External examination

Course: 505: **Open Source Web Based Programming**

Course Code	505
Course Title	**Open Source Web Based Programming**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks/ Semester	15 (Including Class work, examination, preparation, holidays etc.)
Review / Revision	June 2020
Purpose of Course	This course helps students to understand fundamentals of Open Source web based Programming. The course also imparts students learning about Open source web based scripting language PHP and Mysql database. It also includes MVC or Three tier architecture of web based programming and Javascript technology like ReactJS.
Course Objective	Student will learn fundamentals and advance topics of Open source Web technology
Course Outcome	CO1 : Explain students the fundamental as well as Advanced aspects of the Open Source Web based Technology. CO2 : Train students about react JS and difference between React JS and React Native. CO3 : Train students to understand MVC structure and it's benefits. CO4 : Explain and train students to deal with possible problem while developing websites and it's solution. CO5 : Expose the students with the analysis and development process of Websites. CO6 : After studying the course, students will be able to understand how Open source web technology works. They will also be able to create database driven Professional Websites.
Mapping between COs with PSOs	
Pre-requisite	Knowledge of HTML, Javascript and SQL
Course Content	**Unit 1 : Introduction to Open source Web based Programming** 1.1 Introduction to PHP & MySql 1.2 Installation of PHP and MySql 1.3 Language Characteristics & Features 1.4 Operators and Variables, Control Structures, Looping and Error handling 1.5 PHP functions 1.5.1 String Functions 1.5.2 Array Functions 1.5.3 Mathematical Functions 1.5.4 Graphics Library (GD Support) 1.5.6 Date and Time Functions 2.5.7 Misc. Function 1.6 State management Techniques 1.7 Object Oriented Features of PHP 1.7.1 Classes and Objects 1.7.2 Use of constructors 1.7.3 Serialization

	1.7.4 Inheritance **Unit 2 : MySQL database server** 2.1 Configuring the MySQL Server 2.2 MySQL Tables, Displaying MySQL Database , Adding and removing user access 1.3 Database connection and data processing functions **Unit 3 : Advance PHP** 3.1 Ajax Basics 3.1.1HTTP Request and Response Fundamentals 3.1.2 The XMLHttpRequest Object XMLHttpRequest Methods 3.1.3 XMLHttpRequest Properties 3.1.4 Cross-Browser Usage Sending a Request to the Server 3.1.5 PHP and Ajax Client-Driven Communication 3.1.6 Server-Side Processing Expanding and Contracting Content 3.1.7 Form Validation 3.1.8 Ajax-Based Database Querying 3.2 XML 3.3 Web services **Unit 4 : MVC** 4.1 Introduction to MVC 4.2 CodeIgniter: Introduction, Features and Application Flow Chart 4.3 Controller 4.4 Views 4.5 Models 4.6 Helpers 4.7 Creating and Usage of Libraries and Helpers 4.8 URL Routing 4.9 Error Handling 4.10 Profiling Application **Unit 5 : Introduction to React JS** 5.1 What is React JS 5.2 Environment Setup 5.3 JSX and ES6 5.4 Components 5.5 Props and State 5.6 Components API and Lifecycle 5.7 Forms and Events 5.8 Difference between React JS and React Native
Reference Books	1. Beginning PHP, Apache, MySQL Web Development - Elizabeth Naramore, Jason Gerner , Yann Le Scouarnec,Jeremy Stolz,Michael K. Glass, Gary Mailer – Wrox Publication 2. Professional PHP Programming - Jesus Castagnetto ,Wrox Press Ltd 3. Beginning PHP and MySQL: From Novice to Professional - W. Jason Gilmore, Apress 4. Php: The Complete Reference - Steven Holzner, Tata Mcgraw Hill Education Private Limited

	5. AJAX and PHP: Building Responsive Web Applications - Bogdan Brinzarea, Cristian Darie packtpub 6. CodeIgniter for Rapid PHP Application Development - David Upton ,packtpub 7. Professional CodeIgniter- Thomas Myer, Wrox Press Ltd 8. Learning React - Kirupa Chinnathambi , Paperback – 2018 9. Mastering React- Adam Horton and Ryan Vice, packtpub 10. Php manual – www. Php.com
Teaching Methodology	Class work, Discussion, Self Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment is based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 70% assessment is based on semester end University External examination

Course: 506: **Programming Skills XI**

Course Code	506
Course Title	**Programming Skills XI**
Credit	2
Teaching per Week	3 Hrs.
Minimum weeks/ Semester	15 (Including Lab. work, examination, preparation, holidays etc.)
Review / Revision	June 2020
Purpose of Course	This course helps students to implement the Unix Internals with shell programming/IOT practically.
Course Objective	Learning to implement fundamentals and advanced topics of Unix Internals with Shell Scripting/IOT practically
Pre-requisite	Practical programming in desktop environment / Embedded Technology
Course Outcome	After studying the course, students will be able to practically work on advanced technology platforms of Unix Internals with Shell Scripting /IOT.
Course Content	Practical based on paper no 501. Separate journal to be prepared for this subject based on 501.
Reference Books	-----
Teaching Methodology	Lab work, Practical Programming Exercises (to be documented in a separate journal), Self-study, and/or Assignment
Evaluation Method	30% Internal assessment is based on Lab attendance, practical test, practical internal examination etc. 70% assessment is based on semester end University External practical examination

Course: 507: **Programming Skills XII**

Course Code	507
Course Title	**Programming Skills XII**
Credit	3
Teaching per Week	3 Hrs.
Minimum weeks/ Semester	15 (Including Lab. work, examination, preparation, holidays etc.)
Review / Revision	June 2020
Purpose of Course	This course helps students to understand the Networking and its security practically
Course Objective	Learning to implement Network and its security practically.
Pre-requisite	Network fundamentals
Course Outcome	After studying the course, students will be able to practically implement network and its security
Course Content	Practical based on paper no 503. Separate journal to be prepared for this subject 503.
Reference Books	-----
Teaching Methodology	Lab work, Practical Exercises (to be documented in a separate journal), Self-study, and/or Assignment
Evaluation Method	30% Internal assessment is based on Lab attendance, practical test, practical internal examination etc. 70% assessment is based on semester end University External practical examination

Course: 508: **Programming Skills XIII**

Course Code	508
Course Title	**Programming Skills XIII**
Credit	2
Teaching per Week	3 Hrs.
Minimum weeks/ Semester	15 (Including Lab. work, examination, preparation, holidays etc.)
Review / Revision	June 2020
Purpose of Course	This course helps students to learn network administration
Course Objective	Students will learn administration of network practically
Pre-requisite	Networking fundamentals
Course Outcome	After studying the course, students will be able to practically perform administrative tasks of networks practically
Course Content	Practical based on paper no 504. Separate journal to be prepared for this subject 504.
Reference Books	-----
Teaching Methodology	Lab work, Practical Exercises (to be documented in a separate journal), Self-study, and/or Assignment
Evaluation Method	30% Internal assessment is based on Lab attendance, practical test, practical internal examination etc. 70% assessment is based on semester end University External practical examination

Course: 509: **Programming Skills XIV**

Course Code	509
Course Title	**Programming Skills XIV**
Credit	3
Teaching per Week	3 Hrs.
Minimum weeks/ Semester	15 (Including Lab. work, examination, preparation, holidays etc.)
Review / Revision	June 2020
Purpose of Course	This course helps students to implement the basic and advanced concepts of PHP/MySql practically.
Course Objective	Learning to develop and deploy websites using PHP/MySql practically.
Pre-requisite	Basic scripting, programming, html.
Course Outcome	After studying the course, students will be able to practically develop dynamic websites using PHP/MySql.
Course Content	Practical based on paper no 505. Separate journal to be prepared for this subject based on 505.
Reference Books	-----
Teaching Methodology	Lab work, Practical Programming Exercises (to be documented in a separate journal), Self-study, and/or Assignment
Evaluation Method	30% Internal assessment is based on Lab attendance, practical test, practical internal examination etc. 70% assessment is based on semester end University External practical examination

MCA 4th Semester

Course: 401: **Seminar**

Course Code	401
Course Title	**Seminar**
Credit	6
Review / Revision	June 2021

- The students are required to prepare a seminar on a relevant topic concerning the subject of interest of the student; as well as latest technology.
- The students must prepare documentation of the seminar.
- At the end of the semester, the students have to submit the seminar reports in spiral bounded form to the institution.
- Seminar Completion Certificate issued by the institute is mandatory for appearing in Seminar Presentations.
- The Seminar Presentation will be conducted as per the University exam schedule.
  The students have to submit the following reports at the institution:

  1. Seminar Topic Chosen
  2. Institution Certificate for Seminar

Course: 402: **Project**

Course Code	402
Course Title	**Project**
Credit	24
Review / Revision	June 2021

- The students are required to carry out full time software development project in a company.
- The students must prepare documentation of the project completed as per the guidelines given by the institute.
- At the end of the semester, the students have to submit the project reports in bounded form to the institution.
- Project Completion Certificate issued by the institute is mandatory for appearing in Project Presentation and Viva – Voce.
- The Project Presentation and Viva – Voce will be conducted as per the University exam schedule.

The students have to submit the following reports at the institution:

1. Project Joining Report
2. Progress Reports
3. Project Completion Certificate from the company
4. Institution Certificate for Project
5. Non-disclosure of Source Code Certificate (In case the student is unable to submit project source code)