Estd:1980

SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE (AUTONOMOUS)

(Affiliated to JNTUK, Kakinada), (Recognized by AICTE, New Delhi)

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CHINNA AMIRAM (P.O):: BHIMAVARAM :: W.G.Dt., A.P., INDIA :: PIN: 534 204

INFORMATION TECHNOLOGY

(Accredited by NBA)

SCHEME OF INSTRUCTION & EXAMINATION

(Regulation R19)

IV/IV B.TECH

I-SEMESTER

(With effect from **2019-2020**Admitted Batch onwards**)**

Course Code	Name of the Course	Category	Cr.	L	T	P	Internal Marks	External Marks	Total Marks
B19IT4101	Cryptography and Network Security	PC	3	3	--	--	25	75	100
B19IT4102	Machine Learning	PC	4	3	1	--	25	75	100
B19IT4103	Cloud Computing	PC	3	3	--	--	25	75	100
# PE-III	Professional Elective -III	PE	3	3	--	--	25	75	100
#PE-IV	Professional Elective -IV	PE	3	3	--	--	25	75	100
#OE-II	Open Elective-II	OE	3	3	--	--	25	75	100
B19IT4114	Unified Modeling Language (UML) Lab	PC	1	--	--	2	20	30	50
B19IT4115	Project Work-I	PR	2	--	--	4	20	30	50
B19MC4101	IPR & Patents	MC	0	3	--	--	--	--	--
	TOTAL		**22**	**21**	**1**	**6**	**190**	**510**	**700**

	Course Code	Course
#PE-III	B19IT4104	Bigdata Analytics
	B19IT4105	Social Networking
	B19IT4106	Ad-hoc and Sensor Networks
	B19IT4107	Agile Software Process
	B19IT4108	Design Patterns
#PE-IV	B19IT4109	Distributed Systems
	B19IT4110	DevOps
	B19IT4111	Internet of Things
	B19IT4112	Data Science
	B19IT4113	Biometrics
#OE-II	Student has to study one Open Elective offered by CE or ECE or EEE or ME or S&H from the list enclosed.	

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19IT4101	PC	3	--	--	3	25	75	3 Hrs.

CRYPTOGRAPHY & NETWORK SECURITY

(For IT)

Course Objectives: The main objectives of this course are

1.	Solve problems using algorithm design methods such as the RSA,DES, AES
2.	Analyze the performance of algorithms.
3.	Demonstrate a familiarity with major algorithms and Approaches.

Course Outcomes: By the end of the course, the student will be able to:

S.No	Outcome	Knowledge Level
1.	Understand, apply and analyze the algorithms on security problems	K3
2.	Understand, apply and analyze symmetric and asymmetric approaches.	K3
3.	Understand, apply and analyze security measurements	K3
4.	Understand, apply and analyze various malicious software.	K3

SYLLABUS

UNIT-I (12 Hrs)	**INTRODUCTION:** The need for security-Security approaches, principals of security , plain text and cipher Text- Types of attacks –substitution and Transportation Techniques – Encryption Techniques –Encryption and Decryption- Symmetric and Asymmetric Cryptography – Stenography-KDC **SYMMETRIC KEY CRYPTOGRAPHIC ALGORITHMS:** Feistel Cipher Structure, Data encryption standard, Triple DES, AES, Stream Ciphers and RC4.
UNIT-II (12 Hrs)	**ASYMMETRIC KEY CRYPTOGRAPHIC ALGORITHMS:** Overview of asymmetric key cryptography, Diffie Hellman Key exchange, RSA algorithm-symmetric and asymmetric key cryptography together-Message Digest- MAC- HMAC- digital signatures.
UNIT-III (10 Hrs)	**PUBLIC KEY INFRASTRUCTURE:** Introduction-Digital certificates-Private Key management-The PKIX model. **USER AUTHENTICATION MECHANISMS:** Introduction-Authentication basics-passwords authentication tokens-certificate based authentication-biometrics authentication-Kerberos.
UNIT-IV (10 Hrs)	**INTERNET SECURITY PROTOCOLS:** Basic concepts -SSL-SHTTP-TSP-SET- SSL versus SET-3D secure protocol -Email security-WAP security -security in GSM – 3G Security, Introduction to firewalls-IP security-Virtual Private Networks**.**
UNIT-V (8 Hrs)	**MALICIOUS SOFTWARE:** Types of Malicious Software, Viruses, Viruses countermeasures, Warms, Bots, and Honey pots, Denial of Service Attacks and Flooding Attacks.

Text Books:	
1.	Cryptography and Network security, Atul Kahate ,Tata McGraw-Hill Pub company Ltd., New Delhi
2.	Computer Security by William stallings and Lawrie Brown, Pearson Pub
Reference Books:	
1.	Network Security Private Communication in a public world, Charlie Kaufman, Radia Perlman & Mike Speciner, Prentice Hall of India Private Ltd., New Delhi.
2.	Network Security: The Complete Reference by Roberta Bragg, Mark Phodes- Ousley, Keith Strassberg Tata Mcgraw-Hill.

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19IT4102	PC	3	1	--	4	25	75	3 Hrs.

MACHINE LEARNING

(For IT)

Course Objectives:

1	Familiarity with a set of well-known supervised, unsupervised and semi-supervised learning algorithms.
2	The ability to implement some basic machine learning algorithms
3	Understanding of how machine learning algorithms are evaluated

Course Outcomes: By the end of the course, the student will be able to:

S.No	Outcome	Knowledge Level
1	Recognize the characteristics of machine learning that make it useful to real world Problems.	K3
2	Implement various machine learning algorithms as supervised, semi supervised and Unsupervised.	K4
3	Implement various machine learning toolboxes to use support vector machines, regularized regression algorithms, Naivy Bayes algorithms.	K4
4	Understand the concept behind neural networks for implementing non-linear functions.	K4

SYLLABUS

UNIT-I (12Hrs)	The ingredients of machine learning, Tasks: the problems that can be solved with machine learning, Models: the output of machine learning, Features, the workhorses of machine learning. Binary classification and related tasks: Classification, Scoring and ranking. Beyond binary classification: Handling more than two classes: Multi-class classification, Regression, Unsupervised and descriptive learning. (Peter Flach)
UNIT-II (10 Hrs)	Concept learning: The hypothesis space, Paths through the hypothesis space, Beyond conjunctive concepts. Tree models: Decision trees, Ranking and probability estimation trees, Tree learning as variance reduction. Rule models: Learning ordered rule lists, Learning unordered rule sets, Descriptive rule learning, First-order rule learning. (Peter Flach)
UNIT-III (10 Hrs)	Linear models: The least-squares method: Univariate linear regression, The perceptron: a heuristic learning algorithm for linear classifiers, Support vector machines, obtaining probabilities from linear classifiers. Distance Based Models: Introduction, Neighbours and exemplars, Nearest Neighbours classification, Distance Based Clustering, Hierarchical Clustering. (Peter Flach)
UNIT-IV	Probabilistic models: The normal distribution and its geometric interpretations,

(8 Hrs)	Probabilistic models for categorical data, Discriminative learning by optimizing conditional likelihood Probabilistic models with hidden variables. Features: Kinds of feature, Feature transformations, Feature construction and selection. Model ensembles: Bagging and random forests, Boosting. (Peter Flach)
UNIT-V (10Hrs)	Dimensionality Reduction: Principal Component Analysis (PCA), Implementation and demonstration. Artificial Neural Networks: Introduction, Neural network representation, appropriate problems for neural network learning, Multilayer networks and the back propagation algorithm. (Tom M. Mitchell)

Text Books:	
1.	Machine Learning: The art and science of algorithms that make sense of data
2.	Machine Learning
Reference Books:	
1.	Understanding Machine Learning: From Theory to Algorithms
2.	Machine Learning in Action

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19IT4103	PC	3	-	--	3	25	75	3 Hrs.

CLOUD COMPUTING

(For IT)

Course Objectives:

1	To implement Virtualization
2	To implement Task Scheduling algorithms
3	Apply Map-Reduce concept to applications
4	To build Private Cloud
5	Broadly educate to know the impact of engineering on legal and societal issues involved

Course Outcomes: By the end of the course, the student will be able to:

S.No	Outcome	Knowledge Level
1	Interpret the key dimensions of the challenge of Cloud Computing	K3
2	Examine the economics, financial, and technological implications for selecting cloud computing for own organization	K3
3	Assessing the financial, technological, and organizational capacity of employer's for actively initiating and installing cloud-based applications	K3
4	Evaluate own organizations' needs for capacity building and training in cloud computing-related IT areas	K3
5	Illustrate Virtualization for Data-Center Automation	K3

SYLLABUS

UNIT-I (12Hrs)	Introduction: Network centric computing, Network centric content, peer-to –peer systems, cloud computing delivery models and services, Ethical issues, Vulnerabilities, Major challenges for cloud computing. Parallel and Distributed Systems: introduction, architecture, distributed systems, communication protocols, logical clocks, message delivery rules, concurrency, and model concurrency with Petri Nets.
UNIT-II (10 Hrs)	Cloud Infrastructure: At Amazon, The Google Perspective, Microsoft Windows Azure, Open Source Software Platforms, Cloud storage diversity, Inter cloud, energy use and ecological impact, responsibility sharing, user experience, Software licensing. Cloud Computing: Applications and Paradigms: Challenges for cloud, existing cloud applications and new opportunities, architectural styles, workflows, The Zookeeper, HPC on cloud.
UNIT-III (10 Hrs)	Cloud Resource virtualization: Virtualization, layering and virtualization, virtual machine monitors, virtual machines, virtualization- full and para, performance and security isolation, hardware support for virtualization, Case Study: Xen, vBlades. Cloud Resource Management and Scheduling: Policies and Mechanisms, Applications of control theory to task scheduling, Stability of a two-level resource allocation

	architecture, feedback control based on dynamic thresholds, coordination, resource bundling, scheduling algorithms, fair queuing, start time fair queuing, cloud scheduling subject to deadlines, Scheduling Map Reduce applications, Resource management and dynamic application scaling
UNIT-IV (8 Hrs)	Storage Systems: Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system. Apache Hadoop, Big Table, Megastore (Text book 1), Amazon Simple Storage Service(S3) (Text book 2) Cloud Security: Cloud security risks, security – a top concern for cloud users, privacy and privacy impact assessment, trust, OS security, Virtual machine security, Security risks
UNIT-V (10Hrs)	Cloud Application Development: Amazon Web Services : EC2 – instances, connecting clients, security rules, launching, usage of S3 in Java, Cloud based simulation of a Distributed trust algorithm, Cloud service for adaptive data streaming (Text Book 1), Google: Google App Engine, Google Web Toolkit (Text Book 2), Microsoft: Azure Services Platform, Windows live, Exchange Online, Share Point Services, Microsoft Dynamics CRM (Text Book 2)
Text Books:	
1.	Cloud Computing, Theory and Practice,1st Edition, Dan C Marinescu, MK Elsevier publisher ,2013
2.	Cloud Computing, A Practical Approach, 1st Edition, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH, 2017.
Reference Books:	
1.	Mastering Cloud Computing, Foundations and Application Programming,1st Edition, Raj Kumar Buyya, Christen vecctiola, S Tammarai selvi, TMH,2013.
2.	Essential of Cloud Computing, 1st Edition, K Chandrasekharan, CRC Press, 2014.
3.	Cloud Computing, A Hands on Approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2014.

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19IT4104	PE	3	--	--	3	25	75	3 Hrs.

BIGDATA ANALYTICS

(For IT)

Course Objectives:

1.	To optimize business decisions and create competitive advantage with Big Data analytics
2.	To learn to analyze the big data using intelligent techniques
3.	To introduce programming tools PIG & HIVE in Hadoop echo system

Course Outcomes: By the end of the course, the student will be able to:

S.No	Outcome	Knowledge Level
1.	**Identify** the characteristics of datasets and compare the trivial data and big data for various applications. Illustrate big data challenges in different domains.	K2
2.	**Explore** various techniques for mining data streams in real time analytics	K3
3.	**Explore** the features of Distributed File System in Hadoop framework.	K3
4.	**Illustrate** the features of Map-Reduce programming model to analyze the big data in Hadoop environment.	K3
5.	**Explore** the tools in Hadoop Eco system and Data Visualization techniques.	K3

SYLLABUS

UNIT-I (10 Hrs)	**Introduction:** Introduction to big data: Types of data, Characteristics of Big Data, Introduction to Big Data Platform, Challenges of Conventional Systems, Intelligent data analysis, Nature of Data, Analytic Processes and Tools, Analysis vs Reporting.
UNIT-II (10 Hrs)	**Stream Processing:** Mining data streams: Introduction to Streams Concepts, Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting 1's in a Window, Decaying Window, Real time Analytics Platform (RTAP) Applications, Case Study - Real Time Sentiment Analysis.
UNIT-III (10 Hrs)	**Introduction to Hadoop:** History of Hadoop, the Hadoop Distributed File System, Components of Hadoop Analysing the Data with Hadoop, Scaling Out, Hadoop Streaming, Design of HDFS, Java interfaces to HDFS Basics.
UNIT-IV (10 Hrs)	**Developing a Map Reduce Application:** How Map Reduce Works, Anatomy of a Map Reduce Job run, Failures, Job Scheduling, Shuffle and Sort, Task execution, Map Reduce Types and Formats, Map Reduce Features Hadoop environment.
UNIT-V (10 Hrs)	**Frameworks and Applications:** Hadoop Echo System, Applications on Big Data Using Pig, Pig Architecture, Data processing operators in Pig, Applications on Big Data Using Hive, Hive Architecture, HiveQL, Querying Data in Hive, fundamentals of HBase and

	ZooKeeper. Visualizations, Visual data analysis techniques, interaction techniques, Systems and application
Text Books:	
1.	Tom White, “Hadoop: The Definitive Guide”, Third Edition, O’reilly Media, Fourth Edition, 2015.
2.	Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data”, McGrawHill Publishing, 2012.
3.	Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, CUP, 2012.
Reference Books:	
1.	Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley& sons, 2012.
2.	Paul Zikopoulos, DirkdeRoos, Krishnan Parasuraman, Thomas Deutsch, James Giles, David Corrigan, “Harness the Power of Big Data:The IBM Big Data Platform”, Tata McGraw Hill Publications, 2012.
3.	Arshdeep Bahga and Vijay Madisetti, “Big Data Science & Analytics: A Hands On Approach “, VPT, 2016.
4.	Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications (WILEY Big Data Series)”, John Wiley & Sons, 2014.

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19IT4105	PE	3	--	--	3	25	75	3 Hrs.

SOCIAL NETWORKING

(For IT)

Course Objectives:

1	Formalize different types of entities and relationships as nodes and edges and represent this information as relational data
2	Plan and execute network analytical computations
3	Use advanced network analysis software to generate visualizations and perform empirical investigations of network data
4	Interpret and synthesize the meaning of the results with respect to a question, goal, or task
5	Collect network data in different ways and from different sources while adhering to legal standards and ethics standards

Course Outcomes: By the end of the course, the student will be able to:

S.No	Outcome	Knowledge Level
1	Know basic notation and terminology used in network science	K2
2	Be able to visualize, summarize and compare networks	K3
3	Illustrate basic principles behind network analysis algorithms	K3
4	Develop practical skills of network analysis in R programming language	K3
5	Be capable of analyzing real work networks	K3

SYLLABUS

UNIT-I (10 Hrs)	Social Network Analysis: Preliminaries and definitions, Erdos Number Project, Centrality measures, Balance and Homophily.
UNIT-II (10 Hrs)	Random graph models**:** Random graphs and alternative models, Models of network growth, Navigation in social Networks, Cohesive subgroups, Multidimensional Scaling, Structural equivalence, roles and positions.
UNIT-III (10 Hrs)	Network topology and diffusion, Contagion in Networks, Complex contagion, Percolation and information, Navigation in Networks Revisited.
UNIT-IV (8 Hrs)	Small world experiments, small world models, origins of small world, Heavy tails, Small Diameter, Clustering of connectivity, The ErdosRenyi Model, Clustering Models.
UNIT-V (12 Hrs)	Network structure -Important vertices and page rank algorithm, towards rational dynamics in networks, basics of game theory, Coloring and consensus, biased voting, network formation games, network structure and equilibrium, behavioral experiments, Spatial and agent-based models.

Text Books:	
1.	S. Wasserman and K. Faust. “Social Network Analysis: Methods and Applications”, Cambridge University Press.
2.	D. Easley and J. Kleinberg, “Networks, Crowds and Markets: Reasoning about a highly connected world” , Cambridge University Press, 1st edition,2010
Reference Books:	
1.	Maarten van Steen. “Graph Theory and Complex Networks. An Introduction”, 2010.
2.	Reza Zafarani, Mohammed Ali Abbasi, Huan Liu. “Social Media Mining: An Introduction”. Cambridge University Press 2014.
3.	Maksim Tsvetovat and Alexander Kouznetsov. “Social Network Analysis for Startups”. O’Reilly Media, 2011.

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19IT4106	PE	3	--	--	3	25	75	3 Hrs.

AD-HOC AND SENSOR NETWORKS

(For IT)

Course Objectives:

From the course the student will learn

1	Architect sensor networks for various application setups
2	Devise appropriate data dissemination protocols and model links cost
3	Understanding of the fundamental concepts of wireless sensor networks and has a basic knowledge of the various protocols at various layers
4	Evaluate the performance of sensor networks and identify bottlenecks

Course Outcomes: By the end of the course, the student will be able to:

S.No	Outcome	Knowledge Level
1	Evaluate the principles and characteristics of mobile ad hoc networks (MANETs) and what distinguishes them from infrastructure-based networks	K3
2	Determine the principles and characteristics of wireless sensor networks	K3
3	Discuss the challenges in designing MAC, routing and transport protocols for wireless ad-hoc sensor networks	K3
4	Illustrate the various sensor network Platforms, tools and applications	K3
5	Demonstrate the issues and challenges in security provisioning and also familiar with the mechanisms for implementing security and trust mechanisms in MANETs and WSNs	K3

SYLLABUS

UNIT-I (10 Hrs)	Introduction to Ad Hoc Wireless Networks- Cellular and Ad Hoc Wireless Networks, Characteristics of MANETs, Applications of MANETs, Issues and Challenges of MANETs, Ad Hoc Wireless Internet, MAC protocols for Ad hoc Wireless Networks-Issues, Design Goals and Classifications of the MAC Protocols.
UNIT-II (10 Hrs)	Routing Protocols for Ad Hoc Wireless Networks- Issues in Designing a Routing Protocol, Classifications of Routing Protocols, Topology-based versus Position-based Approaches, Issues and design goals of a Transport layer protocol, Classification of Transport layer solutions, TCP over Ad hoc Wireless Networks, Solutions for TCP over Ad Hoc Wireless Networks, Other Transport layer protocols.
UNIT-III (10 Hrs)	Security protocols for Ad hoc Wireless Networks- Security in Ad hoc Wireless Networks, Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management, Secure Routing in Ad hoc Wireless Networks, Cooperation in MANETs, Intrusion Detection Systems.

UNIT-IV (8 Hrs)	Basics of Wireless Sensors and Applications- The Mica Mote, Sensing and Communication Range, Design Issues, Energy Consumption, Clustering of Sensors, Applications, Data Retrieval in Sensor Networks-Classification of WSNs, MAC layer, Routing layer, Transport layer, High-level application layer support, Adapting to the inherent dynamic nature of WSNs.
UNIT-V (12 Hrs)	Security in WSNs- Security in WSNs, Key Management in WSNs, Secure Data Aggregation in WSNs, Sensor Network Hardware-Components of Sensor Mote, Sensor Network Operating Systems–TinyOS, LA-TinyOS, SOS, RETOS, Imperative Language-nesC, Dataflow Style Language- TinyGALS, Node- Level Simulators, NS-2 and its sensor network extension, TOSSIM.

Text Books:

1	Ad Hoc Wireless Networks – Architectures and Protocols, C. Siva Ram Murthy, B. S. Murthy, Pearson Education, 2004.
2	Ad Hoc and Sensor Networks – Theory and Applications, Carlos Corderio Dharma P.Aggarwal, World Scientific Publications / Cambridge University Press, March 2006.
3	Wireless Sensor Networks – Principles and Practice, Fei Hu, Xiaojun Cao, An Auerbach book, CRC Press, Taylor & Francis Group, 2010

Reference Books:

1	Wireless Sensor Networks: An Information Processing Approach, Feng Zhao, Leonidas Guibas, Elsevier Science imprint, Morgan Kauffman Publishers, 2005, rp2009.
2	Wireless Ad hoc Mobile Wireless Networks – Principles, Protocols and Applications, Subir Kumar Sarkar, et al., Auerbach Publications, Taylor & Francis Group, 2008.
3	Ad hoc Networking, Charles E.Perkins, Pearson Education, 2001
4	Wireless Ad hoc Networking, Shih-Lin Wu, Yu-Chee Tseng, Auerbach Publications, Taylor & Francis Group, 2007

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19IT4107	**PE**	**3**	**--**	**--**	**3**	**25**	**75**	**3 Hrs.**

AGILE SOFTWARE PROCESS

(For IT)

Course Objectives:

1.	Organize Agile Software Development, Extreme Programming and Software Development Rhythms.
2.	Describe their unique features relative to traditional software practices
3.	Examine their applications in the real world and addresses their impacts on developing software.

Course Outcomes: By the end of the course, the student will be able to:

S.No	Outcome	Knowledge Level
1.	Summarize the agile methodologies: extreme programming, scrum, and feature driven programming.	K3
2.	Apply The Twelve XP Practices and Illustrate pair programming and its characteristics	K3
3.	Apply XP to a small project	K3
4.	Examine Feature-Driven Development and Regaining Control	K3
5.	Relate Agile Modeling and RUP and Choose Tools to help with Agile Development	K3

SYLLABUS

UNIT-I (10 Hrs)	**Introduction:** Introduction: Agile Methods, Agile Manifesto, and Agile Modeling, Introduction, What Is Agile, The Agile Manifesto, Agile Methods, XP: Extreme Programming, DSDM, SCRUM, Feature-Driven Development, Modeling Misconceptions, Agile Modeling, Tools of Misconceptions, Updating Agile Models
UNIT-II (10 Hrs)	**Extreme Programming:** Introduction, Core XP Values, The Twelve XP, Practices, About Extreme Programming, Planning XP Projects, Test First Coding, Making Pair Programming Work
UNIT-III (10 Hrs)	**Agile Modeling and XP:** Introduction, The Fit, Common Practices, Modeling Specific Practices, XP Objections to Agile Modeling, Agile Modeling and Planning XP Projects, XP Implementation Phase
UNIT-IV (10 Hrs)	**Feature-Driven Development:** Introduction, Incremental Software Development, Regaining Control: The Motivation

	behind FDD, Planning an Iterative Project, Architecture Centric, FDD and XP
UNIT-V (10 Hrs)	**Agile Methods with RUP and PRINCE2 and Tools and Obstacles:** Agile Modeling and RUP, FDD and RUP, Agile Methods and Prince2, Tools to Help with Agile Development, Eclipse: An Agile IDE, Obstacles to Agile Software Development, Management Intransigence, The Failed Project Syndrome, Contractual Difficulties, Familiarity with Agility
Text Books:	
1	Agile software construction,1/e,John hunt, springer, 2005
2	Agile and Iterative Development: a manager's guide, Addison-Wesley Craig Larman, [Pearson Education] - 2004.
Reference Books:	
1	The Art of Agile Development, Pearson, Robert C. Martin, Juli, James Shore, Chromatic, 2013, O'Reilly Media.
2	Agile Testing, Elisabeth Hendrickson, Quality Tree Software Inc 2008.

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19IT4108	PE	3	--	--	3	25	75	3 Hrs.

DESIGN PATTERNS

(For IT)

Course Objectives:

1	Demonstration of patterns related to object oriented design.
2	Describe the design patterns that are common in software applications
3	Analyze a software development problem and express it
4	Design a module structure to solve a problem, and evaluate alternatives
5	Implement a module so that it executes efficiently and correctly

Course Outcomes: By the end of the course, the student will be able to:

S.No	Outcome	Knowledge Level
1	Construct a design consisting of a collection of modules	K3
2	Examine well-known design patterns (such as Iterator, Observer, Factory and Visitor)	K3
3	Distinguish between different categories of design patterns	K3
4	Ability to understand and apply common design patterns to incremental/iterative development	K3
5	Identify appropriate patterns for design of given problem	K3
6	Design the software using Pattern Oriented Architectures	K3

SYLLABUS

UNIT-I (10 Hrs)	Introduction: Design Pattern, Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern. A Case Study: Designing a Document Editor: Design Problems, Document Structure, Formatting, Embellishing the User Interface, Supporting Multiple Look-and-Feel Standards, Supporting Multiple Window Systems, User Operations Spelling Checking and Hyphenation.
UNIT-II (10 Hrs)	Creational Patterns: Abstract Factory, Builder, Factory Method, Prototype, Singleton, Discussion of Creational Patterns.
UNIT-III (10 Hrs)	Structural Pattern: Adapter, Bridge, Composite, Decorator, açade, Flyweight, Proxy.
UNIT-IV (8 Hrs)	Behavioral Patterns: Chain of Responsibility, Command, Interpreter, Iterator, Mediator, Memento, Observer.

UNIT-V (12 Hrs)	Behavioral Patterns: State, Strategy, Template Method, Visitor, Discussion of Behavioral Patterns.What to Expect from Design Patterns, a Brief History, the Pattern Community an Invitation, a Parting Thought.
Text Books:	
1.	Design Patterns", Erich Gamma, Pearson Education.
Reference Books:	
1	"Head First Design patterns", Eric Freeman & Elisabeth Freeman, O'REILLY, 2007.
2	"Design Patterns in Java", Steven John Metsker & William C. Wake, Pearson education, 2006
3	"J2EE Patterns", Deepak Alur, John Crupi & Dan Malks, Pearson education, 2003.
4	"Design Patterns in C#", Steven John metsker, Pearson education, 2004.
5	"Pattern Oriented Software Architecture", F.Buschmann & others, John Wiley & Sons

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19IT4109	PE	3	--	--	3	25	75	3 Hrs.

DISTRIBUTED SYSTEMS

(For IT)

Course Objectives:

1	To understand the foundations of distributed systems.
2	To learn issues related to clock Synchronization and the need for global state in distributed systems.
3	To learn distributed mutual exclusion and deadlock detection algorithms.
4	To understand the significance of agreement, fault tolerance and recovery protocols in Distributed Systems
5	To learn the characteristics of peer-to-peer and distributed shared memory systems

Course Outcomes: By the end of the course, the student will be able to:

S.No	Outcome	Knowledge Level
1	Enumerate the foundations and issues of distributed systems	K3
2	Illustrate the various synchronization issues and global state for distributed systems	K3
3	Demonstrate the Mutual Exclusion and Deadlock detection algorithms in distributed systems	K3
4	Describe the agreement protocols and fault tolerance mechanisms in distributed systems	K3
5	Describe the features of peer-to-peer and distributed shared memory systems	K3

SYLLABUS

UNIT-I (10 Hrs)	Introduction: Definition, Relation to computer system components, Motivation, Relation to parallel systems, Message-passing systems versus shared memory systems, Primitives for distributed communication, Synchronous versus asynchronous executions, Design issues and challenges. A model of distributed computations: A distributed program, A model of distributed executions, Models of communication networks, Global state, Cuts, Past and future cones of an event, Models of process communications. Logical Time: A framework for a system of logical clocks, Scalar time, Vector time, Physical clock synchronization: NTP.
UNIT-II (10 Hrs)	Message ordering and group communication: Message ordering paradigms, Asynchronous execution with synchronous communication, Synchronous program order on an asynchronous system, Group communication, Causal order (CO), Total order. Global state and snapshot recording algorithms: Introduction, System model and definitions, Snapshot algorithms for FIFO channels

UNIT-III (10 Hrs)	Distributed mutual exclusion algorithms: Introduction – Preliminaries – Lamport‘s algorithm – Ricart- Agrawala algorithm – Maekawa‘s algorithm – Suzuki–Kasami‘s broadcast algorithm. Deadlock detection in distributed systems: Introduction – System model – Preliminaries – Models of deadlocks – Knapp‘s classification – Algorithms for the single resource model, the AND model and the OR model
UNIT-IV (8 Hrs)	Check pointing and rollback recovery: Introduction – Background and definitions – Issues in failure recovery – Checkpoint-based recovery – Log-based rollback recovery – Coordinated check pointing algorithm – Algorithm for asynchronous check pointing and recovery. Consensus and agreement algorithms: Problem definition – Overview of results – Agreement in a failure – free system – Agreement in synchronous systems with failures.
UNIT-V (12 Hrs)	Peer-to-peer computing and overlay graphs: Introduction – Data indexing and overlays – Chord – Content addressable networks **–** Tapestry. Distributed shared memory: Abstraction and advantages – Memory consistency models – Shared memory Mutual Exclusion
Text Books:	
1	Distributed Systems Concepts and Design, George Coulouris, Jean Dollimore and Tim Kindberg, Fifth Edition, Pearson Education, 2012.
2	Distributed computing: Principles, algorithms, and systems, Ajay D Kshemkalyani and Mukesh Singhal, Cambridge University Press, 2011.
Reference Books:	
1	Distributed Operating Systems: Concepts and Design, Pradeep K Sinha, Prentice Hall of India, 2007.
2	Advanced concepts in operating systems. Mukesh Singhal and Niranjan G. Shivaratri, McGraw-Hill, 1994.
3	Distributed Systems: Principles and Paradigms, Tanenbaum A.S., Van Steen M.,Pearson Education, 2007.

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19IT4110	PE	3	--	--	3	25	75	3 Hrs.

DevOps

(For IT)

Course Objectives:

1	DevOps improves collaboration and productivity by automating infrastructure and workflows and continuously measuring applications performance

Course Outcomes: By the end of the course, the student will be able to:

S.No	Outcome	Knowledge Level
1	Enumerate the principles of continuous development and deployment, automation of configuration management, inter-team collaboration, and IT service agility	K3
2	Describe DevOps & DevSecOps methodologies and their key concepts	K3
3	Illustrate the types of version control systems, continuous integration tools, continuous monitoring tools, and cloud models	K3
4	Set up complete private infrastructure using version control systems and CI/CD tools	K3

SYLLABUS

UNIT-I (10 Hrs)	Phases of Software Development life cycle. Values and principles of agile software development.
UNIT-II (10 Hrs)	Fundamentals of DevOps: Architecture, Deployments, Orchestration, Need, Instance of applications, DevOps delivery pipeline, DevOps eco system.
UNIT-III (10 Hrs)	DevOps adoption in projects: Technology aspects, Agiling capabilities, Tool stack implementation, People aspect, processes
UNIT-IV (8 Hrs)	CI/CD: Introduction to Continuous Integration, Continuous Delivery and Deployment, Benefits of CI/CD, Metrics to track CICD practices
UNIT-V (12 Hrs)	Devops Maturity Model: Key factors of DevOps maturity model, stages of Devops maturity model, DevOps maturity Assessment

Text Books:

1	The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations, Gene Kim , John Willis , Patrick Debois , Jez Humb,1st Edition, O'Reilly publications, 2016.
2	What is Devops? Infrastructure as code, 1st Edition, Mike Loukides ,O'Reilly publications, 2012.

Reference Books:	
1	Building a DevOps Culture, 1st Edition, Mandi Walls, O'Reilly publications, 2013.
2	The DevOps 2.0 Toolkit: Automating the Continuous Deployment Pipeline With Containerized Microservices, 1st Edition, Viktor Farcic, CreateSpace Independent Publishing Platform publications, 2016
3	Continuous Delivery: Reliable Software Releases Through Build, Test, and Deployment Automation, 1st Edition, Jez Humble and David Farley, 2010.
4	Achieving DevOps: A Novel About Delivering the Best of Agile, DevOps, and Microservices, 1st Edition, Dave Harrison, Knox Lively, Apress publications, 2019.

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19IT4111	PE	3	--	--	3	25	75	3 Hrs.

INTERNET OF THINGS

Course Objectives:

1	To understand not objects and IoT architectures
2	To learn about design principles of IoT devices
3	To learn about IoT related protocols
4	To understand the data link layer of IoT
5	To understand data analytics and cloud in context of IoT

Course Outcomes: By the end of the course, the student will be able to:

S.No.	Outcome	Knowledge Level
1	Evaluate the concept of Internet of Things in different contexts.	K4
2	Understand about design principles IoT devices.	K2
3	Analyze various protocols of IoT.	K4
4	Identify the need of data link layer in IoT.	K3
5	Apply data analytics and cloud offerings related to IoT.	K4

SYLLABUS

UNIT-I (8 Hrs)	**The Internet of Things: An Overview** Internet of Things, IoT architectural view, Technology behind IoTs: major components of IoT system, Sources of the IoTs, M2M Communication, M2M architecture, software development tools, Examples of IoTs: Wearable smart watch, smart home, smart cities.
UNIT-II (10 Hrs)	**Design Principles for Connected Devices** IoT/M2M systems LAYERS AND designs standardizations, Modified OSI Stack for the IoT/M2M Systems, ETSI M2M domains and High-level capabilities, Communication Technologies: Bluetooth, Zigbee, Wi-Fi, Data Enrichment and Consolidation and Device Management Gateway, Ease of designing and affordability.
UNIT-III (9 Hrs)	**Design Principles for the Web Connectivity for connected-Devices** Web Communication protocols for Connected Devices: Constrained RESTful environment (CoRE), Service oriented protocol (COAP), Communication protocols based on the exchange of messages (MQTT), Web Connectivity for connected-Devices network using SOAP,REST and HTTP RESTFUL.
UNIT-IV (8 Hrs)	**Data link layer of IoT**, Wireless Communication Technologies, Wired Communication Technologies, Manet Networks: Network Layer of IoT, 6lowPAN adaptation layer for devices with limited resources, Dynamic routing protocols for wireless adhoc networks
UNIT-V	**Data Acquiring, Organizing and Analytics**

(10 Hrs)	Data Acquiring and Storage, Organizing Data, Transactions, Business Processes, Integration and Enterprise Systems. Data Collection, Storage and Computing Using a Cloud Platform, Cloud computing paradigm for data collection, storage, and computing, cloud service models: IOT based cloud based services using Xively ,Nimbits

Textbooks:	
1	Internet of Things: Architecture, Design Principles And Applications,Rajkamal, McGraw Hill Higher Education.
2	Internet of Things, A.Bahgya and V.Madisetti, Univesity Press, 2015.
3	Internet of Things from Hype to Reality: The road to Digitization, Ammar Rayes Samersalam.
Reference Books:	
1	Designing the Internet of Things, Adrian McEwen and Hakim Cassimally, Wiley.
2	Getting Started with the Internet of Things Cuno Pfister , Oreilly.
3	Internet of Things and Data Analytics Handbook, HWAIYU GENG, Wiley publications.

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19IT4112	PE	3	--	--	3	25	75	3 Hrs.

DATA SCIENCE

(For IT)

Course Objectives:

From the course the student will learn

1	Provide you with the knowledge and expertise to become a proficient data scientist.
2	Demonstrate an understanding of statistics and machine learning concepts that are vital for data science
3	Learn to statistically analyze a dataset.
4	Explain the significance of exploratory data analysis (EDA) in data science.
5	Critically evaluate data visualizations based on their design and use for communicating stories from data

Course Outcomes: By the end of the course, the student will be able to:

S.No	Outcome	Knowledge Level
1	Describe what Data Science is and the skill sets needed to be a data scientist	K3
2	Explain in basic terms what Statistical Inference means. Identify probability distributions commonly used as foundations for statistical modeling. Fit a model to data	K3
3	Use R to carry out basic statistical modeling and analysis	K3
4	Apply basic tools (plots, graphs, summary statistics) to carry out EDA	K3
5	Describe the Data Science Process and how its components interact.	K3
6	Use APIs and other tools to scrap the Web and collect data	K3
7	Apply EDA and the Data Science process in a case study	K3

SYLLABUS

UNIT-I (10 Hrs)	Introduction, The Ascendance of Data, Motivating Hypothetical: Data Sciencester, Finding Key Connectors, The Zen of Python, Getting Python, Virtual Environments, Whitespace Formatting, Modules, Functions, Strings, Exceptions, Lists, Tuples, Dictionaries defaultdict, Counters, Sets, Control Flow, Truthiness, Sorting, List Comprehensions, Automated Testing and assert, Object-Oriented Programming, Iterables and Generators, Randomness, Regular Expressions, Functional Programming, zip and Argument Unpacking, args and kwargs, Type Annotations, Type Annotations.
UNIT-II (10 Hrs)	Visualizing Data: matplotlib, Bar Charts, Line Charts, Scatterplots. Linear Algebra: Vectors, Matrices, Statistics: Describing a Single Set of Data, Correlation, Simpson's Paradox, Some Other Correlational Caveats, Correlation and Causation. Gradient Descent: The Idea Behind Gradient Descent, Estimating the Gradient, Using the Gradient, Choosing the Right Step Size, Using Gradient Descent to Fit Models, Minibatch and Stochastic Gradient Descent.

UNIT-III (10 Hrs)	Getting Data: stdin and stdout, Reading Files, Scraping the Web, Using APIs, Working with Data: Exploring Your DataUsing NamedTuples Dataclasses, Cleaning and Munging, Manipulating Data, Rescaling, Dimensionality Reduction. Probability: Dependence and Independence, Conditional Probability, Bayes's Theorem, Random Variables, Continuous Distributions, The Normal Distribution, The Central Limit Theorem
UNIT-IV (8 Hrs)	Machine Learning: Modeling, Overfitting and Underfitting, Correctness, The Bias-Variance Tradeoff, Feature Extraction and Selection, k-Nearest Neighbors, Naive Bayes, Simple Linear Regression, Multiple Regression, Digression, Logistic Regression
UNIT-V (12 Hrs)	Support Vector Machines, Decision Trees, Neural Networks: Perceptrons, Feed-Forward Neural Networks, Backpropagation. Clustering: The Idea, The Model, Choosing k, Bottom-Up Hierarchical Clustering. Recommender Systems: Manual Curation, Recommending What's Popular, User-Based Collaborative Filtering, Item-Based Collaborative Filtering, Matrix Factorization Data Ethics, Building Bad Data Products, Trading Off Accuracy and Fairness, Collaboration, Interpretability, Recommendations, Biased Data, Data Protection IPython, Mathematics, NumPy, pandas, scikit-learn, Visualization, R

Text Books:

1	Joel Grus, "Data Science From Scratch", OReilly.
2	Allen B.Downey, "Think Stats", OReilly

Reference Books:

1	Doing Data Science: Straight Talk From The Frontline, 1st Edition, Cathy O'Neil and Rachel Schutt, O'Reilly, 2013.
2	Mining of Massive Datasets, 2nd Edition, Jure Leskovek, Anand Rajaraman and Jeffrey Ullman, v2.1, Cambridge University Press, 2014.
3	"The Art of Data Science", 1st Edition, Roger D. Peng and Elizabeth matsui, Lean Publications, 2015
4	"Algorithms for Data Science", 1st Edition, Steele, Brian, Chandler, John, Reddy, Swarna, Springer's Publications, 2016.

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19IT4113	PE	3	--	--	3	25	75	3 Hrs.

BIOMETRICS

(For IT)

Course Objectives:

1	Describe the principles of the three core biometric modalities (face, fingerprint and iris), and know how to deploy them in authentication scenarios
2	Organize and conduct biometric data collections, and apply biometric databases in system evaluation
3	Calculate distributions of within- and between-class matching scores, and calculate various error estimates based on these distributions
4	Identify the privacy and security concerns surrounding biometric systems, and know how to address them in such a way that balances both
5	Recognize differences between algorithm design and systems engineering in biometrics
6	Deploy statistical methods in biometric system evaluation
7	Itemize the most up-to-date examples of real biometric applications in human authentication

Course Outcomes: By the end of the course, the student will be able to:

S.No	Outcome	Knowledge Level
1	Demonstrate knowledge of the basic physical and biological science and engineering principles underlying biometric systems	K3
2	Analyze biometric systems at the component level and be able to analyze and design basic biometric system applications	K3
3	Illustrate to work effectively in teams and express their work and ideas orally and in writing	K3
4	Identify the sociological and acceptance issues associated with the design and implementation of biometric systems	K3
5	Elaborate various Biometric security issues in real world applications	K3

SYLLABUS

UNIT-I (10 Hrs)	Biometrics- Introduction, benefits of biometrics over traditional authentication systems, benefits of biometrics in identification systems, selecting a biometric for a system, Applications, Key biometric terms and processes, biometric matching methods, Accuracy in biometric systems
UNIT-II (10 Hrs)	Physiological Biometric Technologies- Fingerprints, Technical description, characteristics, Competing technologies, strengths, weaknesses, deployment, Facial scan, Technical description, characteristics, weaknesses, deployment, Iris scan, Technical description, characteristics, strength, weaknesses, deployment

UNIT-III (10 Hrs)	Physiological Biometric Technologies- Hand Biometric: Palm Print, Vein Pattern, Signature and Hand Writing Technology-Technical description, characteristics, strengths, weaknesses and deployment.
UNIT-IV (8 Hrs)	Behavioural Biometric Technologies- Voice Recognition and Key stroke dynamics: Introduction, working, strengths and weaknesses, Voice Recognition Applications, Understanding Voice Recognition, Choice of Features, Speaker modeling, Pattern Matching, Key Stroke Dynamics, Active and Passive Biometrics.
UNIT-V (12 Hrs)	Multi biometrics and multi factor biometrics- two-factor authentication with passwords, tickets and tokens, executive decision, implementation plan, Securing Biometric Template-Cancelable Biometrics, Authentication, Security Analysis.
Text Books:	
1	A Privacy Enhancing Biometric, Chuck Wilson, Vein pattern recognition, CRC press, 2010
2	Biometrics: Identity Verification in a Network, 1st Edition, Samir Nanavathi, Michel Thieme, and Raj Nanavathi, Wiley Eastern, 2002
3	Implementing Biometric Security, 1st Edition, John Chirillo and ScottBlaul Wiley Eastern Publication, 2005
Reference Books:	
1	Security, Risk and the Biometric State: Governing Borders and Bodies, 1st Edition, Benjamin Muller, Routledge, 2010
2	Handbook of Biometrics, Jain, Anil K.; Flynn, Patrick; Ross, Arun A. (Eds.), Springer, 2008
3	Handbook of Biometrics, Anil K. Jain, Patrick Flynn, Arun A. Ross, Springer, 2007 Biometrics for Network Security, 1st Edition, John Berger, Prentice Hall, 2004

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19IT4114	PC	--	--	2	1	20	30	3 Hrs.

UNIFIED MODELING LANGUAGE (UML) LAB

(For IT)

Course Objectives: This Course will enable students to

1	To know the practical issues of the different object-oriented analysis and design concepts
2	Inculcate the art of object-oriented software analysis and design
3	Apply forward and reverse engineering of a software system
4	Carry out the analysis and design of a system in an object oriented way

Course Outcomes: By the end of the course, the student will be able to:

S.No	Outcome	Knowledge Level
1	Know the syntax of different UML diagrams	K3
2	Create use case documents that capture requirements for a software system	K3
3	Create class diagrams that model both the domain model and design model of a software system	K3
4	Create interaction diagrams that model the dynamic aspects of a software system	K3
5	Write code that builds a software system	K3
6	Develop simple applications	K3

LIST OF EXPERIMENTS

Note: For performing the experiments consider any case study (ATM/ Banking/ Library/Hospital management systems)

Experiment 1:

a) Familiarization with Rational Rose or Umbrella environment

Experiment 2:

a) Identify and analyze events
b) Identify Use cases
c) Develop event table

Experiment 3:

a) Identify & analyze domain classes
b) Represent use cases and a domain class diagram using Rational Rose
c) Develop CRUD matrix to represent relationships between use cases and problem domain classes

Experiment 4:

a) Develop Use case diagrams
b) Develop elaborate Use case descriptions & scenarios
c) Develop prototypes (without functionality)

Experiment 5:

a) Develop system sequence diagrams and high-level sequence diagrams for each use case
b) Identify MVC classes / objects for each use case
c) Develop Detailed Sequence Diagrams / Communication diagrams for each use case showing interactions among all the three-layer objects

Experiment 6:

a) Develop detailed design class model (use GRASP patterns for responsibility assignment)
b) Develop three-layer package diagrams for each case study

Experiment 7:

a) Develop Use case Packages
b) Develop component diagrams
c) Identify relationships between use cases and represent them
d) Refine domain class model by showing all the associations among classes

Experiment 8:

a) Develop sample diagrams for other UML diagrams - state chart diagrams, activity diagrams and deployment diagrams

Code	Category	L	T	P	C	I.M	E.M	Exam
B19IT4115	**PR**	**--**	**--**	**4**	**2**	**20**	**30**	**3 Hrs.**

PROJECT WORK - I

(For IT)

Course Objectives:

The aim of this course is "To Study, Analyse Real-World Domain and Define a Problem Statement which is feasible for further implementation Using Cutting Edge Technologies in Computer Science and Information Technology**".**

Course Outcomes:

S.No	Outcome	Knowledge Level
1	Students will be able to **Analyze** Real world Problem by using Domain Knowledge.	K4
2	Students will be able to **Define** a Real-World Problem and **Design and Analysis** the System Architecture	K5
3	Students will be able to **Develop** Technical Report as a Project Proposal by following professional Ethics.	K3

*The object of Project Work I is to enable the student to take up investigative study in the broad field of Information Technology, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or a group of students, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

a) Survey and study of published literature on the assigned topic.
b) Working out a preliminary approach to the problem relating to the assigned topic.
c) Conducting preliminary Analysis/Modeling/Simulation/Experiment/Design/ Feasibility.
d) Preparing a written report on the study conducted for presentation to the department.
e) Final Seminar, as oral Presentation before a departmental committee.

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19MC4101	MC	3	--	--	--	--	--	3 Hrs.

IPR & Patents

(For CSE & IT)

Course Objectives:

1.	To know the importance of Intellectual property rights, which plays a vital role in advanced Technical and Scientific disciplines
2.	Imparting IPR protections and regulations for further advancement, so that the students can familiarize with the latest developments

Course Outcomes: By the end of the course, the student will be able to:

S.No	Outcome	Knowledge Level
1.	Demonstrate IPR Laws and patents pave the way for innovative ideas which are instrumental for inventions to seek Patents	K3
2.	Infer an insight on Copyrights, Patents and Software patents which are instrumental for further advancements	K4

SYLLABUS

UNIT-I (08 Hrs)	Introduction to Intellectual Property Rights (IPR): Concept of Property - Introduction to IPR – International Instruments and IPR - WIPO - TRIPS – WTO -Laws Relating to IPR - IPR Tool Kit - Protection and Regulation - Copyrights and Neighboring Rights – Industrial Property – Patents - Agencies for IPR Registration – Traditional Knowledge –Emerging Areas of IPR - Layout Designs and Integrated Circuits – Use and Misuse of Intellectual Property Rights.
UNIT-II (08 Hrs)	Copyrights and Neighboring Rights: Introduction to Copyrights – Principles of Copyright Protection – Law Relating to Copyrights - Subject Matters of Copyright – Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works –Rights of Distribution – Rights of Performers **–** Copyright Registration – Limitations – Infringement of Copyright – Relief and Remedy – Case Law - Semiconductor Chip Protection Act.
UNIT-III (08 Hrs)	Patents: Introduction to Patents - Laws Relating to Patents in India – Patent Requirements – Product Patent and Process Patent - Patent Search - Patent Registration and Granting of Patent - Exclusive Rights – Limitations - Ownership and Transfer — Revocation of Patent – Patent Appellate Board - Infringement of Patent – Compulsory Licensing — Patent Cooperation Treaty – New developments in Patents – Software Protection and Computer related Innovations
UNIT-IV (08 Hrs)	Trademarks: Introduction to Trademarks – Laws Relating to Trademarks – Functions of Trademark – Distinction between Trademark and Property Mark – Marks Covered under

	Trademark Law - Trade Mark Registration – Trade Mark Maintenance – Transfer of rights - Deceptive Similarities Likelihood of Confusion - Dilution of Ownership – Trademarks Claims and Infringement – Remedies – Passing Off Action.
UNIT-V (08 Hrs)	Trade Secrets & Cyber Law and Cyber Crime: Introduction to Trade Secrets – General Principles - Laws Relating to Trade Secrets – Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreements – Breach of Contract –Law of Unfair Competition – Trade Secret Litigation – Applying State Law. Cyber Law – Information Technology Act 2000 - Protection of Online and Computer Transactions – E-commerce - Data Security – Authentication and Confidentiality - Privacy - Digital Signatures – Certifying Authorities - Cyber Crimes - Prevention and Punishment – Liability of Network Providers.
Text Books:	
1.	T. Ramappa, ―Intellectual Property Rights Under WTO, S. Chand, 2008
Reference Books:	
1.	Intellectual Property Rights (Patents & Cyber Law), Dr. A. Srinivas. Oxford University Press, New Delhi.
2.	Deborah E.Bouchoux: Intellectual Property, Cengage Learning, New Delhi.
3.	PrabhuddhaGanguli: Intellectual Property Rights, Tata Mc-Graw –Hill, New Delhi
4.	Richard Stim: Intellectual Property, Cengage Learning, New Delhi.
5.	Kompal Bansal &Parishit Bansal Fundamentals of IPR for Engineers, B. S. Publications (Press).
6.	Cyber Law - Texts & Cases, South-Western's Special Topics Collections.
7.	R.Radha Krishnan, S.Balasubramanian: Intellectual Property Rights, Excel Books. New Delhi.
8.	M.Ashok Kumar and MohdIqbal Ali: Intellectual Property Rights, Serials Pub.

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Estd:1980

INFORMATION TECHNOLOGY

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SCHEME OF INSTRUCTION & EXAMINATION

(Regulation R19)

IV/IV B.TECH

II-SEMESTER

(With effect from **2019-2020**Admitted Batch onwards**)**

Course Code	Name of the Course	Category	Cr.	L	T	P	Internal Marks	External Marks	Total Marks
B19HS4201	Management and Organizational Behavior	HS	3	3	--	--	25	75	100
#PE-V	Professional Elective-V	PE	3	3	--	--	25	75	100
#OE-III	Open Elective-III	OE	3	3	--	--	25	75	100
B19IT4206	Project Work-II	PR	7	--	--	14	60	90	150
	TOTAL		**16**	**9**	**--**	**14**	**135**	**315**	**450**

	Course Code	Course
#PE-V	B19IT4201	Deep Learning
	B19IT4202	Quantum Computing
	B19IT4203	Blockchain Technologies
	B19IT4204	E-Commerce
	B19IT4205	Network Programming
#OE-III	Student has to study one Open Elective offered by CE or ECE or EEE or ME or S&H from the list enclose	

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19HS4201	HS	3	--	--	3	25	75	3 Hrs.

MANAGEMENT AND ORGANIZATIONAL BEHAVIOR

(For CSE & IT)

Course Objectives:

1.	To familiarize with the concept of management, functions, and principles
2.	To provide conceptual knowledge on functional management that is on Human resource management and Marketing management
3.	To provide basic insight into contemporary management practices and Strategic Management
4.	To learn theories of motivation and also deals with individual behavior, their attitude and perception of individuals
5	To understand about organizations groups that affect the climate of an entire organizations which helps employees in stress management

Course Outcomes: By the end of the course, the student will be able to:

S.No	Outcome	Knowledge Level
1.	Explain management functions and principles	K2
2.	Describe the concepts of functional management that is HRM and Marketing functions	K2
3.	Discuss about vision, mission, goal, objective and a strategy based on which the corporate planning depends	K2
4.	Recognise strategically contemporary management practices and describe corporate planning process	K2
5.	Discuss about individual behaviour and motivational theories	K2
6.	Explain about ways in managing conflicts and stress	K2

SYLLABUS

UNIT-I (12 Hrs)	**Introduction to Management**: Management: Concept, Nature and importance of Management, Functions of management, Evolution of Management thought, Taylor's Scientific Management, Fayol's principles of Management, Social Responsibility of Business.
UNIT-II (10 Hrs)	**Functional Management**: Human Resource Management (HRM): Concepts of HRM, Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development, Compensation & Performance Appraisal. Marketing Management: Concept, Functions of marketing; Marketing Mix - Product, Price, Place & Promotion; Marketing strategies based on Product life cycle, Channels of distribution.
UNIT-III (10 Hrs)	**Strategic Management**: Vision, Mission, Goal, Objective, Policy, Strategy. Elements of Corporate planning process; Environmental scanning; SWOT analysis; steps in Strategy formulation, implementation, evaluation & control; Bench Marking; Balanced Score Card.

UNIT-IV (08 Hrs)	**Organisational Behaviour**: Individual Behavior: Perception-Perceptual process; Attitude-Attitudinal change, Organisational Change, Factors Influencing Change, Types of Change. Motivation: Meaning, Theories of Motivation - Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation.
UNIT-V (10 Hrs)	**Group Dynamics**: Types of Groups, Stages of Group development; Organizational conflicts -Reasons for Conflicts, Consequences of Conflicts in Organization, Types of Conflicts, Strategies for Managing Conflicts, Stress - Causes and effects, coping strategies of stress.

Text Books:	
1.	SubbaRao.P Management & Organizational Behavior, Himalaya Publishing House. Mumbai
2.	A.R Aryasri - Management Science McGraw Hill Pvt Ltd, New Delhi
Reference Books:	
1.	Fred Luthans Organizational Behaviour, TMH, NewDelhi.
2.	Robins, Stephen P., Fundamentals of Management, Pearson,India.
3.	Kotler Philip & Keller Kevin Lane: Marketing Management 12/e, PHI,
4.	Koontz &Weihrich: Essentials of Management, 6/e, TMH

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19IT4201	PE	3	--	--	3	25	75	3 Hrs.

DEEP LEARNING

(For IT)

Course Objectives:

1	Demonstrate the major technology trends driving Deep Learning
2	Build, train and apply fully connected deep neural networks
3	Implement efficient (vectorized) neural networks
4	Analyze the key parameters and hyper parameters in a neural network's architecture

Course Outcomes: By the end of the course, the student will be able to:

S.No	Outcome	Knowledge Level
1	Demonstrate the mathematical foundation of neural network	K3
2	Describe the machine learning basics	K3
3	Compare the different architectures of deep neural network	K3
4	Build a convolutional neural network	K3
5	Build and train RNN and LSTMs	K3

SYLLABUS

UNIT-I (10 Hrs)	Linear Algebra: Scalars, Vectors, Matrices and Tensors, Matrix operations, types of matrices, Norms, Eigen decomposition, Singular Value Decomposition, Principal Components Analysis.Probability and Information Theory: Random Variables, Probability Distributions, Marginal Probability, Conditional Probability, Expectation, Variance and Covariance, Bayes' Rule, Information Theory. Numerical Computation: Overflow and Underflow, Gradient-Based Optimization, Constrained Optimization, Linear Least Squares.
UNIT-II (10 Hrs)	Machine Learning: Basics and Underfitting, Hyper parameters and Validation Sets, Estimators, Bias and Variance, Maximum Likelihood, Bayesian Statistics, Supervised and Unsupervised Learning, Stochastic Gradient Descent, Challenges Motivating Deep Learning. Deep Feedforward Networks: Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and other Differentiation Algorithms.
UNIT-III (10 Hrs)	Regularization for Deep Learning: Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, Tangent Prop and Manifold Tangent Classifier. Optimization for Training Deep Models: Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter

	Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second-Order Methods, Optimization Strategies and Meta-Algorithms.
UNIT-IV (8 Hrs)	Convolutional Networks: The Convolution Operation, Pooling, Convolution, Basic Convolution Functions, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features, Basis for Convolutional Networks.
UNIT-V (12 Hrs)	Sequence Modeling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, Echo State Networks, LSTM, Gated RNNs, Optimization for Long-Term Dependencies, Auto encoders, Deep Generative Models.
Text Books:	
1	Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press,2016.
2	Josh Patterson and Adam Gibson, "Deep learning: A practitioner's approach", O'Reilly Media, First Edition, 2017
Reference Books:	
1	Fundamentals of Deep Learning, Designing next-generation machine intelligence algorithms, Nikhil Buduma, O'Reilly, Shroff Publishers, 2019
2	Deep learning Cook Book, Practical recipes to get started Quickly, Douwe Osinga, O'Reilly, Shroff Publishers, 2019

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19IT4202	PE	3	--	--	3	25	75	3 Hrs.

QUANTUM COMPUTING

(For IT)

Course Objectives:

1	This course teaches the fundamentals of quantum information processing, including quantum computation, quantum cryptography, and quantum information theory

Course Outcomes: By the end of the course, the student will be able to:

S.No	Outcome	Knowledge Level
1	Analyze the behaviour of basic quantum algorithms	K3
2	Implement simple quantum algorithms and information channels in the quantum circuit model	K3
3	Simulate a simple quantum error-correcting code	K3
4	Prove basic facts about quantum information channels	K3

SYLLABUS

UNIT-I (10 Hrs)	Introduction: Quantum Measurements Density Matrices, Positive-Operator Valued Measure, Fragility of quantum information: Decoherence, Quantum Superposition and Entanglement, Quantum Gates and Circuits.
UNIT-II (10 Hrs)	Quantum Basics and Principles: No cloning theorem & Quantum Teleportation, Bell's inequality and its implications, Quantum Algorithms & Circuits.
UNIT-III (10 Hrs)	Algorithms: Deutsch and Deutsch–Jozsa algorithms, Grover's Search Algorithm, Quantum Fourier Transform, Shore's Factorization Algorithm.
UNIT-IV (8 Hrs)	Performance, Security and Scalability: Quantum Error Correction: Fault tolerance; Quantum Cryptography, Implementing Quantum Computing: issues of fidelity; Scalability in quantum computing
UNIT-V (12 Hrs)	Quantum Computing Models: NMR Quantum Computing, Spintronics and QED MODEL, Linear Optical MODEL, Nonlinear Optical Approaches; Limits of all the discussed approaches, Future of Quantum computing.

Text Books:

1	Eric R. Johnston, Nic Harrigan, Mercedes and Gimeno-Segovia "Programming Quantum Computers: Essential Algorithms And Code Samples, SHROFF/ O'Reilly.
2	Dr. Christine Corbett Moran, Mastering Quantum Computing with IBM QX: Explore the world of quantum computing using the Quantum Composer and Qiskit, Kindle Edition Packt

3	V.K Sahni, Quantum Computing (with CD), TATA McGrawHill.
Reference Books:	
1	Chris Bernhardt, Quantum Computing for Everyone (The MIT Press)
2	Michael A. Nielsen and Issac L. Chuang, “Quantum Computation and Information”, Cambridge (2002).
3	Riley Tipton Perry, “Quantum Computing from the Ground Up”, World Scientific Publishing Ltd (2012).
4	Scott Aaronson, “Quantum Computing since Democritus”, Cambridge (2013).
5	P. Kok, B. Lovett, “Introduction to Optical Quantum Information Processing”, Cambridge.

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19IT4203	PE	3	--	--	3	25	75	3 Hrs.

BLOCKCHAIN TECHNOLOGIES

(For IT)

Course Objectives:

1	By the end of the course, students will be able to
2	Understand how block chain systems (mainly Bit coin and Ethereum) work and to securely interact with them
3	Design, build, and deploy smart contracts and distributed applications
4	Integrate ideas from block chain technology into their own projects

Course Outcomes: By the end of the course, the student will be able to:

S.No	Outcome	Knowledge Level
1	Demonstrate the foundation of the Block chain technology and understand the processes in payment and funding	K3
2	Identify the risks involved in building Block chain applications	K3
3	Review of legal implications using smart contracts	K3
4	Choose the present landscape of Blockchain implementations and Understand Crypto currency markets	K3
5	Examine how to profit from trading crypto currencies	K3

SYLLABUS

UNIT-I (10 Hrs)	Introduction, Scenarios, Challenges Articulated, Blockchain, Blockchain Characteristics, Opportunities Using Blockchain, History of Blockchain. Evolution of Blockchain : Evolution of Computer Applications, Centralized Applications, Decentralized Applications, Stages in Blockchain Evolution, Consortia, Forks, Public Blockchain Environments, Type of Players in Blockchain Ecosystem, Players in Market.
UNIT-II (10 Hrs)	Blockchain Concepts: Introduction, Changing of Blocks, Hashing, Merkle-Tree, Consensus, Mining and Finalizing Blocks, Currency aka tokens, security on blockchain, data storage on blockchain, wallets, coding on blockchain: smart contracts, peer-to-peer network, types of blockchain nodes, risk associated with blockchain solutions, life cycle of blockchain transaction.
UNIT-III (10 Hrs)	Architecting Blockchain solutions: Introduction, Obstacles for Use of Blockchain, Blockchain Relevance Evaluation Framework, Blockchain Solutions Reference Architecture, Types of Blockchain Applications, Cryptographic Tokens, Typical Solution Architecture for Enterprise Use Cases, Types of Blockchain Solutions, Architecture Considerations, Architecture with Blockchain Platforms, Approach for Designing Blockchain Applications

UNIT-IV (8 Hrs)	Ethereum Blockchain Implementation: Introduction, Tuna Fish Tracking Use Case, Ethereum Ecosystem, Ethereum Development, Ethereum Tool Stack, Ethereum Virtual Machine, Smart Contract Programming, Integrated Development Environment, Truffle Framework, Ganache, Unit Testing, Ethereum Accounts, MyEtherWallet, Ethereum Networks/Environments, Infura, Etherscan, Ethereum Clients, Decentralized Application, Metamask, Tuna Fish Use Case Implementation, OpenZeppelin Contracts
UNIT-V (12 Hrs)	Hyperledger Blockchain Implementation, Introduction, Use Case – Car Ownership Tracking, Hyperledger Fabric, Hyperledger Fabric Transaction Flow, FabCar Use Case Implementation, Invoking Chaincode Functions Using Client Application. Advanced Concepts in Blockchain: Introduction, InterPlanetary File System (IPFS), Zero-Knowledge Proofs, Oracles, Self-Sovereign Identity, Blockchain with IoT and AI/ML Quantum Computing and Blockchain, Initial Coin Offering, Blockchain Cloud Offerings, Blockchain and its Future Potential.
Text Books:	
1	Ambadas, Arshad Sarfarz Ariff, Sham “Blockchain for Enterprise Application Developers”, Wiley
2	Andreas M. Antonpoulos, “Mastering Bitcoin: Programming the Open Blockchain” , O’Reilly
Reference Books:	
1	Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions, Joseph Bambara, Paul R. Allen, Mc Graw Hill.
2	Blockchain: Blueprint for a New Economy, Melanie Swan, O’Reilly

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19IT4204	PE	3	-	--	3	25	75	3 Hrs.

E COMMERCE

(For IT)

Course Objectives:

1	This course introduces the concepts, vocabulary, and procedures associated with E-Commerce and the Internet.
2	To explain the students an overview of all aspects of E-Commerce.
3	To explain the Topics include development of the Internet and E-Commerce, options available for doing business on the Internet, features of Web sites and the tools used to build an E-Commerce web site, marketing issues, payment options, security issues, and customer service.

Course Outcomes: By the end of the course, the student will be able to:

S.No	Outcome	Knowledge Level
1	Ability to **Analyze** the impact of E-Commerce on business model and strategy	K4
2	Ability to **Distinguish** security issues and procedure, Protocols used to protect against security threats.	K4
3	Ability to **Assess** Electronic payment systems and Payment schemes	K4
4	Ability to **Identify** Internet trading relationships including business to consumer, Business to Business, Intra Organizational.	K3

SYLLABUS

UNIT-I (12Hrs)	**Electronic Commerce Environment and opportunities:** Back ground–The Electronic commerce Environment–Electronic Market Place Technologies. Modes of electronic commerce: Overview– EDI–Migration to open EDI–Ecommerce with WWW/Internet–Commerce Net Advocacy–Web commerce going forward.
UNIT-II (10 Hrs)	**Approaches to safe electronic Commerce:** Overview– Secure –Transport Protocols–Secure Transactions– Secure Electronic Payment Protocol–Secure Electronic Transaction–Certificates for Authentication–Security on Web Servers and enterprise networks.
UNIT-III (10 Hrs)	**Electronic cash and electronic payment schemes:** Internet Monitory Payment and Security requirements–payment and purchase order process–online electronic cash.
UNIT-IV (8 Hrs)	**Master card/ Visa Secure electronic transaction:** Introduction – Business requirements - Concepts - Payment Processing. Email and Secure Email Technologies for Electronic Commerce: Introduction –The means of Distribution –A model for Message Handling – How Does an Email Work.
UNIT-V (10Hrs)	**Internet Resources for Commerce: Introduction** –Technologies for Web Servers – Internet Applications for commerce – Internet Charges –Internet Access and Architecture–Searching the Internet.

Text Books:	
1.	Web Commerce Technology Hand Book Daniel Minoli, Emma Minoli McGraw Hill
Reference Books:	
1.	Frontiers of Electronic Commerce Ravi Kalakotar, Andrew B.Whinston Addison-Wesley

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19IT4205	PE	3	--	--	3	25	75	3 Hrs.

NETWORK PROGRAMMING

(For IT)

Course Objectives:

1	To understand to Linux utilities
2	To understand file handling, signals
3	To understand IPC, network programming in Java
4	To understand processes to communicate with each other across a Computer Network

Course Outcomes: By the end of the course, the student will be able to:

S.No	Outcome	Knowledge Level
1	Demonstrate functional layering of network software architectures	K3
2	Write your own socket-based network application programs	K3
3	Apply software tools for network troubleshooting	K3

SYLLABUS

UNIT-I (10 Hrs)	Linux Utilities-File handling utilities, Security by file permissions, Process utilities, Disk utilities, Networking utilities, Filters, Text processing utilities and Backup utilities. Bourne again shell(bash) – Introduction, pipes and redirection, here documents, running a shell script, the shell as a programming language, shell meta characters, file name substitution, shell variables, command substitution, shell commands, the environment, quoting, test command, control structures, arithmetic in shell, shell script examples.Review of C programming concepts-arrays, strings (library functions), pointers, function pointers, structures, unions, libraries in C.
UNIT-II (10 Hrs)	Files-File Concept, File types File System Structure, Inodes, File Attributes, file I/O in C using system calls, kernel support for files, file status information-stat family, file and record locking-lockf and fcntl functions, file permissions- chmod fchmod,\ file ownership-chown, lchown, fchown, links-soft links and hard links – symlink, link, unlink. File and Directory management – Directory contents, Scanning Directories- Directory file APIs. Process- Process concept, Kernel support for process, process attributes, process control – process creation, replacing a process image, waiting for a process, process termination, zombie process, orphan process.
UNIT-III (10 Hrs)	Signals- Introduction to signals, Signal generation and handling, Kernel support for signals, Signal function, unreliable signals, reliable signals, kill, raise , alarm, pause, abort, sleep functions. Interprocess Communication – Introduction to IPC mechanisms, Pipes- creation, IPC between related processes using unnamed pipes, FIFOs-creation, IPC between unrelated processes using FIFOs(Named pipes), differences between unnamed and named pipes, popen and pclose library functions, Introduction to message queues, semaphores and shared

	memory. Message Queues- Kernel support for messages, UNIX system V APIs for messages, client/server example. Semaphores-Kernel support for semaphores, UNIX system V APIs for semaphores.
UNIT-IV (8 Hrs)	Shared Memory- Kernel support for shared memory, UNIX system V APIs for shared memory, client/server Network IPC – Introduction to Unix Sockets, IPC over a network, Client-Server model ,Address formats(Unix domain and Internet domain), Socket system calls for Connection Oriented – Communication, Socket system calls for Connectionless-Communication, Example-Client/Server Programs- Single Server-Client connection, Multiple simultaneous clients, Socket options – setsockopt, getsockopt, fcntl.
UNIT-V (12 Hrs)	Network Programming in Java-Network basics, TCP sockets, UDP sockets (datagram sockets), Server programs that can handle one connection at a time and multiple connections (using multithreaded server), Remote Method Invocation (Java RMI)-Basic RMI Process, Implementation details-Client- Server Application.

Text Books:	
1	Unix System Programming using C++, T.Chan, PHI.(Units II,III,IV)
2	Unix Concepts and Applications, 4th Edition, Sumitabha Das, TMH.(Unit I)
3	An Introduction to Network Programming with Java, Jan Graba, Springer, rp 2010.(Unit V)
4	Unix Network Programming ,W.R. Stevens, PHI.(Units II,III,IV)
5	Java Network Programming,3rd edition, E.R. Harold, SPD, O'Reilly.(Unit V)
Reference Books:	
1	Linux System Programming, Robert Love, O'Reilly, SPD
2	Advanced Programming in the UNIX environment, 2nd Edition, W.R.Stevens, Pearson Education
3	UNIX for programmers and users, 3rd Edition, Graham Glass, King Ables, Pearson Education
4	Beginning Linux Programming, 4th Edition, N.Matthew, R.Stones, Wrox, Wiley India Edition.
5	Unix Network Programming The Sockets Networking API, Vol.-I,W.R.Stevens, Bill Fenner, A.M.Rudoff, Pearson Education.Unix Internals, U.Vahalia, Pearson Education.

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19IT4206	PR	--	--	14	7	60	90	3 Hrs.

PROJECT WORK - II

(For IT)

Course Objectives:

The aim of this course is "To build a Solution for Real World Problem Using Cutting Edge Technologies in Computer Science and Information Technology**".**

Course Outcomes:

S.No	Outcome	Knowledge Level
1	Students will be able to **Design and Analysis** the System Architecture for the Proposed Problem.	K5
2	Students will be able to **Implement** System Architecture and **Evaluate** Outcomes using Modern Engineering Tools.	K6
3	Students will be able to **Develop** Technical Report as a Project Thesis by following professional Ethics.	K3

* The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up under Project Work I, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership.

The assignment to normally include:

a) In depth study of the topic assigned in light of Report prepared under Project Work I.
b) Review and finalization of the approach to the problem relating to the assigned topic.
c) Preparing an Action Plan for conducting the investigation, including team work.
d) Detailed Analysis/ Modeling/Simulation/Design/Problem Solving/Experiment as needed.
e) Final development of product/process, testing, results, conclusions and future directions.
f) Preparing a paper for Conference presentation/publication in Journals, if possible.
g) Preparing a dissertation in the standard format for being evaluated by the department.